

# PSYCHOLOGICAL FACTORS IN PHYSICAL EDUCATION AND SPORT

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# PSYCHOLOGICAL FACTORS IN PHYSICAL EDUCATION AND SPORT

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# Editorial: Psychological Factors in Physical Education and Sport

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**Keywords:** motivation, education, sport, physical education, psychological well-being

## Editorial on the Research Topic

### Psychological Factors in Physical Education and Sport

During the last decades, human development has been extensively investigated by a whole approach centered on a widespread description of growth. This multidimensional perspective underlies the close interaction between the individual and context, focusing on the body, person, and society, as the main components describing personal functioning, both in health and disability.

Moreover, it is becoming increasingly a shared opinion that an inactive lifestyle is a risk factor for significant rates of psychosocial impairments, onset, or exacerbation of medical diseases, and welfare assistance, with a consequent increase in health costs.

Following this perspective, the systematic and regular practice of physical activity (PA) is considered a significant factor that positively affects the physical and mental health of participants. PA acts as a pivotal factor contributing to well-being and health across the entire lifespan, from childhood to old age, and in different contexts ranging from school with physical education classes to specialized contexts such as gyms and competitive sports.

So, in all these contexts, such as sports and physical education classes, awareness, knowledge, and management of psychological variables such as attitude (Cruz et al.), attention, self-confidence, stress control, anxiety, motivation, cohesion, self-control, emotional self-regulation, and interpersonal skills can influence compliance to PA and sports performance.

Regarding the younger ages, in school and after-school contexts, the psychological benefits of PA are primarily recognized for cognitive, emotional, and social development. PA can influence global development through multiple pathways by creating an “enriched environment” that demands multiple cognitive, motivational, and emotional functions, thus challenging and enhancing them (Gentile et al.). These pathways consist of exciting and enjoyable programs, opportunities for social interaction, cooperation with peers, sharing leisure experiences, enhancing the sense of belonging to a group, increasing the sense of mastery, and personal competence. Moreover, a growing amount of research pointed to the effectiveness of motor programs and moderate to vigorous aerobic exercise programs to improve children’s executive functions, given the close interplay between cognitive and motor domains (Gentile et al.).

Hybrid and mixed education programs, based on teaching personal and social responsibility and gamification strategies, are also an example of the benefits, in cardiorespiratory fitness, agility, speed, APA-weekdays and APA-weekends, and reducing the sedentary time. Again, the development of Specialist Sports Programs demonstrates a positive influence on students’ engagement with school, and that this engagement had a positive impact on their academic achievement (Melero-Cañas et al.).

Sport is an emotional experience. Studies have shown that high emotional intelligence (EI) is associated with better sports performance, though different aspects of sports experience and their

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relationship with EI are still unclear. This study examined the possible relationships between sports experience and EI dimensions of undergraduate athletes (Rodríguez-Romo et al.).

The use of technology, in the form of individualized heart rate feedback during running, was an indicator that should be implemented in regular PE classes systematically and repeatedly to create a controllable and attainable situation that allows students to actively adjust their own behavior to achieve appealing and realistic goals, as it apparently increased the motivation of participants to run and to enjoy running at higher levels of exertion (Stöckel and Grimm). Also, the smartphone management of smartphone app-use patterns is important for the performance of professional golfers (Lee et al.).

Sports activities trigger not only essential technical elements but motor and cognitive growth. For example, during a football match players need to respond quickly and correctly to the actions enacted by teammates and opponents during the game, monitor the match conditions, and play strategies. Therefore, football movements require high-level cognitive processes to perceive and analyze changing play situations, decision-making by choosing tactical strategies, and performing technical and kinetic abilities (Zhou).

Nevertheless, as concerns the sports context, research emphasized psychological components as crucial factors to increase athlete performance (Samełko et al.; Martínez et al.). Sports success is the result of the interplay among technical skills and an adaptive motivational profile. This profile is multifaceted and derives from positive self-esteem and sport self-efficacy, adequate perception of competence, causal attribution to the effort, task-oriented goals, and persistence in the face of difficulties. These components predispose the athletes for the maximum use of sports skills by maximizing their sports efficiency. Criteria to mark sports success includes more than athletes' personal characteristics (sport skills and motivational profile), such as the social environment and the motivational climate created by coaches. In detail, a mastery-oriented motivational climate reinforces the perception of performance as a result of task mastery and outlines skills as potentials that can be enhanced by personal effort. On the other hand, an ego-oriented motivational climate reinforces the competition and rivalry with team members by producing anxiety and decreasing enjoyment and satisfaction within the sports environment.

Furthermore, it has also been confirmed that a highly competitive context can generate fear of failure and feelings of shame, causing some degree of insecurity, stress or burnout, and avoidance behaviors in athletes and students. All these factors, in turn, negatively affect well-being, interpersonal behavior, and performance (González-Hernández et al.).

The Pandemic has had an impact on sport, and higher physical activity levels may help buffer the negative psychological consequences of Coronavirus Disease (Antunes et al.).

Based on these theoretical premises, this Research Topic aimed to address essential questions and collect the most recent research on factors influencing physical and psychological well-being and adherence to PA in the context of physical education classes and sport.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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# The Influence of an Enriched Sport Program on Children's Sport Motivation in the School Context: The ESA PROGRAM

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**Purpose:** Besides the evident positive effect on body development, physical activity has proven to boost executive functions, especially if the exercises are enriched with cognitive stimuli. Previous studies have shown that introducing challenging exercises in the physical activity routine can also enhance motivation. Therefore, enriching a physical education program with cognitively challenging exercises may also foster children's motivation during physical education classes, where the motivation is high at the beginning of the school year and low at the end of it. Therefore, the purpose of this paper is to test if a sport program enriched by cognitive stimuli may improve kids' motivation or take them out from a state of amotivation along the school year.

**Methods:** A sample of 342 school children (203 boys, 139 girls) took part in the study. Participants were asked to complete a battery of motivation and perceived social support questionnaires before and after they completed the ESA Program, a sport program enriched with cognitive stimuli. Moreover, parents of these children attended four seminars about the importance of supporting children for the practice of regular physical activity (PA). A control group consisting of children that attended the ordinary physical education school class was also included.

**Results:** A repeated measures MANOVA model showed that the ESA Program was able to improve children's general motivation, in particular the intrinsic motivation. The program was not effective in social support, but, independently from the group, the family social support in sports activities decreased for females.

**Conclusion:** Apart from cognitive improvement, the ESA Program can have beneficial effects on children's sports motivation in physical education, but not on perceived social support.

**Keywords:** motivation, social support, enriched sport program, physical education, gender difference



## INTRODUCTION

The practice of sport activities has undoubtedly positive effects on children's physical fitness and psychological well-being. These benefits concern improved physical fitness, balance, and endurance jump as well as the decrease of obesity and type 2 diabetes (Janssen and LeBlanc, 2010; Golubović et al., 2012; Reid et al., 2015; Navarro-Patón et al., 2019). From the psychological perspective, positive effects concern the increase of self-determination, self-esteem, and self-efficacy, and the decrease of anxiety and depression. Recent studies confirmed its beneficial effects on cognitive functioning that, in turn, is connected to an improvement in academic achievement (Donnelly and Lambourne, 2011; Misuraca et al., 2017; Egger et al., 2019; Harveson et al., 2019; Mavilidi et al., 2020). However, children are likely to drop-out from taking part in sport activities, especially those characterized by parental inactivity (Silva et al., 2019), and it seems that girls' participation declines more than their males counterparts (Malina, 2001). As showed by the latest Eurobarometer on sport and physical activity (PA), the rates of frequency and levels of engagement in sport or other PA decreases from Northern to Southern countries, and the rate of drop-outs increase with age. Therefore, identifying those factors that prevent children (especially girls') drop-out can be useful to empower their cognitive functioning and to prevent poor health and obesity.

A review of Sallis et al. (2000) reported a strong relationship across studies between social support by parents and PA. Parents, or caretakers, are considered one of the first sources influence on youth sport-related behavior since they serve as a model and guide for health-enhancing and health-compromising habits (Beets et al., 2010). Apart from family, other studies confirmed that social support coming from friends and school might predict the likelihood to engage in PA (Duncan et al., 2005; Hohepa et al., 2007). Indeed, friends' social support could have an even stronger impact than parents' support on children's likelihood to PA (Efrat, 2009; Loucaides and Tsangaridou, 2017). Moreover, school is an ideal, accessible and cost-effective context to implement interventions aimed at enhancing engagement in PA because of its possibility to involve all cohorts of children and adolescents and its wide application (Piercy et al., 2015). School-based PA interventions concern several domains ranging from specific PE curriculum to classroom activity breaks or after-school programs (Gråstén, 2017).

A recent systematic review analyzed the effects of school-based PA interventions, such as PA components during school lessons or during morning, lunch and afternoon breaks, on a variety of motivational measures of PA in school-aged children and adolescents (Demetriou et al., 2019). Results provided evidences of the efficacy of strategies implemented in the school setting to enhance and maintain students' motivation toward PA and hence to increase their PA during school and after-school hours.

Nevertheless, children's engagement in physical education class depends on their motivation (Ntoumanis, 2005). In particular, an adaptive motivational disposition based on positive self-esteem and perception of competence, effort attribution style, task-oriented goals and persistence when faced with failures,

increases the probabilities of sport participation and success (Granero-Gallegos et al., 2017). This topic has been framed within the self-determination theory (SDT) by Deci and Ryan (2008). The theory differentiates among three types of self-determined motivation, namely, intrinsic motivation, extrinsic motivation, and amotivation (Ntoumanis, 2005). Intrinsically motivated individuals perform certain behaviors due to interest and joy; this represents the highest self-determined motivation. When individuals engage in an activity because of its outcome (e.g., rewards, praise), they are extrinsically motivated. In physical education, three types of extrinsic motivation have been detected (Goudas et al., 1994), that are identified regulation, introjected regulation, and external regulation. Identified regulation concerns the activity that individuals perform since they previously internalized the value, but they do not necessarily enjoy it. A behavior driven by introjected regulation was slightly internalized, and it is performed with a sense of guilt or shame. The external regulation guides the individuals in the engagement of behaviors directed to attain tangible rewards or avoid punishment. Finally, amotivation represents the absence of motivation. Individuals, thus, display no intention to engage in an activity. However, as noted by Gröpel et al. (2016), when talking about PA, an important feature of motivation is achievement. The authors found that an implicit need for achievement predicts regular engagement in sport activities.

To what concerns sport programs created for children, according to Diamond (2012) the forecasted PA should challenge children throughout the program. Indeed, if kids are not pushed to perform better, they stop improving. Moreover, if the children perceive no challenge, they get bored and abandon the program. Therefore, creating a program stimulating cognitive functions that also challenge participants' competence may improve children's cognitive function and, at the same time, sustain their sport motivation (Ryan et al., 1997). However, no studies were found about the effects of a sport program enriched through cognitive stimuli on children's sport motivation.

The current study hypothesizes a positive effect of an enriched school-based sport program, the ESA Program, on children's motivation and social support. Enriched Sports Activity program (ESA program) is a sport program enriched through cognitive stimuli, experimented within the Erasmus + Project Enriched Sports Activity Program (ESA Program; Agreement Nr.: Sport-579661-EPP-1-2016-2-IT-SPO-SCP). The project aimed to enhance social inclusion, equal opportunity, and psycho-social well-being in children by stimulating their cognitive growth and motivational aspects (Alesi et al., 2017). The program consisted of physical exercises that were modified to stimulate the three core executive functions, namely inhibitory control, working memory, and task shifting. ESA Program revealed to have positive effects on children's physical performance (Thomas et al., 2020) and executive functions (in particular, on working memory and task shifting) (Gentile et al., 2020).

The ESA Program session differ from a traditional physical education class in the standardization of the sessions, consisting in a warm-up phase and a stimulation phase, while a physical education class follows less rigid schemes. Moreover, children

are encouraged to enhance their skills by increasing the exercise difficulty step-by-step. Finally, a cognitively engaging physical activity produces improvements in executive functions, while mere aerobic exercise does not produce the same enhancement (Schmidt et al., 2016).

In the first phase (t1), data collection was conducted at the beginning of the school year, when children usually show high motivation, while the second data collection (t2) occurred at the end of the school year, when motivation is notably lower compared to the beginning. Therefore, we expect an overall decline in terms of motivation, and children attending the ESA Program should experience less reduction of motivation at t2 compared to those children who did not attend the program, showing a protective effect of the program on motivational decline. Concerning social support, since parents whose children attended ESA Program were also involved in seminars and informative days, we expect a general improvement of perceived social support along the school year.

Finally, we will look for gender differences in motivation. In principle, it is expected a lower degree of internal and identified motivation and a higher degree in amotivation and external regulation in females, since sport is generally considered more suitable for men than for women (Gentile et al., 2018). The same phenomenon should occur for social support from families and friends. If the sports is commonly seen as not suitable for women, then female participants will not receive as much support as the male counterpart.

## MATERIALS AND METHODS

### Participants

The sample consisted of 342 schoolchildren (203 boys, 139 girls) coming from Italy, Germany, and Lithuania (Table 1). Data were collected in November (t<sub>1</sub>) and in May (t<sub>2</sub>) of the same school year. The study was implemented according to the Helsinki Declaration (Hong Kong revision, September 1989) and received permission from the Lithuanian Sports University's Research Ethics Committee in Social Sciences with approval No 579661-EPP-1-2016-2-IT-SPO-SCP (2018-02-05).

### Procedure

After parents' signature of the consent form, children school classes were split in experimental and control group. Children from both experimental (ESA group) and control group completed two forms detecting sport motivation (Lonsdale et al., 2008; Viladrich et al., 2013) and social support (Sallis et al.,

2002; Dishman et al., 2010). After 6 months, children from both experimental and control groups completed the same forms for the second time. All the measures were translated and adapted to each context with the authors' permission.

### Youth Behavioral Regulation in Sport Questionnaire (YBRSQ)

The Youth Behavioral Regulation in Sport Questionnaire (YBRSQ) is an adaptation by Viladrich et al. (2013) of the Behavioral Regulation in Sport Questionnaire (BRSQ), and it is mainly focused on children's motivation (Lonsdale et al., 2008). The questionnaire is based on Self-Determination Theory (Deci and Ryan, 2008), and consists of 20 items on a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree). The questionnaire measures general motivation (4 items, sample item "I participate in my sport because I like it"), amotivation (4 items, sample item "I participate in my sport... but I question why I continue"), external (4 items, sample item "I participate in my sport because people push me to play"), introjected (4 items, sample item "I participate in my sport because I would feel guilty if I quit") and identified (4 items, sample item "I participate in my sport because the benefits of sports are important to me") regulations.

### Social Support

Social support was assessed through the adaptation of the Social Support subscale from the Social Provisions Scale (Motl et al., 2004) made by Dishman et al. (2010). The scale is made up of 7 items, detecting perceived social support from family (4 items, sample item "during a typical week, how often has a member of your household [for example, your father, mother, brother, sister, grandparent, or other relative] done a physical activity or played sports with you?") and from friends (3 items, sample item "during a typical week, how often do your friends encourage you to do physical activities or play sports?") on a 5-point Likert scale, from 1 = "never" to 5 = "every day."

### ESA Program

ESA Program is a sport program conceived for children from 7 to 14 years, attending the physical education class in schools. The program's strengths are the standardization of the warm-up phase and its enrichment with cognitive stimuli, attaining the three core executive functions, namely, inhibition, working memory, and task shifting. The implementation of the program lasted 14 weeks, running twice a week, for a total amount of 27 units. All the units lasted 25 min and were divided into a baseline phase and a stimulation phase. For the baseline phase, children were asked to perform an exercise, while in the stimulation phase, children were asked to follow some specific rules. The forecasted exercises were distinguished for cognitive stimulation and movement domain. The cognitive stimulation concerned the alternate enrichment of the activity with cognitive features that could involve inhibitory control, working memory and task switching stimuli. The inhibitory control stimulation consisted of replicating a gesture, previously associated, and after the coach command, in the execution of another movement, before explained by the coach.

**TABLE 1 |** Participants per country distinguished in Control and Intervention groups.

	Intervention	Control
Italy	77	87
Lithuania	56	37
Germany	38	36
Total	171	160

For example, when the coach said “skip-ahead,” children had to perform the “kick-ahead” movement. The working memory stimulation occurred through the introduction of a series of exercises that children had to replicate in a reverse order. Finally, regarding task shifting stimulation, children created a circle of exercise, each of them performing one exercise. At the coach's whistle, they had to change the exercise with the one that the kid ahead was performing. In this way, all the children performed one by one all the exercise of the circuit.

The movement domain could relate to athletic drills, sport ball and smart circuits. Therefore, the program was articulated as follows: the first nine units were classified as beginner level (B), and alternatively concerned athletic drill, sport ball and smart circuits, alternatively enriched through inhibitory control, working memory and task shifting stimulation. An identical structure was replicated for the Intermediate level (I) and for the advanced level (A). The standardization of the protocol across the European Countries was guaranteed by a video-tutorial uploaded on an Internet platform. The ESA Program was implemented ensuring a safe environment for children.

## Parents Involved in ESA Program

Parents whose children attended the ESA Program were involved in four seminars of 1 h each about the benefits of PA in children. Specifically, during the first seminar, the main objectives of the ESA Program were introduced. Moreover, parents participated in a group discussion about the sport motivation of their children. The second seminar focused on raising awareness about the importance of regular PA in children with a final group discussion on the topic. During the third seminar, parents were informed about the harmful effects of physical inactivity during adulthood and the benefits of PA in terms of cognitive functioning. The

fourth and last seminar focused on the identification of parental support mode and support for children's autonomy.

## Data Analysis

First, descriptive statistics were calculated on the sample (Table 2). A repeated measures Multivariate Analysis of Variance (MANOVA) with Group (Experimental vs. Control), Time (pre-test vs. post-test condition), Gender (male vs. female), and Motivation (Intrinsic, Integrated, Introjected, Extrinsic, Amotivation) was calculated to detect the general effect of ESA Program on motivational aspects, and to test whether any gender differences exist. The model was designed following the procedure described by O'Brien and Kaiser (1985). Afterward, a *post-hoc* analysis with repeated measure ANOVA was performed to detect which aspects of motivation were affected the most. Concerning social support, since family and peers promote PA independently from one another, two distinct repeated measure ANOVA with Group (Experimental vs. Control), Time (pre-test vs. post-test condition), and Gender (male vs. female) were conducted to detect the effect of ESA Program on perceived social support and test for gender differences.

## RESULTS

### The Effect of ESA Program on Children's Motivation

The repeated measure MANOVA revealed a violation of the sphericity assumption ( $W = 0.71$ ,  $p < 0.001$ ). Therefore, Wilks Lambda ( $\Lambda$ ) was chosen as estimator of the test statistics for multivariate effect. First of all, gender did not produce any significant main effect and was hence excluded from subsequent

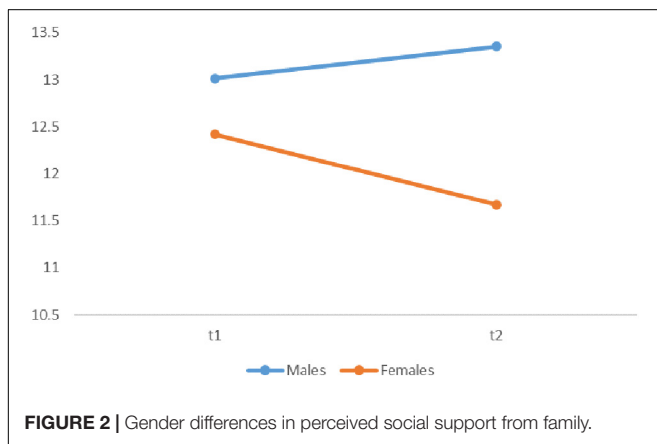
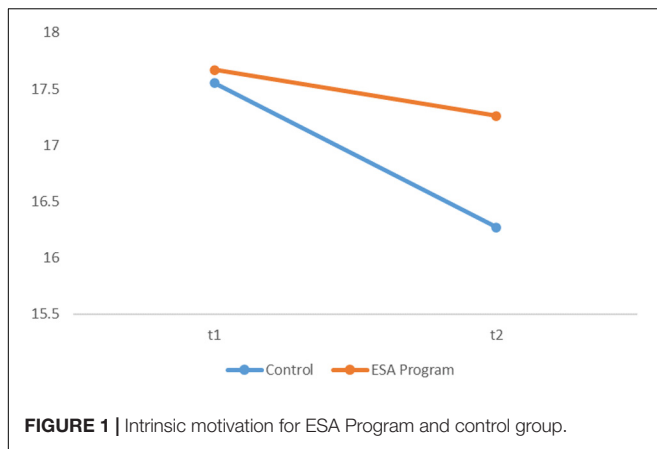
**TABLE 2 |** Mean and SD of intervention and control groups in pre- and post-test condition.

	Intervention				Control			
	Pre-test		Post-test		Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Intrinsic regulation	17.70	3.02	17.30	3.47	17.60	3.13	16.30	4.64
Identified regulation	16.30	3.20	14.10	5.95	16.0	3.35	14.80	4.71
Introjected regulation	9.14	4.42	9.98	4.23	9.11	3.88	10.50	4.32
External regulation	7.82	3.82	8.43	3.50	7.41	3.51	8.63	3.79
Amotivation	7.94	3.45	9.63	3.94	7.96	3.55	10.20	4.25
Social support from family	13.60	3.17	12.90	3.73	12.10	4.10	12.40	4.16
Social support from friends	7.99	3.11	8.38	3.34	8.14	3.26	8.32	3.26

**TABLE 3 |** Mean and SD distinguished by gender between pre- and post-test.

	Males				Females			
	Pre-test		Post-test		Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Social support from family	13.0	3.61	13.4	3.49	12.40	3.94	11.7	4.37
Social support from friends	8.37	3.19	8.85	3.24	7.57	3.11	7.69	3.26





analyses. The model thus became a 2 (intervention vs. control)  $\times$  2 (pre-test vs. post-test)  $\times$  5 (intrinsic, introjected, identified, external, amotivation) design, with the first factor manipulated between participants. An interaction effect between Time  $\times$  Motivation was detected [ $\Lambda = 0.75$ ,  $F(4, 291) = 24.42$ ,  $p < 0.001$ ] meaning that motivation has changed over time. A significant three-way interaction between Time, Motivation and Group emerged [ $\Lambda = 0.96$ ,  $F(4, 291) = 2.70$ ,  $p = 0.031$ ] meaning that the evolution of motivation over time depends on the participation into the ESA program.

The repeated measure ANOVA revealed that ESA Program had a protective effect on intrinsic motivation [ $F(1, 294) = 4.15$ ,  $p = 0.04$ ;  $d = 0.28$ ; **Figure 1**], but not on identified regulation [ $F(1, 304) = 2.77$ ,  $p = 0.09$ ;  $d = -0.31$ ], introjected regulation [ $F(1, 294) = 0.98$ ,  $p = 0.32$ ;  $d = -0.13$ ], external regulation [ $F(1, 294) = 1.99$ ,  $p = 0.16$ ;  $d = -0.17$ ], and amotivation [ $F(1, 294) = 1.48$ ,  $p = 0.22$ ;  $d = -0.17$ ]. Intrinsic motivation tends to decrease along the school year but only for children who did not take part in the ESA Program.

## The Effect of ESA Program on Children Social Support

Concerning perceived social support from family, a significant effect of gender was observed [ $F(1, 289) = 6.00$ ,  $p = 0.015$ ,  $\eta_p^2 = 0.02$ ]. Specifically, girls perceive less social support

in sports activity from family than boys, independently from the participation to the ESA Program. Moreover, an interaction between Gender  $\times$  Time emerged [ $F(1, 289) = 7.60$ ,  $p = 0.006$ ,  $\eta_p^2 = 0.03$ ; see **Table 3**] indicating that the evolution of perceived support from family over the school year varies differently for boys and girls (mean difference<sub>boys</sub> = 0.40, mean difference<sub>girls</sub> = -0.70,  $d = 0.29$ ; **Figure 2**). Regarding the ESA Program, no interaction Group  $\times$  Time was found [ $F(1, 291) = 3.00$ ,  $p = 0.09$ ], and the program effect did not show gender differences [ $F(1, 289) = 0.51$ ,  $p = 0.47$ ].

Concerning perceived social support from friends, a significant effect of gender emerged [ $F(1, 287) = 12.86$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.043$ ], where girls perceive less support from friends than boys. The ESA Program did not produce any significant main effect [ $F(1, 287) = 0.44$ ,  $p = 0.50$ ,  $\eta_p^2 = 0.002$ ] nor interactions with time [ $F(1, 287) = 0.53$ ,  $p = 0.46$ ,  $\eta_p^2 = 0.002$ ] and gender [ $F(1, 287) = 0.02$ ,  $p = 0.86$ ,  $\eta_p^2 = 0.000$ ].

## DISCUSSION

Keeping children's sport motivation high and supporting them throughout the sport practice can prevent their drop-out from the sport practice in the future. Within this perspective, the current paper aimed at assessing if a school-based sport program enriched by cognitive challenges could improve children's sport motivation or, at least, limit motivational loss over the school year. From the analyses, we found that ESA Program has a general effect on children's motivation in both boys and girls, compared to common physical education class. In particular, the program seems to have a protecting effect on children's intrinsic motivational decline along the school year (Archambault et al., 2010).

Previous research has shown that intrinsic motivation is the main determinant of the engagement in PA over time (Richard et al., 1997). It's largely recognized how children that are motivated to PA from external sources and with controlled forms of motivation are more likely to perform PA with a sense of pressure and coercion by effecting, in the long term, on decreasing the enjoyment and, in a complementary way, increasing negative affect and attitudes toward PA (Costa et al., 2020). Thus, the introduction of cognitive challenging exercises enhances intrinsic motivation, and hence favors the adherence to sport programs, avoiding the drop out. Naturally, task difficulties must be adapted to the participants' skill levels (Mandigo and Holt, 2000). In sum, the analysis of motivational data revealed that ESA Program is a valid tool for maintaining a high level of intrinsic motivation in children involved in sport activities.

Considering that parents involved in the program attended four seminars about the importance of supporting children in the practice of PA, we expected an enhancement in perceived social support from family in participants involved in the ESA program. Unexpectedly, ESA Program did not influence children

perceived social support from family and friends. Perceived social support from family declined in girls over the school year. The same did not happen for boys who kept perceiving a support from their families all along the year. This result is in line with Anderssen and Wold (1992), but appears to be in contrast to Davison (2004), who found no gender differences in parents' support to the adolescents' activity.

Social support coming from family is one of the strongest predictors of motivation and children's future participation in sports (Beets et al., 2010). The differences in perceived social support from family could explain the higher rate of girls' drop-out from the sport practice compared to boys. These gender differences do not emerge by chance. They are probably related to the persistence of gender stereotypes in sports which leads to considering these practices as unnecessary activities for girls (Eccles and Harold, 1991; Gentile et al., 2018). Moreover, regardless of the participation in the program, perceived social support of friends revealed to be stable both for males and females.

In addition to the enrichment with challenging cognitive tasks, the strength point of this research is the delivery of ESA program in school context. Children spend a large amount of their day hours in school, so this is a perfect context to address all cohorts of students over prolonged periods of time. School revealed to be an increasing setting to implement accessible and effective programs to improve motivation to PA (Wallhead et al., 2014).

Although the results of this study are encouraging, certain theoretical and methodological shortcomings must be acknowledged. First of all, we did not control for some variables that might influence the study outcome, such as socioeconomic status or motivational climate. Moreover, we did not control for the perception of self-competence and self-efficacy. The role of these variables on the intention to go on taking part in sport activities and sport programs will be investigated in future research. Finally, Germany did not carry out all the units the program, and spread some leaflet about the importance of sports activity instead of conducting seminars with parents. However, the results are encouraging even if the program was not entirely conducted there.

Another relevant condition to control in the future is the relationship between the intensity of PA and the strength of the motivation. Ekkekakis et al. (2011) found that sub-threshold intensity exercises lasting from 10 to 30 min produce a pleasant affective changes for most individuals. The matching among physical activity task intensity or difficulty and individual skills needs to be carefully considered to establish challenges suitable for each individual and, as a consequence, stimulate positive affect such as enjoyment, pride, and adaptive motivation. As concern methodological limitations, all variables were measured through self-report questionnaires. This procedure allow respondent to systematically manage their answers to show to the interviewer a positive self-image. For

the psychological constructs considered there are alternative assessment tool available relying on implicit measures (Lawrence and Jordan, 2009). Nevertheless, these assessment methods are complicated, time consuming, and require standardized lab equipment. For these reasons they are rarely used in large scale investigations like this one.

From a psycho-educational perspective, practitioners and families must be aware of the key role of PA to promote well-being and to impact on the whole child's development. It is important that public health organizations address the primary aim to plan and implement evidence-based school programs to encourage sport motivation and the enjoyment in sport and PA practice. The results of the current study could be useful for physical education teachers in structuring classes able to foster children's sport motivation. Moreover, school teachers should be aware of the gender differences in social support, for avoiding girls' drop-out during adolescence.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Lithuanian Sports University's Research Ethics Committee in Social Sciences with approval no. 579661-EPP-1-2016-2-IT-SPO-SCP (2018-02-05). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

AG, AB, and MA: conceptualization. AG, AB, and SB: data curation and formal analysis. AB and MA: funding acquisition and project administration. FS, ÖG, SP, YD, DS, MG-L, and IZ: investigation. AB, SB, and MA: methodology. DM, CB, IZ, and OD: resources. FS and DS: software. YD, SP, CB, and ÖG: supervision. MG-L and IZ: validation. AG and MA: visualization. AG, SB, AB, MA, and MG-L: roles/writing – original draft. FS, IZ, SP, YD, DS, CB, and ÖG: writing – review and editing. All authors contributed to the article and approved the submitted version.

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# Examining Portuguese High School Students' Attitudes Toward Physical Education

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Portugal ranks fourth among countries with the highest rate of overweight population, considering that 67.6% of the Portuguese population over the age of 15 is overweight or obese. To our knowledge, limited studies have investigated students' attitudes toward physical education in Portugal. Such research is necessary because it can provide valuable insights for policy and application in the curriculum development for physical education, which may eventually increase participation in physical and sports activities. This study analyzed students' attitudes toward physical education (PE) according to sociodemographic variables, including grade level, socioeconomic status, and gender, and their participation in extracurricular sports activities and respective PE grades. The sample comprised 476 high school students (from the 7th, 8th, and 9th-grade levels) from five public schools located in Portugal. The Students' Attitudes toward Physical Education Questionnaire was adapted and validated for use with Portuguese students as a two-factor model. Findings show that students generally have a moderately positive attitude toward PE. However, students' positive attitudes tend to decrease throughout high school, which is particularly significant in the 9th grade. Furthermore, students' attitudes are influenced by gender, extracurricular sports practice, and grades. These findings may help stakeholders reflect on how to frame PE in a more meaningful way to create a solid foundation for maintaining an active lifestyle throughout life. Implications for further research and practice are discussed.

**Keywords:** school, pedagogy, curriculum, extracurricular sports, physical activity

## INTRODUCTION

Previous research has shown an increase in sedentary behavior among young people over the last 20 years (Li et al., 2014), which has contributed to the rise in global obesity rates. The Organization for Economic Cooperation and Development (OECD, 2019) has reported that obesity has been gradually increasing since the early 2000s among adults; specifically, 67.6% of the Portuguese population over the age of 15 is considered overweight or obese. Portugal, together with Finland, ranked fourth in the OECD countries with the highest rates of overweight population, preceded by Chile (74.2%), Mexico (72.5%), and the United States (71%) who are in the top three.

The decrease in participation of young people in physical activities and sports, which has a significant impact on the overall health (Guthold et al., 2020), stresses the need to identify the factors that contribute to increasing the level of participation. Therefore, compulsory physical education (PE) in Portugal may be essential. A primary goal of PE is to encourage young people to adopt



active lifestyles by teaching them to engage in persistent and meaningful lifelong participation in physical activities and sports (Marttinen et al., 2018). This means that PE should provide youth with substantial physical activity in the school environment since it is particularly important for those who engage in low levels of daily physical activity (Hu et al., 2014). Additionally, PE also creates firm foundations for participation in sports activities outside school (McKenzie, 2003; Wallhead and Buckworth, 2004; Constantinides and Silverman, 2018). However, considering this objective, we might find PE classes to be insufficient to meet the recommendations of the World Health Organization (2010) and the American College of Sports Medicine (2018) to promote substantial autonomous extracurricular sports activities (Sierra-Díaz et al., 2019). For instance, in Portugal, students from 5th to 12th year (i.e., students aged above 11 years) have 150 min per week of compulsory PE, which does not meet the standards set by the World Health Organization (2010).

Previous studies have highlighted the influence of some variables on students' subsequent participation in physical activities and sports outside the school context (Subramaniam and Silverman, 2000; Jaakkola et al., 2017). One of these variables is *attitudes* (Mercier et al., 2017). Eagly and Chaiken (1993, p. 1), in their seminal work, state that attitudes can be understood as a hypothetical construct referring to the "psychological trend that is expressed in a favorable or unfavorable assessment of a specific entity." A long-term goal of PE programs worldwide is to develop positive attitudes toward PE (Donovan et al., 2015). Thus, several studies have shown that the development of positive attitudes toward PE can help young people engage in physical activities outside school and promote active lifestyles during their school years (Hagger et al., 2003; Phillips and Silverman, 2015; Solmon, 2015) and adulthood (Telama et al., 2005; Subramaniam and Silverman, 2007).

Several models facilitate our understanding of how students' attitudes influence behavior, such as the theory of reflected action/theory of reasoned action (TRA; Fishbein and Ajzen, 1975), the theory of planned action/theory of planned behavior (TPB; Ajzen, 1985), and the reasoned action model (RAM; Fishbein and Ajzen, 2010). Most studies on students' attitudes toward PE developed in the 21st century were guided by TRA (Silverman, 2017), which supports the notion that all behavior is a choice among several alternatives, and therefore, behavioral intention (i.e., predisposition toward a behavior) is the best predictor of behavior. Behavioral intention is determined by two important factors: an individual's attitude toward the behavior (i.e., personal influence on behavior) and subjective norms (i.e., social pressures that affect behavior).

In recent decades, the number of studies that focus on students' attitudes toward PE (Silverman and Subramaniam, 1999; Subramaniam and Silverman, 2000; Chung and Phillips, 2002; Koca and Demirhan, 2004; Li et al., 2014) has increased after the review article published by Silverman and Subramaniam (1999) suggested the need to further develop the field and strive for quality PE. Additionally, they revealed that most previous studies used non-validated instruments, qualitative methodologies, and were conceptually fragile (Silverman and Subramaniam, 1999). Recently, Silverman (2017) reinforced

the need to develop theory-based research that involved more rigorous designs. As such, the construction and validation of the Students' Attitudes toward Physical Education Questionnaire (SATPE; Subramaniam and Silverman, 2000) motivated many studies on students' attitudes toward PE.

The SATPE (Subramaniam and Silverman, 2000) was designed to assess students' attitudes toward PE, and has favorable psychometric properties of validity and fidelity (Subramaniam and Silverman, 2000; Montalvo and Silverman, 2008; Donovan et al., 2015; Constantinides and Silverman, 2018). Over the past 20 years, most studies that have used SATPE have found that students have moderate to high positive attitudes toward PE. However, it should be noted that most of these studies were conducted in the United States (Subramaniam and Silverman, 2000, 2007; Montalvo and Silverman, 2008; Zeng et al., 2011; Donovan et al., 2015; Phillips and Silverman, 2015; Scrabis-Fletcher et al., 2016; Mercier et al., 2017; Scrabis-Fletcher and Silverman, 2017; Marttinen et al., 2018), while only a few have been conducted in European (Lazarević et al., 2015; Constantinides and Silverman, 2018; Evangelou and Digelidis, 2018; Orlić et al., 2018) and Asian countries (Koca and Demirhan, 2004; Hu et al., 2014). Moreover, research in non-English-speaking countries, which include diverse education systems, is still scarce. Considering the increase in the number of obese individuals and those who do not have an active lifestyle across European countries (OECD, 2019), more insight about students' attitudes toward PE is necessary to provide important implications for policy, research, and practice.

According to the literature, several variables determine students' attitudes toward PE, such as grade level, gender, and family's socioeconomic status. Regarding the educational level, most studies suggest that students' positive attitudes toward PE decrease after high school (Subramaniam and Silverman, 2000, 2007; Hu et al., 2014; Lazarević et al., 2015; Scrabis-Fletcher et al., 2016; Mercier et al., 2017; Evangelou and Digelidis, 2018; Marttinen et al., 2018). Concerning gender, most studies did not show statistically significant differences between males and females (Subramaniam and Silverman, 2000, 2007; Hu et al., 2014; Scrabis-Fletcher et al., 2016; Marttinen et al., 2018; Orlić et al., 2018), while others have reported that male students have more positive attitudes than female students (Lazarević et al., 2015; Mercier et al., 2017). Finally, a study conducted at a North American high school (Zeng et al., 2011) found no significant differences in attitudes toward PE based on students' socioeconomic status. Nevertheless, research on the impact of socioeconomic status on students' attitudes toward PE is still scarce.

Recently, interest in the association between students' attitudes toward PE and their participation in extracurricular physical activities has been increasing. The development of positive attitudes toward PE has been considered a determinant for young people to remain active outside the school environment (Hagger et al., 2003; Solmon, 2003; Phillips and Silverman, 2015), in high school (Lazarević et al., 2015; Orlić et al., 2018), or secondary school (Koca and Demirhan, 2004).

Attitudes toward PE are also influenced by contextual factors (Phillips and Silverman, 2015), such as teachers and the

curriculum (Subramaniam and Silverman, 2000; Silverman, 2011; Mercier et al., 2017). Silverman (2011) seminal work highlighted curriculum as the most influential factor in developing students' attitudes toward PE. Additionally, Luke and Sinclair (1991) alluded to the fact that teachers' behaviors constitute the second most decisive factor in students' negative attitudes toward PE.

The present study was conducted in Portugal. Similar to other European countries, compulsory education in Portugal last for 12 years. PE is part of the curriculum in the first 4 years (first to fourth-grade levels; children aged between 6 and 10 years). However, in some cases, it is disregarded by generalist teachers, and engaging in various extracurricular physical activities and sports is not compulsory. Conversely, PE is a compulsory class for 5th to 12th grade. Students' grades in PE are also considered in their weighted average and application to universities.

To our knowledge, studies that investigate students' attitudes toward PE in the Portuguese context are scarce, and there is a lack of validated instruments that focus on this field. Therefore, this study proposed to (a) validate the SATPE (Subramaniam and Silverman, 2000) for use in the Portuguese population, (b) analyze Portuguese high school students' attitudes toward PE, and (c) examine the influence of sociodemographic variables (i.e., educational and socioeconomic level and gender), extracurricular sports participation, and school performance in PE (i.e., grade attained) on students' attitudes toward PE. The following hypothesis guided the present study: (1) high school students' have a moderately positive attitude toward PE; (2) high school students' attitudes decrease throughout grades in PE; (3) male high school students have more positive attitudes toward PE than their female counterparts; (4) high school students with higher socioeconomic status have more positive attitudes toward PE than students with lower socioeconomic status; (5) high school students who engage in extracurricular sports activities have higher positive attitudes toward PE than those who do not; (6) high school students with higher grades have more positive attitudes toward PE.

## MATERIALS AND METHODS

### Study Design

Based on Ato et al.'s (2013) classification system for research designs in psychology, our study design represents empirical research purposes and involved a retrospective design or *ex post facto*. Thus, we examined causal relationships between independent and dependent variables. A correlational design was used since the independent and dependent variables were not manipulated. Furthermore, sampling was not determined based on these variables (Tuckman, 2002).

### Study Phases

The present study involved two phases. In the first phase, we validated the SATPE by conducting several analytical steps, as suggested by previous research (Subramaniam and Silverman, 2000). This process involved the translation of the instrument, the use of confirmatory factor analysis, and an assessment of the questionnaire's fidelity. In the second phase, after the validation

process, the questionnaire was administered to a large sample of high school students.

### Sample

A non-probabilistic sampling method was utilized to recruit participants. A convenience sample of 476 students was included in the present study. The participants were students from the 7th, 8th, and 9th grades who were recruited from five urban high schools in five districts in northern and central Portugal. Of the sample, 52.3% ( $n = 249$ ) were male and 47.7% ( $n = 227$ ) were female. The students' ages ranged between 12 and 17 years ( $M = 13.38$ ;  $SD = 0.95$ ). Regarding the socioeconomic status, 47.7, 38.4, and 13.9% came from middle, low, and high-class families, respectively. Socioeconomic status was determined according to the criteria proposed by Simões (2000) for the Portuguese population. Moreover, 65.5 and 58.1% of male and female students, respectively, were involved in extracurricular physical activities and sports. Furthermore, 38.7, 49.8, and 9.2% had a final grade of 3, 4, and 5, respectively. Only 2.3% failed in PE and had a final grade of 2.

### Procedure

Before conducting the present study, ethical approval was attained from the Ministry of Education (Office of Statistics and Education Planning), and school directors were presented with the study objectives, scope, and implications. PE teachers, parents, tutors, and students were briefed about the study, and informed consent was obtained. Data were collected between March 2019 and June 2019. The SATPE was administered during the beginning or the end of a PE class, with at least one researcher present to provide any clarifications as needed. The questionnaire included information about the purpose of the study and instructions for the participants. Participants were informed that they were not being evaluated (scored) to avoid the effects of social desirability. Additionally, they were notified about the confidentiality of the questionnaire data, and that PE teachers would not have access to the results.

### The SATPE Questionnaire

It comprises 20 items, 8 of which are negatively worded. Responses are provided using a five-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*), with scores ranging from 20 to 100, with higher scores indicating more positive attitudes toward PE. Based on the previous notions, attitudes are based on two key components (cognitive or perceived utility and affective or enjoyment) (Subramaniam and Silverman, 2007), which contain two sub-factors each (teacher and curriculum). The SATPE (see section "Appendix" for the complete questionnaire) involves 10 items associated with cognitive or perceived utility (items 4, 6, 7, 8, 10, 13, 14, 16, 17, and 18) and 10 items associated with the affective or enjoyment component (items 1, 2, 3, 5, 9, 11, 12, 15, and 19).

### Translation

Permission was granted from the authors who constructed the original questionnaire to validate it in the Portuguese context. We

used a back-translation method to ensure the appropriateness of the translation. It is a most widely used method in social sciences to assess the appropriateness and clarity of language (Douglas and Craig, 2007). We requested two university professors who were fluent in English language to translate the questionnaire into Portuguese. These two translations were subsequently compared with no major differences between them. We then asked another university professor to translate the final Portuguese version into English. The original version of the instrument was compared with the back-translated version with no major differences; hence, the questionnaire was considered suitable. Subsequently, a pilot study was conducted with a group of 30 students to test the clarity of language and appropriateness of the items.

This subsample of students was not included in the main study. The average of the students was 13.53 years ( $SD = 1.13$ ) with 47.7% males and 53.3% females. No issues were raised regarding the items' appropriateness and clarity of language.

## Data Analysis

In the first phase of the study, we examined SATPE's psychometric properties using the *Analysis of Moment Structures* software (AMOS; version 24). First, univariate and multivariate normality were determined by the asymmetry coefficients ( $Sk$ ;  $|Sk| < 3$ ), kurtosis ( $Ku$ ;  $|Ku| < 10$ ), and Mardia's (1970) coefficient. Asymmetry values higher than 3 and kurtosis values higher than 10 need transformation (Kline, 2016). Furthermore, Mardia's coefficient is considered appropriate when the value is lower than  $p(p + 2)$ , which represents the number of observed variables (Bollen, 1989). Second, a confirmatory factorial analysis (CFA) was conducted using the maximum likelihood estimation method. This procedure assessed whether the SATPE followed the factorial structure proposed in the original version (Subramaniam and Silverman, 2000). Third, model adequacy was tested using absolute and relative fit indexes recommended in previous literature (Hu and Bentler, 1999; Jackson et al., 2009; Byrne, 2010; Marôco, 2014). Absolute fit indexes included Chi-square ( $\chi^2$ ), Chi-square and degrees of freedom ratio ( $\chi^2/df$ ), and the goodness of fit index (GFI). Conversely, the relative fit indexes were the comparative fit index (CFI), normed fit index (NFI), and Tucker-Lewis index (TLI). The following incremental indexes were also utilized: root mean square error of approximation (RMSEA) and root mean square residual (RMSR). Previous studies have suggested that there is appropriate model adequacy when  $\chi^2/df < 2$ ;  $GFI \geq 0.95$ ;  $CFI \geq 0.95$ ;  $NFI \geq 0.95$  e  $TLI \geq 0.95$ ;  $RMSEA < 0.06$ ;  $RMSR < 0.08$ . However, these values have been considered acceptable:  $\chi^2/df < 5$ ,  $GFI > 0.90$ ,  $CFI > 0.90$ ,  $NFI > 0.90$ ,  $TLI > 0.90$ ,  $RMSEA < 0.10$ ,  $RMSR < 0.10$  (Hu and Bentler, 1999; Byrne, 2010; Kline, 2016). Fourth, individual reliability ( $\lambda^2$ ) and composite reliability (CR) were tested to verify construct reliability. On the other hand, concurrent reliability was tested through the average variance extracted (AVE) of each factor with a cut-off point of 0.50 (Hair et al., 2018). Finally, the discriminant validity of each factor was assessed through a comparison between the AVE and average shared squared variance. We assessed the temporal stability of SATPE through a test-retest procedure. Thus, this procedure involved 46

students who filled the questionnaire on two occasions with a 2-week interval. Results were analyzed using Pearson's correlation coefficient. According to Keszei et al. (2010), a 10–14 days interval between the test and retest is deemed appropriate. Furthermore, they also consider 0.70 and 0.80 as acceptable reliability coefficients.

In the second phase of the study, data were subjected to several procedures using the Statistics Package for Social Sciences (SPSS; version 24). Negatively formulated items were quoted inversely. The students' individual scores were analyzed according to the whole questionnaire as well as for each of the two notable components (perceived utility and enjoyment). A descriptive analysis (i.e., average and standard deviation) of the scores attained by the different groups of students was performed. Several MANOVAs were conducted to determine the differences in scores for the whole instrument depending on the grade level (i.e., 7th, 8th, and 9th grade), gender (male vs. female), socioeconomic status (i.e., upper, middle, and lower), and extracurricular sports practice (practice vs. no practice). MANOVA was used to analyze the differences in students' global attitudes toward PE (dependent variable) based on their grade level (7th, 8th, and 9th grade), gender (female vs. male), socioeconomic status (upper, middle, and lower), and extracurricular sports practice (practice vs. no practice), which were treated as independent variables. If the MANOVA were statistically significant, discriminant analysis was conducted, specifically ANOVA, to determine differences between groups (Stevens, 2002). ANOVA was used to examine the influence of students' grades on their attitudes toward PE.

## RESULTS

### Validation

In the validation stage of the SATPE, a subsample of 399 students was included (51.6% males and 48.4% females; mean age = 13.37;  $SD = 0.93$ ). The variables presented univariate normality as the  $Sk$  and  $Ku$  values were lower than  $|1.15|$  e  $|1.23|$ , respectively (Table 1). Thus, there were no significant normality violations. According to Marôco (2014),  $|Sk| < 3$  e  $|Ku| < 10$  are considered acceptable.

Concerning multivariate normality, Mardia's coefficient was 39.53, which is lower than  $p(p + 2)$ . The two-factor model tested through CFA presented acceptable fit indices [ $\chi^2(342) = 1146.2$ ;  $p < 0.001$ ;  $\chi^2/df = 3.3$ ;  $GFI = 0.88$ ;  $CFI = 0.91$ ;  $NFI = 0.89$ ;  $TLI = 0.89$ ;  $RMSEA = 0.07$ ;  $RMSR = 0.09$ ]. To increase model adequacy, trajectories between the residuals of items 12 and 15 (i.e., factor enjoyment) as well as 14 and 18 (i.e., factor perceived utility) were included. Thus, the model adequacy was slightly higher than the original model ( $GFI = 0.86$ ;  $AGFI = 0.82$ ;  $RMSEA = 0.08$ ;  $RMSR = 0.09$ ). Therefore, we did not remove any item.

Table 1 shows data from standardized factorial weights, individual reliability ( $\lambda^2$ ), CR, and AVE. Most items have factorial weights higher than 0.50, which is considered acceptable (Hair et al., 2018). Only items 2 ("The games I learn in my



**TABLE 1** | SATPE's descriptives per item.

Factor	Item	Average	SD	Sk	Ku	$\lambda$	$\lambda^2$	CR	AVE
Perceived utility	4	3.96	1.32	-1.02	-0.28	0.53	0.28	0.81	0.54
	6	4.01	1.26	-1.14	0.18	0.56	0.32		
	7	4.03	0.99	-0.92	0.36	0.73	0.54		
	8	4.11	0.89	-0.43	0.73	0.80	0.64		
	10	3.70	1.31	-0.77	-0.47	0.57	0.32		
	13	3.88	1.05	-0.67	-0.05	0.70	0.49		
	14	3.43	1.39	-0.31	-1.22	0.48	0.23		
	16	3.75	1.30	-0.79	-0.46	0.55	0.30		
	17	4.10	0.95	-0.89	0.45	0.76	0.58		
Enjoyment	18	3.97	1.25	-1.01	-0.08	0.54	0.29	0.86	0.51
	1	4.17	0.85	-0.65	-0.51	0.75	0.56		
	2	3.96	1.22	-0.92	-0.23	0.49	0.24		
	3	4.09	0.93	-0.80	-0.02	0.73	0.54		
	5	3.99	1.23	-1.08	-0.15	0.57	0.33		
	9	4.09	0.91	-0.85	0.44	0.74	0.54		
	11	4.06	0.94	-0.68	-0.30	0.74	0.55		
	12	3.96	1.18	-0.93	-0.13	0.56	0.31		
	15	3.97	1.26	-0.96	-0.26	0.52	0.27		
	19	4.06	0.93	-0.89	0.64	0.75	0.57		
	20	4.14	0.87	-0.68	-0.15	0.77	0.59		

**TABLE 2** | Scores in the SATPE according to the grade level and gender.

Factor	7th grade (n = 151; 31.7%)			8th grade (n = 232; 48.7%)			9th grade (n = 93; 19.5%)			Total (n = 476; 100%)		
	Male	Female	Male + Female	Male	Female	Male + Female	Male	Female	Male + Female	Male	Female	Male + Female
Enjoyment	41.89	41.46	41.70	39.29	42.10	40.66	38.84	39.70	39.25	40.06	41.43	40.71
Perceived usefulness	40.48	38.38	39.50	38.62	40.77	39.66	37.39	37.18	37.29	38.99	39.33	39.15
Total attitudes	82.37	79.81	81.20	77.91	82.87	80.32	76.22	76.89	76.54	79.04	80.75	79.86

physical education class make learning unpleasant for me") and 14 ("The games I learn in my physical education class seem unimportant to me") presented lower values of 0.49 and 0.48, respectively.

The two dimensions of "perceived utility" and "enjoyment" had high CR. Further, the AVE values were above the cutoff point of 0.5, which suggests good concurrent validity. Concerning the concurrent validity, the correlation between the square factors ( $0.522 = 0.027$ ) was significantly lower than the AVE values for each factor. Thus, these factors are distinct.

The test-retest correlation was  $r = 0.869$  for the entire questionnaire. Specifically, the coefficients for the perceived utility and enjoyment components were  $r = 0.828$  and  $r = 0.826$ , respectively. These results showed that SATPE had acceptable temporal stability.

## Descriptive Analysis

Students reported positive attitudes toward PE. The average score of most high school students concerning their attitudes toward PE was 79.86 (SD = 14.91). Male students obtained an average SATPE score of 79.04 (SD = 15.63), while female students had an average score of 80.75 (SD = 14.04). Furthermore, the average scores obtained by students in the 7th, 8th, and 9th grades were

81.20 (SD = 13.81), 80.32 (SD = 13.57), and 76.54 (SD = 16.95), respectively (Table 2).

Regarding socioeconomic status, low, middle, and high-class students had average scores of 78.05 (SD = 17.20), 81.03 (SD = 13.40), and 80.85 (SD = 12.51; Table 3), respectively.

Of the sample, 62% participated in extracurricular sports activities. Regarding the grade level, 64.9, 67.2, and 44.1% of students from the 7th, 8th, and 9th grades, respectively, were involved in extracurricular sports activities. Furthermore, 65.5% of boys and 58.1% of girls practiced extracurricular sports activities. Concerning students' participation in sports activities based on their socioeconomic status, findings showed that 60.6% of high class, 70.5% of middle class, and 51.9% of low-class students were involved in such activities. Students who practiced extracurricular sports activities had an average score of 82.75 (SD = 13.59) in the SATPE, while those who did not practice averaged at 75.14 (SD = 15.76; Table 4).

Regarding grades in PE (in Portuguese school settings, grades range from 1 to 5), students who attained a grade of 3 had an average score of 76.32 (SD = 14.14) in the SATPE. Conversely, those who obtained a grade of 4 had an average of 81.91 (SD = 15.26), while those who attained 5 had an average of 84.50 (SD = 13.38; Table 5).

**TABLE 3 |** Scores in the SATPE according to the socioeconomic status.

Factor	Low ( <i>n</i> = 183; 38.4%)	Middle ( <i>n</i> = 227; 47.7%)	High ( <i>n</i> = 66; 13.9%)
Enjoyment	39.72 (8.53)	41.36 (7.15)	41.23 (6.27)
Perceived usefulness	38.33 (9.05)	39.67 (6.93)	39.62 (6.76)
Total	78.05 (17.19)	81.03 (13.40)	80.85 (12.51)

**TABLE 4 |** Scores in the SATPE according to practice vs. non-practice of extracurricular sport activities.

Factor	Do sports ( <i>n</i> = 295; 62%)	Do not play sports ( <i>n</i> = 181; 38%)
Enjoyment	42.11 (7.02)	38.44 (7.90)
Perceived usefulness	40.65 (7.25)	36.71 (8.40)
Total	82.75 (13.59)	75.14 (15.76)

**TABLE 5 |** Scores in the SATPE according to grades in PE.

Factor	Grade in PE – 3 ( <i>n</i> = 184; 38.7%)	Grade in PE – 4 ( <i>n</i> = 237; 49.8%)	Grade in PE – 5 ( <i>n</i> = 44; 9.2%)
Enjoyment	38.60 (7.32)	42.04 (7.64)	42.93 (7.17)
Perceived usefulness	37.72 (7.38)	39.87 (8.10)	41.57 (6.69)
Total	76.32 (14.14)	81.91 (15.26)	84.50 (13.38)

## Inferential Analysis

Generally, the groups of students mentioned above obtained higher scores in the enjoyment factor than in the perceived usefulness factor. Thus, **Table 6** shows the results of MANOVA for students' attitudes toward PE, considering the main effects of each of the four independent variables and their interaction effects.

Multivariate analysis showed statistically significant univariate effects of grade level [Wilk's lambda = 0.973,  $F_{(4, 880)} = 3.066$ ,  $p < 0.05$ ,  $\eta_p^2 = 0.014$ ], gender [Wilk's Lambda = 0.986,  $F_{(2, 440)} = 3.172$ ,  $p < 0.05$ ,  $\eta_p^2 = 0.014$ ], and extracurricular sports activities [Wilk's Lambda = 0.967,  $F_{(2, 440)} = 7.559$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.033$ ] on students' global attitude toward PE. In contrast, students' socioeconomic status did not influence their attitudes toward PE. There were no significant interaction effects between the four independent variables (grade level, gender, socioeconomic status, and extracurricular sports participation).

Concerning the grade level, discriminant analysis showed differences only in the perceived utility factor of attitudes [ $F_{(2)} = 3.055$ ,  $p < 0.05$ ,  $\eta_p^2 = 0.013$ ]. ANOVA indicated that students from the eighth-grade had significantly higher scores on enjoyment and perceived utility factors than their ninth-grade counterparts. Concerning gender, univariate analysis highlighted statistically significant differences between male and female students regarding the affective factor of attitudes toward PE [ $F_{(1)} = 3.863$ ,  $p \leq 0.05$ ,  $\eta_p^2 = 0.08$ ], with the latter obtaining higher values. Regarding extracurricular sports practice, univariate analysis showed that statistically significant differences were associated with enjoyment [ $F_{(1)} = 27.412$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.055$ ] and perceived utility [ $F_{(1)} = 30.36$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.060$ ] factors of the SATPE.

**TABLE 6 |** MANOVA for the students' global attitude toward PE.

Variables	MANOVA				
	Wilks' $\lambda$	<i>F</i>	<i>gl</i>	Sig.	$\eta_p^2$
Grade level (GL)	0.973	3.066	4	0.016	0.014
Gender	0.986	3.172	2	0.043*	0.014
Socioeconomic status (ST)	0.984	1.813	4	0.124*	0.008
Sports practice (SP)	0.967	7.559	2	0.001	0.033
GL × gender	0.992	0.833	4	0.504**	0.004
GL × ST	0.967	1.878	8	0.060	0.017
GL × SP	0.994	0.688	4	0.600	0.003
Gender × ST	0.994	0.669	4	0.613	0.003
Gender × SP	0.999	0.166	2	0.847	0.001
ST × SP	0.998	0.259	4	0.904	0.001
GL × gender × ST	0.980	1.135	8	0.336	0.01
GL × gender × SP	0.991	1.032	4	0.390	0.005
GL × ST × SP	0.973	1.539	8	0.140	0.014
Gender × ST × SP	0.983	1.898	4	0.109	0.009
GL × gender × ST × SP	0.983	1.286	6	0.261	0.009

\* $p < 0.05$ , \*\* $p < 0.01$ .

Finally, we examined the relationship between students' school grades and their attitudes toward PE. Through ANOVA, the data obtained showed statistically significant differences in attitudes toward PE [ $F_{(3)} = 6.673$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.041$ ] and in its two factors, enjoyment [ $F_{(3)} = 8.924$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.054$ ] and perceived utility [ $F_{(3)} = 4.234$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.026$ ], depending on the students' grades. Scheffe's *post hoc* test showed that these differences were evident between students who had grades of 4 and 5 in PE.

## DISCUSSION

This study examined Portuguese high school students' attitudes toward PE. The SATPE was validated to achieve this objective. Our findings showed that the instrument presented acceptable psychometric properties concerning validity and reliability and may be used to assess Portuguese high school students' attitudes toward PE, which provides new opportunities for researchers to explore this line of inquiry. However, it is essential to continue testing the instrument either by using different samples or examining whether the four-factor structure imparts a more appropriate adjustment.

Our findings showed that students generally had a moderately positive attitude toward PE, which confirms hypothesis (1). Specifically, our study suggests that students enjoy PE classes and consider it an important discipline. Thus, Portuguese students' scores in the SATPE were slightly higher than those reported in previous studies conducted in the United States (Subramaniam and Silverman, 2007; Scrabis-Fletcher and Silverman, 2017; Marttinen et al., 2018), Europe (Lazarević et al., 2015), and Asia (Hu et al., 2014), despite having a similar sample. Research has shown that positive attitudes toward PE are associated with the nature of this discipline. Moreover, several researchers (Delfosse et al., 1997; Piéron, 2005) have stated that PE is

a practical discipline wherein social interaction, fun, freedom, and movement-play are crucial, as opposed to other disciplines in the curriculum.

The findings confirmed hypothesis (2), which was centered around the association between grade level and attitudes toward PE. Thus, we found that students' positive attitudes toward PE decreased throughout high school, especially in the 9th grade. This decrease may derive from the cognitive component that is associated with the perceived usefulness of PE, which in turn largely depends on the curriculum and the PE teacher. Our results are corroborated by previous studies (Subramaniam and Silverman, 2000, 2007; Hu et al., 2014; Lazarević et al., 2015; Scrabis-Fletcher et al., 2016; Mercier et al., 2017; Evangelou and Digelidis, 2018; Marttinen et al., 2018) that show that students' attitudes toward PE become less positive as they age. However, in these studies, this decline in positive attitudes toward PE is predominantly related to the affective component, which was not the case in our study.

It is of utmost importance for researchers, policymakers, and, particularly, PE teachers to understand the reasons for the decrease in positive attitudes toward PE. This is paramount because students' attitudes toward PE impact their participation in extracurricular activities and sports, and the creation of a foundation for active lifestyles (Solmon and Lee, 1996; Kohl and Hobbs, 1998; Hagger et al., 2003; McKenzie, 2003; Subramaniam and Silverman, 2007). One of the reasons for the decrease in positive attitudes toward PE is related to the fact that, in some cases, the curriculum lacks meaningful content that challenges students to increase their motor proficiency within an intrinsically motivated environment (Carlson, 1995; Subramaniam and Silverman, 2007). In Portugal, PE teachers are pressured to teach an extensive range of lessons (Santos et al., 2020) throughout grade levels, which may influence the way they use curriculum ownership and engage with students (Carlson, 1995; Subramaniam and Silverman, 2007). It is necessary to be informed regarding curricular reforms, consider students' attitudes toward PE, and use enjoyment and perceived utility as guiding variables for further development (Subramaniam and Silverman, 2000, 2002, 2007; Rikard and Banville, 2006; Montalvo and Silverman, 2008; Silverman, 2011; Phillips and Silverman, 2015; Mercier et al., 2017; Scrabis-Fletcher and Silverman, 2017; Subramaniam and Mercier, 2017; Marttinen et al., 2018; Orlić et al., 2018). Curriculum ownership has been associated with an intrinsically motivated environment (Farias et al., 2020). Specifically, several factors have been considered crucial in fostering a positive climate in PE: (a) a task-oriented climate, (b) the integration of learner-centered models, such as the sports education model and a variety of teaching styles, and (c) the promotion of enjoyment, competency, and positive social relationships (Siedentop, 1994, 2004; Subramaniam and Silverman, 2002, 2007; Digelidis et al., 2003; Silverman, 2011; Mercier et al., 2017; Scrabis-Fletcher and Silverman, 2017; Constantinides and Silverman, 2018; Orlić et al., 2018).

Previous research has also indicated that as students get older, they consider the PE curriculum to be less useful (Constantinides and Silverman, 2018). In Portugal, students in the 9th grade must take exams in a range of disciplines. The

pressure to perform and attain high scores in a vast array of disciplines may also influence how students experience PE, which may ultimately result in a lack of enjoyment. It is possible that as students get older, they undertake more demanding performance objectives and go through a set of social forces that value grades in other areas, which may result in reducing the importance of PE.

Hypotheses (3) and (4) were not confirmed. Our findings also showed that female students had more favorable attitudes toward PE than their male counterparts. However, these findings do not support previous studies conducted in the context of high school wherein male students reported having more positive attitudes toward PE (Lazarević et al., 2015; Mercier et al., 2017), or with no statistically significant differences between genders (Subramaniam and Silverman, 2000, 2007; Hu et al., 2014; Scrabis-Fletcher et al., 2016; Marttinen et al., 2018; Orlić et al., 2018). In this study, female students reported significantly higher scores in the affective component, which suggests more enjoyment in PE.

Our findings might have been derived from the way the curriculum in Portugal is currently framed. The PE curriculum involves a range of physical and sports activities, such as dance and badminton. Previous research has shown that female students have more positive attitudes toward activities that value esthetic dimensions (e.g., dance, gymnastics), which are an important part of the PE curriculum, while male students present a more favorable attitude in activities that involve taking on challenges and risks, such as football (Greenwood and Stillwell, 2001; Zeng et al., 2011). Notably, the gender differences in attitudes toward PE may also be derived from cultural and societal value systems. From the perspective of several researchers (Tannehill et al., 1994; Piéron et al., 1997), students' attitudes toward PE are influenced by self-image, family, and social media, which create expectations for motor skill development and performance in various physical activities and sports.

As for the mediating role of students' socioeconomic status, our findings suggest that this variable did not influence attitudes toward PE, as indicated by previous research, which in turn did not confirm hypothesis (4) (Zeng et al., 2011). Our findings suggest that PE contributes to minimizing differences in attitudes among students from different socioeconomic statuses, which is an important variable for participation in extracurricular sports activities (Johnston et al., 2007).

Students who engaged in extracurricular sports activities had a more positive attitude toward PE than those who did not, as supported by previous research (Lazarević et al., 2015; Peralta et al., 2015; Lima et al., 2018; Orlić et al., 2018). This finding confirmed hypothesis (5). Although we did not identify a cause-effect relationship between the two variables, our findings suggest that students have more positive attitudes toward PE when they engage in extracurricular sports activities, which is aligned with the existing literature in this field (Phillips and Silverman, 2015). Furthermore, it was found that students' attitudes toward PE were influenced by their grades, as suggested by Li et al. (2014) and Orlić et al. (2018). This confirmed hypothesis (6). In other words, students with better grades had a more positive attitude

toward PE. Grades have been acknowledged as a mediating variable of attitudes toward PE (Subramaniam and Silverman, 2007). It is noteworthy that there were no significant interaction effects in differentiating students' attitudes toward PE, which requires further exploration.

## CONCLUSION

Positive attitudes toward PE may serve as motivation for PE teachers to achieve the final objective of PE—to foster participation in extracurricular sports and encourage engagement in physical activities throughout life. This study adds to the literature by shedding light on the attitudes of Portuguese high school students. However, this study has several limitations. First, a non-probabilistic sample was used in this study. Second, the sample was not representative of the Portuguese high school context, since only students from the north and center of the country were included. Finally, the model adequacy was only considered acceptable, which may suggest the need for further validation efforts.

As the field progresses, more descriptive and longitudinal studies must be conducted in European education systems to understand how students experience PE. Within this line of inquiry, it is essential to use validated tools and theory-based approaches to deductively characterize students' attitudes toward PE. Describing the variables that are responsible for the increase or decrease in attitudes toward PE could also provide valuable insight for stakeholders and educational institutions. Further studies should also examine the effects of continuing professional development programs on students' attitudes toward PE, which have implications on how to train PE teachers. More Portuguese researchers should follow this line of study, which is paramount for generating sound and evidence-based policy and practice in the coming years.

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## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Portuguese Ministry of Education (Office of Statistics and Education Planning). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

PP: defining purpose, rationale, data collection and analysis, and writing. FS: data collection, revisions, rationale, and writing. DM: revisions and writing. All authors contributed to the article and approved the submitted version.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## APPENDIX

Item	Factor
<p>1. The games I learn in physical education make my physical education class interesting for me. Os jogos que aprendo na aula de educação física fazem com que a aula de educação física seja interessante para mim.</p> <p>2. The games I learn in my physical education class make learning unpleasant for me. Os jogos que aprendo na aula de educação física tornam a aprendizagem algo desagradável para mim.</p> <p>3. The games I learn in my physical education class get me excited about physical education. Os jogos que aprendo na aula de educação física fazem com que fique entusiasmado em relação à educação física.</p> <p>5. I feel the games I learn in physical education make my physical education class boring for me. Eu sinto que os jogos que aprendo na educação física fazem com que a aula de educação física seja aborrecida.</p> <p>9. My physical education teacher makes my physical education class interesting for me. O meu professor de educação física faz com a aula de educação física seja interessante para mim.</p> <p>11. I feel my physical education teacher makes learning in my physical education class fun for me. Eu sinto que o meu professor de educação física faz com que aprender na aula de educação física seja divertido para mim.</p> <p>12. I feel my physical education teacher makes my physical education class boring for me. Eu sinto que o meu professor de educação física faz com que a aula de educação física seja aborrecida para mim.</p> <p>15. My physical education teacher makes learning in my physical education class unpleasant for me. Eu sinto que o meu professor de educação física faz com que aprender na aula de educação física seja desagradável para mim.</p> <p>19. My physical education teacher gets me excited about physical education. O meu professor de educação física faz com que fique entusiasmado com a educação física.</p> <p>20. I feel the games I learn in my physical education class make learning fun for me. Eu sinto que os jogos que aprendo na aula de educação física fazem com que aprender seja divertido para mim.</p>	Factor 1: Enjoyment
<p>4. My physical education teacher makes my physical education class seem unimportant to me. O meu professor de educação física faz com que as aulas de educação física não sejam importantes para mim.</p> <p>6. I feel the games I learn in my physical education class are useless to me. Eu sinto que os jogos que aprendo na aula de educação física são inúteis para mim.</p> <p>7. The games I learn in my physical education class seem important to me. Eu sinto que os jogos que aprendo na aula de educação física são importantes para mim.</p> <p>8. My physical education teacher makes my physical education class seem important to me. O meu professor de educação física faz com que as aulas de educação física sejam importantes para mim.</p> <p>10. The games I learn in my physical education class are useful to me. Eu sinto que os jogos que aprendo na aula de educação física são úteis para mim.</p> <p>13. I feel the games I learn in my physical education class are valuable to me. Eu sinto que os jogos que aprendo na aula de educação física são essenciais para mim.</p> <p>14. The games I learn in my physical education class seem unimportant to me. Eu sinto que os jogos que aprendo na aula de educação física não são importantes para mim.</p> <p>16. My physical education teacher makes my physical education class useful for me. Eu sinto que o meu professor de educação física faz com que aprender na aula de educação física seja útil para mim.</p> <p>17. I feel my physical education teacher makes learning in my physical education class valuable for me. Eu sinto que o meu professor de educação física faz com que aprender na aula de educação física seja essencial para mim.</p> <p>18. I feel my physical education teacher makes learning in my physical education class useless for me. Eu sinto que o meu professor de educação física faz com que aprender na aula de educação física seja inútil para mim.</p>	Factor 2: Usefulness



# Corrigendum: Examining Portuguese High School Students' Attitudes Toward Physical Education

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**Keywords:** school, pedagogy, curriculum, extracurricular sports, physical activity

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The authors apologize for these errors and state that they do not change the scientific conclusions of the article in any way. The original article has been updated.

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# Subjective Rank of the Competition as a Factor Differentiating Between the Affective States of Swimmers and Their Sport Performance

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**Purpose:** The aim of the study was to establish the differences in affective states of swimmers depending on the subjective rank of the competition and the relationship between affective states and performance in sports competitions of low, medium and high subjectively perceived rank.

**Methods:** The respondents ( $n = 31$ ) aged from 15 to 23 years ( $18.1 \pm 2.397$ ) were studied using the psychological questionnaires *Perceived Stress Scale* (PSS-10), *Profile of Mood State* (POMS), and *Positive and Negative Affect Schedule* (PANAS) during sports events. 362 measurements using POMS and 232 measurements using PANAS before the starts were collected. The significance of intergroup differences was determined using the Kruskal-Wallis test. A stepwise regression analysis was used to determine the emotional predictors of sports results.

**Results:** Subjective rank of sports competition differentiated significantly anger ( $\chi^2 = 6.826$ ;  $p = 0.033$ ), confusion ( $\chi^2 = 11.345$ ;  $p = 0.003$ ), depression ( $\chi^2 = 10.2$ ;  $p = 0.006$ ), fatigue ( $\chi^2 = 49.394$ ;  $p \leq 0.001$ ), vigour ( $\chi^2 = 11.345$ ;  $p \leq 0.001$ ), positive emotions ( $\chi^2 = 51.233$ ;  $p \leq 0.001$ ), and negative emotions ( $\chi^2 = 11.552$ ;  $p = 0.003$ ). Regression analysis showed the influence of mood states and positive emotions on the sports result.

**Conclusion:** The swimmers' affective state changed depending on the subjective rank of the competition. Depression and positive emotional state made it possible to predict the result in medium- and high-rank competition.

**Keywords:** athletes, emotions, mood, stress, performance

## INTRODUCTION

In the search for predictors of efficiency and effectiveness of sport performance, mental aspects are more and more often noticed since in combination with motor skills, they determine sports success (Cogan, 2019). In terms of mental preparation in swimming it is important to strive for an appropriate and reproducible mental state that will ensure the effective performance of a familiar task. Its important element is affective states, which may have positive or negative valence and could influence specific perception strategies (Bless and Burger, 2017).

Affective states are understood as bipolar constructs currently experienced by an individual in response to a direct or indirect interpretation or appraisal of events and stimuli. It is the combination of emotions and moods (Kontaris et al., 2020). Emotion is a more intense mental state than mood, related to physiological responses. It has a shorter duration and is usually triggered by a specific stimulus (Domínguez-Jiménez et al., 2020). Emotions and moods also differ in intentionality, causes, consequences and function. There are many models that attempt to explain the occurrence of pre-competitive emotions (Lane et al., 2012).

In the traditional approach proposed in the iceberg profile by Morgan (1980), links were sought between the negative or positive affective states and the efficiency of an athlete's performance. This model is still used as a theoretical basis in research (Terry and Parsons-Smith, 2019; Han et al., 2020). The results of some more recent studies support the Morgan's findings that experiencing strong positive states with low levels of negative states is conducive to the achievement of high sporting performance and that successful sportsmen and sportswomen experiencing emotions derive energy from both positive and negative emotions (Martinent et al., 2013).

The results of other studies suggest that in order to act effectively, the athlete should provide himself with as much mental energy as possible, acquired from both positive (e.g., joy) and negative (e.g., anger) affective states (Carter and Sachs, 2012). The complex relations between cognitive antecedents and mediators of affective states in sport are also of interest to researchers (Chadha et al., 2019).

Studies have demonstrated the relationships between sport performance and the appraisal of the emotional state rather than the intensity of affective states alone (Psychountaki and Zervas, 2000). Athletes who positively assessed their somatic excitement before taking part in competitions achieved better results than others (Borek-Chudek, 2011).

According to the transactional concept of stress by Lazarus and Folkman (1984), the response to a situation, e.g., a sports competition, depends on cognitive assessment. An athlete may cognitively assess the start of the competition as a threat or challenge. Lepine et al. (2005) argue that the level of stimulation alone is not as important as the individual's perception of the task. If an athlete approaches the difficulty as a challenge, the probability of experiencing positive states increases (Gross and Thompson, 2007). In turn, conscious experiencing positive emotions improves the effectiveness of coping with stress (Tugade et al., 2004). In a competitive situation, stress depends on the situational context, including the rank of the competition (Gracz and Sankowski, 2007). The high rank of the competition can significantly modify the emotional state of the athlete and influence his or her sports result (Bittner et al., 2005).

The intensification of affective states in a sports competition may, therefore, depend not only on the objective rank of the competition (e.g., national championships), but also on its perception and subjective appraisal by an athlete: the significance of a specific competition for a specific athlete and his or her aspirations (Boldizsár et al., 2016).

Participation in the competition which is the most important from a social standpoint is not always the most important for the athlete. To date, studies on the relationships between the rank of competitions and sport performance have most often used objective rank indicators (Jeon, 2019). Assuming that the measurement of affective states before a sports performance is related to sports results, it is worth analyzing the factors influencing the experience of mood and emotions (Patrícia et al., 2019). We will attempt to fill this gap. It cannot be excluded that subjective rank of competition (understood as a sense of start importance of the athletes themselves) modifies the relationship between the affective states and the sport performance (Ihalainen et al., 2017). The subjective rank of the competition may be determined by the competitor's performance aspirations and his or her inner motivations.

The aim of the study was to establish the differences in affective states of swimmers depending on the subjective rank of the competition and the relationship between affective states and performance in sports competitions of low, medium and high subjectively perceived rank.

## MATERIALS AND METHODS

The study examined 31 swimmers at the national (Polish) level aged 15 to 23 years ( $18.1 \pm 2.397$ ). All participants gave written consent to participate in the study as required by the Helsinki Declaration.

In order to appraise the mood state, the *Profile of Mood State (POMS)* (McNair et al., 1971) was used, with the Polish adaptation of Dudek and Koniarek (1987). The psychometric properties of the inventory are satisfactory (Cronbach's alpha is in the range 0.74–0.91). The tool has been used many times in the studies of athletes' mood states, starting with Morgan's research (1980). The adjectives form six scales: depression, tension, anger, fatigue, confusion and vigor. The Polish version of POMS contains an additional scale of kindness and has satisfactory psychometric properties (Dudek and Koniarek, 1987).

*Positive and Negative Affect Schedule (PANAS)* (Watson et al., 1998) with (Brzozowski, 2010) Polish adaptation (2010) was used to study emotional states. The tool contains the scale of positive and negative affect. The reliability of the scale is satisfactory: the Cronbach's alpha ranges from 0.73 to 0.95 depending on the version and type of sample. The validity of the scale is confirmed by the results of factor analysis, cluster analysis, correlations with other tools and intergroup differences.

The *Perceived Stress Scale (PSS-10)* was used to determine the intensity of stress in the period before the competition. The authors of the original version of the test are S. Cohen et al. (1983), whereas adaptation to the Polish conditions was prepared by Juczyński and Ogińska-Bulik (2009). The validity and reliability of the Polish version of the test are sufficient for the purposes of scientific research.

## Procedure

The respondents completed the questionnaires in writing. Before the study began, they had received detailed instructions from

one of the researchers – a psychologist. Completion of the questionnaires was supervised by three trained assistants.

The actual stage of the study took place during a sports competition. Each sports competition lasted from 3 to 5 days and had two sessions during 1 day. The swimmers were asked to fill in the PSS and POMS during the general warm-up (approx. 1 h before the first start in the morning or afternoon session) in the swimming pool halls.

Moreover, just before (approx. 10 min) each start (race), the swimmers filled out the PANAS questionnaire. Throughout the competition, the assistants observed the athletes in accordance with the minute schedule of starts (set by the event organizer). It happened that one athlete, starting three times in one session, filled out PANAS three times. There were also athletes starting only once in the session, they participated in one measurement with PANAS.

Each of the 31 athletes was therefore tested several times. We obtained in total 232 measurements of mood states (POMS) at the beginning of both sessions of the day (including 164 for men and 68 for women) and 362 measurements of emotional states just before start (PANAS) (248 for men, 114 for women). Due to a small number of respondents, the results of men and women were combined. Previous studies show that women and men – professional athletes do not differ in terms of mental traits important for this study (Olmedilla et al., 2018).

## Sports Results

Data on personal bests for a given distance and swimming style were obtained from respondents each time before the beginning of the race. The results achieved in the races were also recorded<sup>1</sup>. The time results were converted in order to compare the times achieved in different styles and distances. The personal record of an athlete was divided by the score obtained in the race and expressed as a percentage according to the formula: (previous personal best / result achieved in the race)  $\times$  100. A score of more than 100 means that the athlete achieved a better result than his or her personal best.

## Rank of Competition

Each time just before the race (start), after completing the PANAS the athlete evaluated the importance (rank) of a race on the 3-point scale: 1 – *low*, 2 – *medium*, 3 – *high*.

## Statistical Analysis

First, the normality of the investigated quantitative variables was checked using the Kolmogorov-Smirnov test. For most of the variables, distributions different from the Gaussian distribution were noted. For this reason, the Kruskal-Wallis test was used to determine the significance of intergroup differences. As the skewness values of the distributions fell within the range of  $\pm 2$ , it was considered that regression analysis could be performed. A stepwise regression analysis was used to determine the affective predictors of sports results. The sports result was the dependent variable. As factors, the indices of 7 moods (anger, confusion, depression, anxiety, fatigue, vigor, kindness) were entered into

the equation. Regression analyzes were performed separately for races of low, medium and high subjective rank. A regression analysis was also carried out for all races, additionally introducing the rank of race as a factor. Then, analogous regression analyzes were performed with two emotional states (positive-negative) as factors.

## RESULTS

The level of stress did not vary significantly depending on the subjective rank of the race (**Table 1**). The swimmers' mood was the worst on the day of the race of low subjective rank (low perceived importance). Respondents revealed the highest level of negative states and a fairly low level of vigor. The highest level of vigor and the lowest level of four negative mood states were recorded on the day of the high-ranked race (high perceived importance).

In the case of emotional states prior to the start of the race, the differences were not so clear (**Table 2**). The level of positive emotions and negative emotions were significantly different depending on the subjective rank of the race. The level of both positive and negative emotions before the race of the high rank was higher than before the race with lower subjective rank (medium and low).

The sports results obtained at the competition of *low* ( $M \pm 98.15$ ,  $SD \pm 2.765$ ), *medium* ( $M \pm 98.93$ ,  $SD \pm 3.244$ ) and *high* ( $M \pm 99.89$ ,  $SD \pm 1.969$ ) subjective rank were also compared. Their variability was found to be statistically significant ( $\chi^2 = 30.469$ ,  $p < 0.001$ ). The swimmers had better results in races which they rated as the most important, whereas lower scores were observed in less important races.

Stepwise regression analysis was carried out to determine whether the affective states are capable of predicting sports results. First, the predictors were searched for in terms of mood states, separately for the results obtained in low, medium and high-ranked competitions (**Table 3**).

In the case of low-ranked races, sports results can be predicted at almost 20% based on the level of fatigue, which is a negative predictor. Two predictors of the results were identified in middle-ranked races: depression and confusion. In the case of high-ranked races, only depression turned out to be a predictor. Mood states allowed for predicting sport performance during competitions that were assessed the athletes as important. Then, additional factor of a subjective rank of the race was added. Two predictors were revealed: depression (negative predictor) and the rank of the race (positive predictor).

It was also verified whether the emotional state just before the race allows for predicting the results obtained in a given race. The results of the race assessed as medium important and important can be predicted in about 5% based on a positive emotional state.

Two predictors were determined after the introduction of an additional factor of a subjective rank of the race. A positive emotional state and the rank of the race allow for predicting the sport result in about 13%. High results should be expected in high-rank races with swimmers experiencing strong positive pre-competition states measured just before the race (**Table 4**).

<sup>1</sup>The results were publicly available online on the (Megatiming, 2018) website.

**TABLE 1** | Stress levels and mood depending on the subjective rank of the race.

Rank of race	Low rank ( <i>n</i> = 30)		Medium rank ( <i>n</i> = 86)		High rank ( <i>n</i> = 126)		Kruskal-Wallis test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	chi <sup>2</sup>	<i>p</i>
Stress	16.50	5.704	16.15	6.276	14.61	7.122	3.927	0.140
Anger	14.77	5.418	13.12	8.215	11.4	8.287	6.826	0.033
Confusion	11.70	4.268	9.99	4.423	8.80	4.728	11.345	0.003
Depression	19.57	9.111	16.15	12.02	13.63	10.184	10.2	0.006
Fatigue	18.70	4.268	13.99	6.762	10.09	6.715	49.394	<0.001
Tension	14.07	5.47	12.94	6.228	13.16	5.885	1.270	0.53
Vigor	13.43	4.321	15.26	5.129	17.42	6.138	11.087	<0.001
Kindness	17.07	5.948	17.56	4.991	17.13	4.733	1.114	0.573

**TABLE 2** | The emotional states before the race depending on the rank of the race.

Rank of race	low rank ( <i>n</i> = 52)		medium rank ( <i>n</i> = 146)		high rank ( <i>n</i> = 164)		Kruskal-Wallis test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	chi <sup>2</sup>	<i>p</i>
Positive emotions	23.06	9.918	27.65	8.431	32.68	7.582	51.233	<0.001
Negative emotions	14.21	5.263	15.11	5.991	16.02	5.399	11.552	0.003

**TABLE 3** | Mood states as predictors of sports result.

Rank of race	Predictor	$\beta$	$R^2$	<i>F</i>	<i>p</i>
Low	fatigue	−0.470	0.193	7.676	0.010
Medium	depression	−0.558	0.107	5.843	0.04
High	confusion	0.370	0.047	7.116	0.009
	depression	−0.235			
All races	depression	−0.265	0.133	18.926	<0.001
	rank	0.214			

**TABLE 4** | Emotional states as predictors of a sports result.

Rank of race	Predictor	$\beta$	$R^2$	<i>F</i>	<i>p</i>
Low	—				
Medium	positive emotional state	0.252	0.057	9.281	0.03
High	positive emotional state	0.230	0.047	8.921	0.003
All starts	positive emotional state	0.249	0.133	18.926	<0.001
	rank	0.136			

## DISCUSSION

The results of the study confirm our presumption that the subjective rank of competitions differentiates the swimmers' mood. The mood was the best on the day of the high-rank races. On that day, athletes experienced the weakest negative mood states: fatigue, confusion, depression and anger. The level of vigor was the highest at the time. In other studies of swimmers, fatigue by the big amount of training caused a decrease in vigor (Faude et al., 2008). Especially big differences were observed in the level of fatigue: it was much lower before high-ranked races. The results obtained in our study do not question the findings of other researchers (Torres-Luque et al., 2013) concerning

the importance of objectively determined rank of competitions (Gracz and Sankowski, 2007).

Swimmers experienced similar intensity of stress before races, regardless of their perceived importance (subjective rank). Differences in the levels of stress in three different conditions were not statistically significant.

Only negative moods were significant predictors of sports results, regardless of the subjective rank of race. The level of depression was a significant negative predictor of sports results obtained during medium- and high-rank races. The importance of this predictor was also confirmed in the analysis for all races. It can therefore be assumed that this mood is a particularly important factor determining the sports result. The relationship



between depression and the appraisal of a difficult situation is carried in two directions. On the one hand, depression is likely to affect how an athlete perceives the situation and interprets his or her experiences (Wolf et al., 2015; Sahin et al., 2017). On the other hand, a difficult situation can make the athlete feel depressed.

In our swimmers, the level of emotions before the race, both positive and negative, was the highest in races of the high subjective rank. This confirms the findings of Gracz and Sankowski (2007) that the strength of the emotional experience of athletes depends on the rank of the competition: the higher the rank, the stronger the emotional excitation (Fernández et al., 2020). In similar study it turned out that strong negative emotions do not prevent athletes from achieving high sports results. The highest-ranked swimmers felt the strongest positive and negative emotions during the competitions, simultaneously achieving the highest sports results (Samełko et al., 2018). This confirms the observation of other researchers that both positive and negative emotions release energy, which has a positive impact on sport performance (Martinent et al., 2013). Feeling positive affective states may require more attention from athletes than experiencing negative states (Vast and Young, 2010).

Our results suggest that sport performance of swimmers, regardless of the subjective rank of the sporting event, can be predicted based on negative moods on the day of the competition. It is more likely that mood states, especially depression, affect sports results by modifying the cognitive appraisal of the starting situation and expectations of the result. It is worth noting at this point that their predictive power decreased with the rank of the competition. In the case of competitions subjectively assessed as the most important, the significance of mood as the predictor of sports result measured by the coefficient of determination was the lowest. Furthermore, the positive emotional state felt just before the race contributed to the mobilization of energy, which allowed for faster covering of the distance, but only when the athlete assigned a moderate or high rank to the race.

The study has limitations. The survey was conducted in a small group of athletes in one sport, which significantly reduces the possibilities for generalization of results. The only cognitive factor considered was a subjective assessment of the rank of the race. The authors are aware that the POMS tool is a quite old questionnaire. However, currently conducted research on athletes show justification for using this tool (Adrade et al., 2013; Rice et al., 2017).

## FINAL CONSIDERATIONS

Our results suggest that the pre-competitive mood and the emotions are related to performance, which is reflected in other studies (Patrícia et al., 2019). The subjective rank of the race may be a factor modifying the relationship between affective states and results. It seems appropriate to take measures aimed at increasing the ability of athletes to self-regulate emotionally (Doron and Martinent, 2017). Emotions should be an important

area of mental preparation (Samełko et al., 2018). This allows for increasing the effectiveness of athletes also in stressful situations (Gross and Thompson, 2007; Church et al., 2017).

## PRACTICAL IMPLICATIONS

Based on the results obtained, the following guidelines can be formulated for the coaches and athletes:

1. Increased knowledge of coaches about how the athlete subjectively evaluates the importance of a sporting event may favor the optimization of athlete's preparation for the competition;
2. Athletes should develop their affective awareness to cope better with the performance situation;
3. Coaches should educate themselves in recognizing the affective states of athletes for more effective training and performance during the competition;
4. The objective and subjective importance / rank of the competition should be taken into account by the coach and the athlete in the period of setting goals for the season.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because data appear in the doctoral dissertation. The entire dissertation is available for viewing at the library in Józef Piłsudski University of Physical Education. Requests to access the datasets should be directed to Violetta Perzyńska, biblioteka@awf.edu.pl.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Senate Research Ethics Committee (Józef Piłsudski University of Physical Education in Warsaw). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

AS data collection, research organization and project, and description of the results. MG research methodology, statistical analysis, and description of the results. AK collecting literature and manuscript proofreading. All authors contributed to the article and approved the submitted version.

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# Effects of an Educational Hybrid Physical Education Program on Physical Fitness, Body Composition and Sedentary and Physical Activity Times in Adolescents: The Seneb's Enigma

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Physical activity (PA), body composition and sedentary behavior may affect the health of children. Therefore, this study examined the effect of an educational hybrid physical education (PE) program on physical fitness (PF), body composition and sedentary and PA times in adolescents. A 9-month group-randomized controlled trial was conducted in 150 participants (age:  $14.63 \pm 1.38$  years) allocated into the control group (CG,  $n = 37$ ) and experimental group (EG,  $n = 113$ ). Cardiorespiratory fitness, speed, strength, agility, flexibility and body mass index (BMI) were assessed through previously validated field tests. Sedentary time, PA at school and afterschool were evaluated with the Youth Activity Profile-Spain questionnaire. Significant differences were observed concerning to the CG in APA-weekend ( $p = 0.044$ ), speed-agility ( $p = 0.005$ ) and agility ( $p = 0.008$ ). Regarding the intervention, cardiorespiratory fitness ( $p = 0.000$ ), speed-agility ( $p = 0.000$ ), strength ( $p = 0.000$ ), flexibility ( $p = 0.000$ ), agility ( $p = 0.000$ ), PA in school ( $p = 0.011$ ), APA-weekday ( $p = 0.001$ ), APA-weekend ( $p = 0.000$ ), APA-week ( $p = 0.000$ ), and sedentary time ( $p = 0.000$ ) increased significantly in the EG. The use of a hybrid program based on teaching personal and social responsibility and gamification strategies produced enhancements in cardiorespiratory fitness, agility, speed, APA-weekdays and APA-weekends, reducing the sedentary time.

**Keywords:** physical health, body mass index, afterschool period, model-based learning, sedentary behavior

## INTRODUCTION

The Constitution of the World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (World Health Organization, 1946). They assert that both physical and mental well-being are human rights, enabling a life without limitation or restriction. Consistent with this notion, non-communicable diseases are global public health issues that lead to premature death and disability

(Global Burden of Disease 2015 Mortality and Causes of Death Collaborators, 2016). Specifically, the prevalence of physical inactivity, which is considered a key modifiable driver of childhood obesity, has reached alarming levels among European youth (Gómez et al., 2020), with the consequent problems on social, economic and personal levels (Martines et al., 2019; Nittari et al., 2019).

Among the many risk factors, cardiovascular disease and development and progression of a sedentary lifestyle are now recognized as leading contributors to poor cardiovascular health (Poortvliet et al., 2003). Low cardiorespiratory fitness in childhood and adolescence has been associated with increased risk for death and disability later in life (Neovius et al., 2008; Höglström et al., 2016; Henriksson et al., 2019). In this sense, being overweight can contribute to cardiometabolic diseases, such as diabetes or hypertension (Reilly and Kelly, 2011). Reilly et al. considered that more than 77% of overweight children were found to be overweight or obese as adults. For this reason, it is important to know if the relationship among physical activity (PA), body composition and sedentary behavior could be relevant factors in the health of children.

Overall, regular exercise and PA are associated with remarkable widespread health benefits, such as lower blood pressure or higher insulin sensitivity (Nystoriak and Bhatnagar, 2018), directly related to obesity and a sedentary lifestyle (Poortvliet et al., 2003; Nystoriak and Bhatnagar, 2018; Rodríguez-Ayllon et al., 2019). Furthermore, the afterschool period (e.g., 4 PM–8:30 PM) has been recognized as a relevant and feasible time period with a decrease in PA and an increase in sedentary time among children, because they are not restricted by school schedules and have the opportunity to engage in their sedentary pastimes (Riddoch et al., 2004). Additionally, several studies have observed a negative relationship between those factors (sedentarism and PA) and body mass index (BMI) in children (Gao et al., 2011), specifically higher in the afterschool period (Morgan et al., 2007; Colley et al., 2013). The BMI is a factor that can influence the PA level since children that are overweight engage in less PA (Colley et al., 2013; Blanco et al., 2020), with consequent problems, such as neurotrophic growth factors (Mora-González et al., 2019a) and conduct problems, since less PA is associated with a less balanced diet and is positively associated with alcohol consumption in teenagers of both sexes (Grao-Cruces et al., 2015). The European Youth Heart Study determined that devoting 60 min or more to moderate-vigorous PA daily is associated with a healthier cardiovascular fitness level in adolescents (Poortvliet et al., 2003) and better postural control (García-Soidán et al., 2020) and cognitive performance (Ishihara et al., 2020). In addition, there is a close relationship between physical fitness (PF) and PA (Martínez-Vizcaíno and Sánchez-López, 2008). A high level of PF can help to improve the optimal health status and prevent a wide variety of disease morbidities and mortalities (Metter et al., 2002; Kodama et al., 2009). On the other hand, a high level of PF will imply a good physiological

response to musculoskeletal, cardiorespiratory, hemato-circulatory, endocrine-metabolic and psychoneurological levels. It will be inversely proportional whether PF is low (Ortega et al., 2008b).

Educational centers have been identified as the leading places for promoting PA and health, especially during physical education (PE) classes (Sallis and McKenzie, 1991; Kahan and McKenzie, 2015). In this sense, it is important to promote PA during PE and morning recess in order to increase moderate and vigorous physical activity (MVPA), especially in children with overweight/obesity, because they report less PA in all daily segments, including the educational context (Pope et al., 2020). The recent recommendations of WHO for children and adolescents aged 5–17 are they should do at least an average of 60 min per day of MVPA, incorporating those that strengthen muscle and bone, at least 3 days a week (World Health Organization, 2020). Besides that, Gao et al. (2011) identified that children with overweight/obesity participated less in MVPA in PE classes than children of healthy weight. According to gender, it seems that there are differences between boys and girls, with higher values of MVPA in boys, regardless of whether they are measured during the week or on weekends (Aibar et al., 2014). Other studies have not identified differences according to gender in teenagers (Manzano-Sánchez and Valero-Valenzuela, 2018) or children (Svedenkrans et al., 2020).

However, it is necessary to say that there is a tendency of reduction in PA increase with age between childhood and adolescence (Arundell et al., 2013), and the absence of MVPA is important to improve health in children. Sedentary behavior also has a significant influence, leading to poorer health outcomes (Colley et al., 2013). For this reason, it is important measure PE, sedentary time, and PA. To measure PA, some studies used pedometers to measure PA in children and teenagers (Tudor-Locke et al., 2006; Isensee et al., 2018; Fang et al., 2020). It has some advantages, such as the cost, but they can not have the ability to measure different intensities (like MVPA). This is why accelerometry is one of the most reliable instruments to measure the PA of people (Pope et al., 2020). One of the main purposes of PE classes is to improve some variables to increase the adherence to PA in children and teenagers. Some studies that have used model-based learning can improve motivation, autonomy and competence, and these variables have a significant relation with MVPA (Manzano-Sánchez and Valero-Valenzuela, 2018). Recently, the Teaching Personal and Social Responsibility (TPSR) model has demonstrated improvements in these variables (Martínez-Vizcaíno and Sánchez-López, 2008; Manzano-Sánchez and Valero-Valenzuela, 2019; Manzano-Sánchez et al., 2019]. The latter was also demonstrated with the application of a gamification intervention (Pérez-López et al., 2017a,b) that was implemented on a long-term basis in different educational levels (primary and secondary education), social status and educational backgrounds (Fernández-Río et al., 2020).

For these reasons, the objective of the present study was to verify whether a hybrid educational program in PE classes based on TPSR and gamification techniques can increase the parameters of PF and PA; apart from that, it can reduce body



composition and sedentary behavior. Furthermore, gender and age differences will be considered in order to check the results.

## MATERIALS AND METHODS

### Study Design

A group-randomized controlled trial (Montero and León, 2007) was carried out from September 2018 to June 2019. The intervention program lasted for 9 months (**Figure 1**) in two secondary schools assigned to the control group (CG) or experimental group (EG). Sociodemographic and cultural characteristics were similar. Participants aged between 13 and 15 years had to be enrolled in the second or third year of Compulsory Secondary Education at the beginning of the intervention in one of the two secondary schools selected. The contents were selected according to the current education laws (BOE, 2014). Before and after the intervention, the students were required to carry out the tests in two different sessions. Informed consents (participation in the study, confidential data treatment and session recording) were requested from the students and their parents. The study was approved by the Ethics Committee of the University of Murcia (2871/2020).

### Exclusion Criteria and Participants

Participation was proposed to all students enrolled in one of the courses. Participants did not have to present any partial or chronic injury or disease that would prevent them from performing any of the physical and cognitive tests, participating normally in PE lessons or not having been diagnosed as a student with specific needs for educational support.

Initially, 211 adolescents began the intervention (**Figure 2**), with 164 (age:  $14.63 \pm 1.38$  years; 77.73% of the total) who finally formed part of the experience (90 boys and 74 girls) allocated to the CG ( $n = 40$ ) and EG ( $n = 124$ ).

However, a total of 150 participants completed the study, specifically 91.46% of the total number of students who started it, 37 in the CG and 113 in the EG. The reasons why 14 students did not finish the study, three from the CG (2 boys and 1 girl) and 11 from the EG (6 boys and 5 girls) were due to school absenteeism, missing more than 20% of PE lessons ( $n = 6$ ) and discomfort

during the performance of any of the physical or cognitive tests in the post-test ( $n = 8$ ). **Table 1** shows the characteristics of the adolescents who started and finished, as well as the variables.

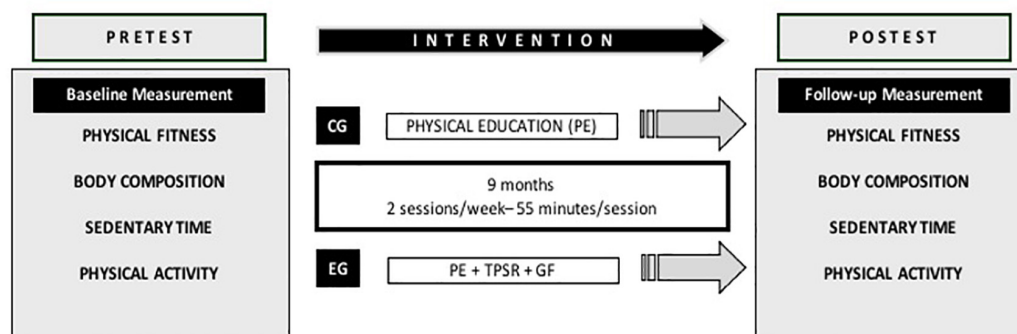
Each group (CG and EG) received two PE lessons per week, lasting 55 min. Whereas the EG participated in a PE program based fundamentally on the hybridization of TPSR and gamification strategies, taking into account game-based learning, the CG used traditional learning methods characterized by non-integration and lack of transfer of learning outside of school. Moreover, the teacher of the CG had no experience in active methodologies like those mentioned above. Experimental and control teachers were filmed by an external observer in order to verify the fidelity of implementation of TPSR and gamification techniques in 10 random sessions (Valero-Valenzuela et al., 2020). The instruments used were the same following a similar evaluation structure and also both experimental and control teachers evaluated their own intervention (self-evaluation). The observer, person trained in the application and evaluation of this type of pedagogical model, analyzed both methodological behaviors and evaluated the frequency that teachers used the hybridization learning models, ranging from 1 to 4 (from never to always). This expert was trained in thanks to a researcher with more than 5 years of experience in this methodology beforehand to check the quality of their record-keeping by calculating the inter-observer and intra-observer reliability concordance using Cohen's kappa coefficient (Cohen, 1988), of which a mean value of more than 0.70 was obtained. Inter reliability was carried out between the observer and the researcher, while the intra-observer was carried out analyzing two different moments over one week, guaranteeing an agreement greater than 80%.

The check list instrument (**Table 2**) and the Tool for Assessing Responsibility-Based Education (TARE) were used to identify the gamification and responsibility elements, respectively (Wright and Craig, 2011).

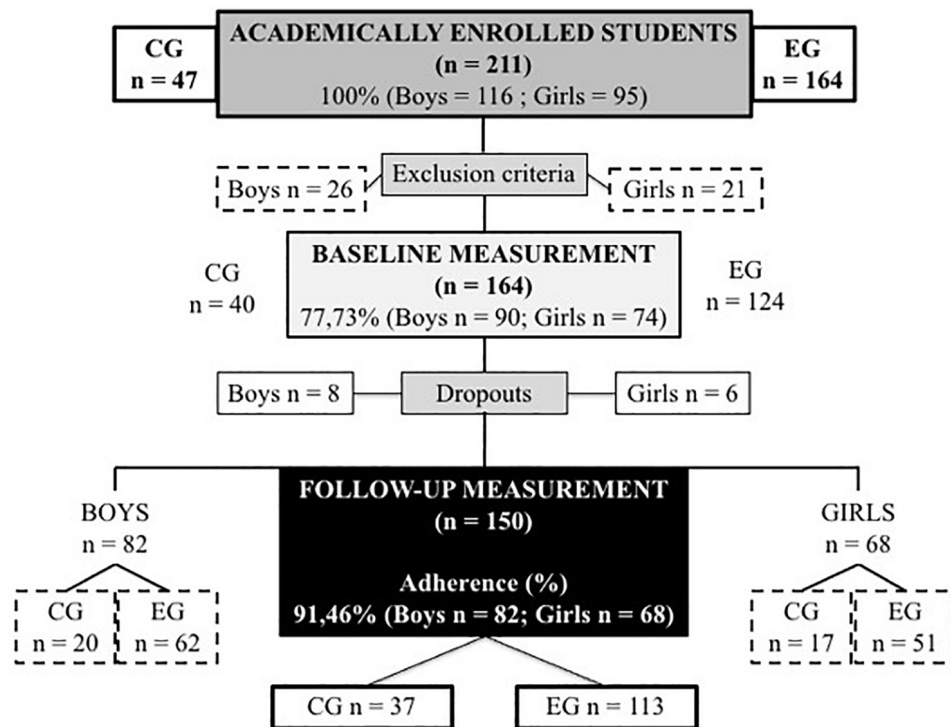
### Procedure

#### TPSR Intervention Program

The sessions followed the Hellison's format (Hellison, 2011) but were modified to keep four of its five parts: (1) Initial greeting: the teacher interacted with the students to create



**FIGURE 1 |** Variables and timeline intervention.



**FIGURE 2 |** The flowchart of the participants.

**TABLE 1 |** Initial data of the participants and variables.

	Participants (n = 150)		EG (n = 113)		CG (n = 37)		p
	Mean	SE	Mean	SE	Mean	SE	
Age (years)	14.33	1.18	14.52	1.24	13.76	0.68	
Height (cm)	156.2	4.82	154.6	3.54	154.03	2.94	
Weight (kg)	48.4	3.24	50.20	3.91	49.46	3.02	
BMI	19.89	6.63	21.46	4.11	21.04	4.05	0.589
PAIS	2.86	0.85	2.86	0.88	2.90	0.73	0.801
APA (weekday)	2.82	0.87	2.71	0.87	3.17	0.79	0.005**
APA (weekend)	2.49	0.97	2.35	0.87	2.95	0.97	0.001**
APA (week)	2.69	0.78	2.57	0.77	3.08	0.71	0.000**
ST	2.66	0.57	2.72	0.57	2.46	0.51	0.017**
CF	4.28	2.28	3.99	2.27	5.08	2.11	0.011**
SPD-AGI	13.16	1.26	13.27	1.29	12.78	1.10	0.041**
Strength	1.52	0.36	1.50	0.37	1.57	0.34	0.325
Flex (average)	3.65	7.64	3.51	7.63	4.38	7.60	0.548
Agility	14.67	2.31	14.93	2.18	13.69	2.17	0.003**

SE, standard error; EG, experimental group; CG, control group; BMI, body mass index; PAIS, physical activity in school; APA, afterschool physical activity; ST, sedentary time; CF, cardiovascular fitness; SPD-AGI, speed/agility; Flex, Flexibility.

bonds with them; (2) Sensitivity talk: the teacher presented the academic and value goals of the session, depending on the responsibility model level; (3) Activity plan: this was the greatest part of the practical lesson, where responsibility strategies were included in the different tasks; and (4) Group meeting and self-assessment: at the end of every session, teacher and students shared their perceptions with regard to individual and collective

responsibilities and behaviors, as well as the teacher's behavior, pointing their thumbs up (positive evaluation), to one side (medium) or down (negative evaluation).

### Gamification Strategies

Regarding the gamification elements in the intervention program, the process of integrating game-design principles

**TABLE 2 |** Fidelity Implementation Instrument (gamification elements).

	Control group			Experimental group		
	SE	EO	Mean SE/EO	SE	EO	Mean SE/EO
1. Setting (ST). Uses background music and/or decorates the place with respect to the narrative of intervention.	2	2	2	4	3	3.5
2. Mechanics (MC). Grants rewards and provides feedback on the accomplishment of the challenges.	1	1	1	4	4	4
3. Dynamics (DN). Introduces a narrative thread into the session. Generates curiosity.	2	1	1.5	3	3	3
4. Components (CO). Generates missions, realms (groups), roles/status, badges, rankings and markers.	1	1	1	4	4	4
5. Leadership (L). Allows students to lead or be in charge of a group.	2	2	2	4	4	4
6. Working in small groups (WSG). Organizes activities and tasks in small groups (4–6 students).	3	2	2.5	4	4	4
7. Task exceeded by the whole group (TEG). Encourages all teammates to succeed.	1	1	1	4	4	4
8. Setting challenges (SC). Tries the challenges that arise during the development of the sessions.	2	1	1.5	4	4	4
9. Groups stability over time (GST). Tries to maintain stability in the kingdoms/groups formed over time for several sessions.	1	1	1	4	4	4
10. Identification/characterization (ID/C). Characterizes students in a way that identifies them with a kingdom/group.	2	1	1.5	4	3	3.5
Total mean	1.69	1.30	1.49	3.92	3.76	3.84

within varying educational experiences appear challenging, and currently, there are no practical guidelines for how to do coherently and efficiently (Dichev and Dicheva, 2017). Therefore, based on the three categories (dynamics, mechanics and components) mentioned by Werbach and Hunter (2014), the following elements were included as part of the gamified context: (a) Powerful narrative: Seneb's Enigma was designed as the common theme in order to discover a complete health, previously extinct; (b) Challenges: on each mythology, students had to reach two different activities, generally outside the school and each one included different difficulty levels to challenge the students individually and in groups; (c) Class climate: the focus was on performing the different tasks, such as helping group members, earning points, and earning badges, and not on outperforming others; (d) Immediate feedback: students knew in advance how to successfully perform each activity, the number of points awarded for each task, and the level effectively achieved through a social platform; (e) Badges for achievements: students could earn points ("healthy years") to obtain several badges on each unit; and (f) Final status: depending on the mythologies overcome, students reach one of the three status (squires, Egyptian "melli" and bearers of Seneb).

Moreover, this intervention has taken in account the four key motivational elements (RAMP) of Marczewski (2013), that a gamified experience should incorporate itself: *Relatedness* or the desire to be connected to others in a social community; *Autonomy*, or the freedom in order to not be controlled or stifled; *Mastery*, or the process of becoming skilled at something feeling their skills are increasing in direct proportion to the level of challenge; *Purpose*, or the meaning of their actions. The reason why it is necessary the intervention.

### Control Group Methodology

Direct instruction was the methodology used by the CG teacher based on content/skill development and teacher-centered decisions and without affective-social interaction with the students, causing automatisms in their learning (Metzler, 2005). Virtually every element was monitored and decided on by the teacher, including content selection, managerial control, task presentations, engagements patterns, instructional interaction, pacing and task progression. The teacher decided when practice started and stopped remaining in full control of the class. Students did not have to make decisions besides participation in the different tasks. His principal goal was paying attention to the result but not to the learning process. The format of each session was divided into three non-connected parts: (1) warm-up: students got ready for the class performing predesigned tasks (i.e., joint mobility); (2) main part: students performed a predesigned set of tasks to improve the selected skills (i.e., badminton hitting drills); and (3) cool down: students performed lighter tasks to get ready for the next class, focusing on stretching their muscles and following the instructions of the teacher (Metzler, 2005).

## Instruments and Measurements

### Physical Fitness

The PF assessment protocol was used in the previously published European HELENA study (Healthy Lifestyle in Europe by

Nutrition in Adolescence<sup>1</sup>) (Ruiz et al., 2006; Ortega et al., 2008a, 2009). The PF tests used have shown optimal validity and reliability in order to be applied in the adolescent population (Ortega et al., 2005; Castro-Pinero et al., 2010; Ardoy et al., 2011). Cardiorespiratory fitness was assessed by the 20 m shuttle run test; speed and agility were evaluated by the 4 × 10 m speed-agility test; lower body strength was measured by the standing broad jump; and low back flexibility was evaluated by the back saver sit-and-reach test and calculating the average of both legs. Additionally, the hexagon test was used to evaluate agility-coordination and dynamic balance (Beekhuizen et al., 2009).

### Body Composition

The assessment of body composition was proposed and used in the HELENA study. The descriptions of the measurements made, the material used for this purpose and the reliability analysis have been previously published (Nagy et al., 2008). Body mass and height measurements were previously taken with the SECA-876 brand height rod and scale, and were used to calculate BMI ( $\text{kg}/\text{m}^2$ ).

### Lifestyle Habits

The Youth Activity Profile-Spain (YAP-S) questionnaire ( $\alpha = 0.73$  and  $0.79$ ; pre- and post-test) was used to analyze the time spent practicing PA (in school and afterschool) and sedentary activities, such as watching television, playing video games or using mobile phones. The reliability was for the whole sample who finished the intervention. It has previously been validated (Sain-Maurice and Welk, 2015) and used in more intervention studies (González-Gross et al., 2003; Ardoy et al., 2010).

### Data Analysis

Initially, we carried out the validation of the instrument by analyzing its internal consistency, both in the pre-test and in the post-test of each of the variables, using Cronbach's alpha test to assess reliability. Then, we carried out an exploratory analysis of the data using box-whisker diagrams and descriptive measurements, detecting that there were significantly different results between groups in the pre-test, so this was taken into account in the inferential analysis that was carried out. Afterschool physical activity (weekday, weekend and week), sedentary time, speed-agility, cardiorespiratory fitness and agility-coordination variables were significantly different in CG.

In a first analysis, a MANOVA of repeated measurements was carried out on the 12 variables obtained from the different PF tests and questionnaire, where we called the intra-subject factor "Time" (with two levels: pre-test and post-test) and we called the inter-subject factor "Group" (with two levels: control and experimental). Additionally, the inter-subject age factor and gender were added as covariates, since we found that this factor could have a significant effect on the measured variables. Additionally, the intervention effect size was estimated using the Cohen's  $d$  (Cohen, 1988) with Hedges correlation for small sample sizes (Nakagawa

and Cuthill, 2007). The effect size was considered small when it was 0.2–0.5, medium when it was 0.51–0.8 and large when it was greater than 0.8. The entire statistical analysis was performed with the Statistical Package for the Social Sciences (IBM SPSS 24.0), establishing the level of significance  $p < 0.05$ .

## RESULTS

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation and the experimental conclusions that can be drawn.

### Inferential Analysis

The MANOVA of repeated measurements at the multivariate level was the first step in the analysis. With regard to the inter-subject analysis, there was a significant difference in the Gender factor (Lambda of Wilks = 0.405;  $F = 16.436$ ;  $p = 0.000$ ) but not with the Age covariate (Lambda of Wilks = 0.870;  $F = 1.663$ ;  $p = 0.082$ ). It was also observed that there were significant differences in the intra-subject analysis between Time and Group interactions (Lambda of Wilks = 0.462;  $F = 12.993$ ;  $p = 0.000$ ). The fact that the Time factor (Lambda of Wilks = 0.860;  $F = 1.812$ ;  $p = 0.052$ ) was not significant did not mean that there were no differences between the pre-test and the post-test, since there were significant interactions with the Group factor. This indicates that there may be differences in the Time factor (i.e., between pre-test and post-test) depending on the group considered (differences for each group separately), as well as taking this factor into account (pre-test and post-test differences between the CG and EG).

In order to observe more specifically which variables showed significant differences, the univariate level was analyzed. Attention was paid to the variables with previously significant results. For the intra-subject factor, significant differences were obtained in Time and Group interactions for APA-weekend ( $p = 0.000$ ), APA-week ( $p = 0.000$ ), sedentary time ( $p = 0.002$ ), BMI ( $p = 0.000$ ), cardiorespiratory fitness ( $p = 0.000$ ), speed-agility ( $p = 0.000$ ), strength ( $p = 0.001$ ), and agility ( $p = 0.000$ ).

Since there were interactions between the Time and Group factors for many of the variables, we can analyze the differences between the CG and the EG for the pre-test and the post-test separately. Similarly, the variables in the pre-test and post-test should be compared separately for each group. Thus, **Table 3** reflects the means and standard errors estimated for the participants with regard to the different variables measured in the pre-test and in the post-test, differentiating by group. In addition, the  $p$ -values obtained by comparing these estimated averages (using Bonferroni correction) are included.

It is relevant to indicate that, in the pre-test, there were significant differences between groups in several variables of interest. However, it is relevant to remark that there were significant differences in the post-test with

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**TABLE 3 |** Intervention multivariate analysis (MANOVA).

Variable	Group	Pre-test		Post-test		Pre – post comparative	
		Mean	SE	Mean	SE	p-value	Dif. (SE)
PA in school	Experimental	2.86	0.88	3.04	0.78	0.011*	−0.18 (0.067)
	Control	2.90	0.73	3.24	0.86	0.005**	−0.34 (0.120)
	p-value + SE	0.956	0.167	0.247	0.152		
APA (weekday)	Experimental	2.71	0.87	3.04	0.91	0.001**	−0.33 (0.095)
	Control	3.17	0.79	3.16	0.85	0.912	0.01 (0.169)
	p-value + SE	0.006**	0.163	0.551	0.173		
APA (weekend)	Experimental	2.35	0.87	3.02	1.01	0.000**	0.67 (0.090)
	Control	2.95	0.97	2.65	0.82	0.020*	0.30 (0.161)
	p-value + SE	0.000**	0.169	0.044*	0.185		
APA (week)	Experimental	2.57	0.77	3.03	0.82	0.000**	−0.46 (0.074)
	Control	3.08	0.71	2.96	0.71	0.223	0.12 (0.132)
	p-value + SE	0.000**	0.141	0.560	0.151		
Sedentary time	Experimental	2.72	0.57	2.47	0.54	0.000**	0.25 (0.059)
	Control	2.46	0.51	2.64	0.58	0.203	−0.18 (0.105)
	p-value + SE	0.024*	0.110	0.238	0.107		
BMI	Experimental	21.46	4.11	21.50	4.05	0.521	−0.04 (0.093)
	Control	21.04	4.05	21.94	3.44	0.000*	−0.90 (0.166)
	p-value + SE	0.934	0.810	0.355	0.774		
CF	Experimental	3.99	2.27	5.04	2.20	0.000**	−1.05 (0.116)
	Control	5.08	2.11	4.70	2.19	0.066	0.38 (0.207)
	p-value + SE	0.001**	0.351	0.443	0.349		
SPD-AGI	Experimental	13.27	1.29	11.63	1.53	0.000**	1.64 (0.098)
	Control	12.78	1.10	12.38	1.21	0.043*	0.40 (0.174)
	p-value + SE	0.004**	0.198	0.005**	0.256		
Strength	Experimental	1.50	0.37	1.64	0.38	0.000**	−0.14 (0.015)
	Control	1.57	0.34	1.61	0.37	0.268	−0.04 (0.027)
	p-value + SE	0.110	0.056	0.723	0.058		
Flexibility (average)	Experimental	3.51	7.63	5.82	7.51	0.000**	−2.31 (0.232)
	Control	4.38	7.60	6.03	8.22	0.000**	−1.65 (0.412)
	p-value + SE	0.496	1.382	0.924	1.381		
Agility	Experimental	14.93	2.18	12.30	1.93	0.000**	2.63 (0.142)
	Control	13.69	2.17	13.30	2.60	0.203	0.39 (0.252)
	p-value + SE	0.003**	0.415	0.008**	0.394		

\* $p < 0.05$ ; \*\* $p < 0.01$ ; SE, standard error; PA, physical activity; APA, afterschool physical activity; BMI, body mass index, CF, cardiorespiratory fitness; SPD-AGI, speed/agility.

APA-weekend ( $p = 0.044$ ), speed-agility ( $p = 0.005$ ), and agility ( $p = 0.008$ ). In addition, there were no significant enhancements with PA in school, APA-week, sedentary time and cardiorespiratory fitness. These last two variables are extremely relevant because they were worse in the CG with respect to the pre-test.

On the other hand, if it compares the effects of intervention, observing the results between the pre-test and post-test for each group, it can observe the same for the CG. There were significant differences in PA in school ( $p = 0.005$ ), speed-agility ( $p = 0.043$ ), flexibility ( $p = 0.000$ ), BMI ( $p = 0.000$ ), and APA-weekend ( $p = 0.020$ ). However, the last two variables decreased concerning to the pre-test. Regarding the EG, the results increased significantly in all variables, except BMI, including cardiorespiratory fitness ( $p = 0.000$ ), speed-agility ( $p = 0.000$ ), strength ( $p = 0.000$ ), flexibility ( $p = 0.000$ ), agility ( $p = 0.000$ ),

PA in school ( $p = 0.011$ ), APA-weekday ( $p = 0.001$ ), APA-weekend ( $p = 0.000$ ), APA-week ( $p = 0.000$ ), and sedentary time ( $p = 0.000$ ).

## DISCUSSION

The main purpose of this study was to verify whether a hybrid educational program in PE classes based on TPSR and gamification can increase the parameters of PF and PA; on the other hand, it can reduce body composition and sedentary behavior.

The results observed in the present study indicate that the implementation of a hybrid program based on TPSR and gamification contributes significantly to the improvement of variables such as cardiorespiratory fitness, speed-agility,



strength, flexibility and agility. Data supports the conclusions of González-Víllora et al. (2019), where combined benefits in the physical/motor, cognitive, affective and social domains have only been observed when merging different pedagogical models concerning to the intervention of an isolated pedagogical model. However, TPSR has never been hybridized with gamification strategies. The hybridizations of pedagogical models in the scientific literature with TPSR as the protagonist have been related to the improvement of psychosocial variables and personal and social development (Hastie and Buchanan, 2000; Menéndez-Santurio and Fernández-Río, 2016; Fernández-Río and Menéndez-Santurio, 2017). However, the variables related to health, physical-motor and cognitive aspects have never been analyzed through pedagogical hybridizations (González-Víllora et al., 2019), as our intervention has carried out, demonstrating that, despite reducing motor physical involvement in the early stages of applying the model, their levels of cardiorespiratory fitness, speed-agility, strength, flexibility and agility were improved. Apart from that, the application of gamification elements in isolated PE interventions has not only contributed to the increase in student motivation and commitment toward PA practice (Joo et al., 2019), but also to the improvement of cardiorespiratory capacity (Mora-González et al., 2019b, 2020) or healthy lifestyle habits (Monguillot-Hernández et al., 2015; Pérez-López et al., 2017a).

That intervention also produced enhancements in PA in school, APA-weekday, APA-weekend, APA-week and sedentary time, as well as an increase in BMI in the group that did not receive it. These results would be related to those obtained in other studies in which they linked the decrease in PA levels to overweight parameters and neurotrophic growth factors problems (Mora-González et al., 2019a) as well as to close future morbidity and mortality disease (Metter et al., 2002; Kodama et al., 2009). Additionally, our results, largely obtained by activities carried out outside of school, would be in line with the studies proposed by Arundell et al. (2013), suggesting that afterschool period is an important time period to enhance PA levels and sedentary time in childhood and adolescence and reducing BMI (Gao et al., 2011). Accordingly to this study, our results indicated that BMI increased significantly in students who did not participate in the intervention and therefore did not perform extra physical activity. It may be the reason to indicate the BMI raised for CG. Other studies (Harris et al., 2009; Thivel et al., 2011; Guerra et al., 2013) have shown non-significantly improvements not only for the EG, but also for the CG (Thivel et al., 2011) in both normal weight and obese children, highlighting the structuring and durability of the intervention program and the insufficient “dose” of physical activity (Harris et al., 2009). A possible reason why PA in school has significantly improved in both group may be the PE sessions themselves, because are based on practice exercise regardless of the type of methodology used. For this reason, it will be so relevant to incorporate this educational program to current curricular requirements in order to promote PA during PE lessons (Pope et al., 2020) and afterschool (Arundell et al., 2013).

Some limitations in this study are that it may not be a sufficient and optimal representation of the population of their age. Consequently, this intervention study may consider the unequal distribution of the participants, with the CG being reduced compared to the EG. It could be convenient not to extend the post-intervention tests until dates close to the evaluations established by the educational centers due to possible experimental deaths. Moreover, the performance of PF tests was determined according to the time assigned in the timeline hours of each group, as a consequence of the curricular organization school.

Due to the time difficulty and number of trained and qualified personnel for the test days, both at the beginning and at the end of the intervention, the evaluators were not the same at both times. It could be a limitation, even though they were previously trained.

Another variable that could affect the reliability of the results is the activity carried out after school hours. The number of days per week they do training, the type of sport or predominant PA and its relationship with the intensity variables, volume and duration of effort should be considered in students who belong to sport teams.

Additionally, other limitation was the instrument used in order to measure the elements of gamification, because it is not a validated instrument and it has never been published. Future studies may consider the use of accelerometry, which would allow a more precise evaluation of daily PA.

## CONCLUSION

The results obtained with the intervention suggested that the use of a hybrid program based on TPSR and gamification strategies produced enhancements in cardiorespiratory fitness, agility and speed-agility. In addition, it improves the APA-weekdays and APA-weekends, reducing the sedentary time. On the other hand, students who did not receive an intervention based on a hybrid of these methodologies were linked to an increase in BMI.

The states and administrations for education should consider the inclusion of innovative programs and their hybridization as a tool to guarantee an optimal state of health in adolescents. Additionally, the afterschool period, concerning to overall PA (particularly during adolescence), may be crucial in this age group. Future studies involving larger sample sizes should confirm or contrast these preliminary findings.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University of Murcia

(2871/2020). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

DM-C and AV-V: conceptualization. DM-C and DN-A: methodology and investigation. DM-C, VM-B, and DM-S: formal analysis. VM-B: resources. DM-C and DM-S: data curation. DM-C: writing—original draft preparation. DM-C and VM-B: writing—review and editing. AV-V: visualization. AV-V and

DN-A: supervision. All authors have read and agreed to the published version of the manuscript.

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# Competitive Recovery–Stress and Mood States in Mexican Youth Athletes

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**Background:** Monitoring recovery–stress balance in sport is becoming more relevant to prevent training maladaptation and reach the optimal performance for each athlete. The use of questionnaires that identify the athlete's recovery–stress state have much acceptance in sports due to reliability and useful, furthermore for its low cost. Identifying possible differences between sport modalities and sex is important to determine specific needs and possible intervention ways to keep a recovery–stress balance. The aim was to analyze the differences in the recovery–stress state and mood states by sex and sport type during the competitive phase in young Mexican athletes. As a secondary objective, the psychometric properties of the Mexican version of the Recovery–Stress Questionnaire for Athletes (RESTQ–Sport) were analyzed.

**Methods:** A cross-sectional study was carried on with 461 athletes (61% women and 39% men), 17.95 ( $\pm 1.2$ ) years old, from six sports disciplines. The RESTQ–Sport and Profile of Mood States (POMS) were applied in a single moment. Differences by sex and sports modality were analyzed. RESTQ–Sport's confirmatory factor analysis was performed after the stress and recovery theoretical structure of two stress (general and sport) and two recovery (general and sport) dimensions, and last, the concurrent validation with the POMS was carried on.

**Results:** Significant differences by sex were found in the General Recovery and Sport Stress dimensions of the RESTQ–Sport as well as Vigor factor of the POMS, being higher for men; furthermore, both the Sport Recovery dimension of RESTQ–Sport and Cholera and the Fatigue and Depression factors from POMS also had differences by sport type, showing a less recovery and high stress for individual sport athletes. Goodness-of-fit indexes of the model for the RESTQ–Sport were acceptable. Pearson's correlation between questionnaires was moderate ( $p < 0.05$ ).

**Conclusion:** The recovery–stress state shows differences in the function of sex and sport modality. More special attention is suggested for women and individual sport



athletes. The higher punctuation for men compared with women in sport stress dimension did not negatively affect the recovery–stress balance for male athletes. Finally, the Mexican context adaptation of the RESTQ-Sport provides a psychometric instrument suitable to assess the recovery–stress balance in Mexican athletes.

**Keywords:** RESTQ-sport, POMS (profile of mood states), gender differences, individual vs. team sports, confirmatory factor analysis-CFA, Mexico

## INTRODUCTION

High demands of sports competition require an intelligent approach to schedule training loads and recovery periods (Elbe et al., 2016). Elevated training loads are associated with higher levels of physical and psychological stress (Nunes et al., 2014), which, along with factors such as competition, performance self-assessment, poor recovery, and contextual aspects, can lead the athlete to decreased performance due to excessive fatigue, overload, and overtraining (Kellmann, 2010).

Overtraining syndrome is characterized by a lack of energy, eating, and sleep disturbances. Among other symptoms, it affects moods and concentration (Halsen, 2014), highlighting recovery as an essential element to achieve optimal athletic performance. Recovery, understood as a multilevel intra- and interindividual process that can have different periods, is a key factor for sports training (Kellmann et al., 2018), so coaches and athletes should focus on keeping and regaining the body's balance between the imposed demands and the available physical and psychosocial resources, allowing athletes to train more and improve their skills (Kellmann, 2010). Therefore, attention to recovery processes from a preventive approach involves the increased control of training load impact and avoid athlete's non-functional maladaptation, as well as promote effective coping strategies to manage stress levels (Heidari et al., 2019; Lope and Solís, 2020).

There are different methods for stress evaluation during training and competition, being the self-report and daily questionnaires reliable tools widely used, that offer non-invasive and low-cost immediate information of the athlete's state (Kellmann, 2010; Halsen, 2014; Nässi et al., 2017). The Profile of Mood States (POMS, McNair et al., 1971), for example, makes it possible to identify overtraining profiles from athletes, evaluating mood changes, which are reflected through their negative and positive factors.

Related studies regarding the impact of high competition on athletes' moods suggest that factors such as age and competition level can influence the modulation of these states, being better in older and more experienced athletes (Peñaloza et al., 2016). On the other hand, there is a consensus that maintaining a positive profile (iceberg profile), where vigor is above the other factors, can predict optimal sports performance, whereas an inverted iceberg profile (vigor below the negative factors) may be associated with the overtraining syndrome and inadequate stress coping by the athlete, in addition to poor performance (Vidal Andreato et al., 2014; Correia et al., 2016).

In the same way, the Recovery–Stress Questionnaire for Athletes (RESTQ-Sport) arises as a response to the need for a

more comprehensive and precise evaluation for psychological symptoms associated with the overtraining syndrome, as well as the athlete's coping tools to face the situation (Kellmann and Kallus, 2001, 2016). Its capability to evaluate not only the stress levels and sources but also the recovery process in a multidimensional way has made it one of the most applied instruments in stress–recovery monitoring (Kellmann, 2010).

Previous research (Nederhof et al., 2008; González-Boto et al., 2009; Molinero et al., 2012) has identified positive correlations between RESTQ-Sport scales of stress and POMS negative factors, as well as between RESTQ-Sport recovery scales and the vigor factor of the POMS, otherwise (negative correlations) between the stress scales and the vigor factor and the recovery scales of the RESTQ-Sport with the POMS negative factors. Authors conclude that there is a concurrent validity between the questionnaires due to the relationship between parameters associated with overtraining factors (stress and negative moods) and the positive factors and scales of the instruments (vigor and recovery).

Other studies focused on analyzing the relationship between precompetitive anxiety levels and athletic performance; for example, one of them (León-Prados et al., 2014) identified a relationship between cognitive anxiety levels that influenced athletic performance in basketball players. However, Reynoso-Sánchez et al., 2017 identified changes in recovery–stress balance, heightening stress, and decreasing recovery levels at the end of a handball competition regarding precompetition evaluations. In the same way, Vacher et al. (2017) report the influence of the recovery–stress states over the emotional responses in swimmers and the relationship with external and perceived training loads.

On the other hand, it has been previously reported that the sport type (Valcarce, 2011; Garinger et al., 2018) and sex (Holden et al., 2019) have a modulating effect on the perception of stress; similar to other psychological variables such as depression (Nixdorf et al., 2016), both being significantly higher for athletes who practice individual sports. However, more research centered on these differences is needed to be able to get an intervention process that promotes the monitoring and maintaining recovery stress balance with more precision in the future.

Therefore, the present study aimed to analyze the differences by sport type and sex of the recovery–stress levels and mood states of young Mexican athletes during a competitive period. As a secondary objective, we intend to confirm the factorial structure of the four dimensions for the Mexican adaptation of the RESTQ-Sport and examine the internal consistency and concurrent validity with the POMS factors in young Mexican athletes. Researchers hypothesize that the evaluated athletes will have differences in sex and sport-type practice, with perceived

stress and negative moods being greater for both women and athletes of individual sports.

## MATERIALS AND METHODS

### Participants

A cross-sectional study was carried out with explanatory-correlational scope. A convenience non-probabilistic sampling was used. Four hundred sixty-one athletes who participated in the National Youth Championship in 2016 (61% women and 39% men), age 17.95 ( $\pm 1.2$  years; range = 16–20) years old, participating at six different sports disciplines (athletics = 10.4%; soccer = 15.2%; handball = 31.7%; racquetball = 2.8%; taekwondo = 21%, water polo = 18.9%) from 26 of the 32 states of the Mexican Republic took part in this study.

### Instruments

#### Recovery–Stress Questionnaire for Athletes 76

Recovery–stress balance was assessed with the RESTQ-Sport 76 (Kellmann and Kallus, 2001, 2016). Athletes indicated how often they participate in different activities and experience different feelings and emotions during the previous 3 days and nights. They answer a seven-point Likert-type scale (0 = never to 6 = always). This questionnaire consists of 76 items distributed in 19 scales that are grouped in four dimensions (Kellmann and Kallus, 2016): There are seven general stress (GS), five general recovery scales (GR), three sport stress (SS), and four Sport Recovery scales (SR). The original proposal of Kellmann and Kallus (2001, 2016) indicates two questionnaire dimensions: stress and recovery, gathered in a general and sports factor for each dimension, which determines the Recovery–stress balance (RSB) by subtracting the total recovery from the total stress. A positive RSB means an adequate balance.

The instrument measures the relationship between activities, experienced moods, and events with respect to current stress and recovery, identifying patterns based on perceived physical and psychosocial stress and the athlete's coping resources, explaining the factors that can generate overtraining in athletes (Kellmann and Kallus, 2016). A positive recovery–stress balance (higher levels of recovery perceived over stress) is associated with athletes' ability to cope with the demands, whereas an imbalance indicates coping inability and overload produced by training and context.

Recovery–Stress Questionnaire for Athletes has been validated in different languages: English (Kellmann and Kallus, 2001, 2016), Spanish (González-Boto et al., 2008), Dutch (Nederhof et al., 2008), and French (Martinent et al., 2014). Additionally, it has been used in different sports such as soccer (Laux et al., 2015), basketball (Nunes et al., 2014), volleyball (Freitas et al., 2014), cycling (Filho et al., 2013), and swimming (Elbe et al., 2016; Vacher et al., 2017), among others. The factorial proposal of the instrument was corroborated by González-Boto et al. (2008) and Nicolas et al. (2019). The internal consistency coefficient of the entire questionnaire and each factor has been higher than 0.70 (González-Boto et al., 2008; Nederhof et al., 2008; Martinent et al., 2014), which allows the acceptance of the model.

The use of the RESTQ-Sport has been reported in four studies with Mexican samples; three of them using a Mexican context adapted version. All of them had adequate Cronbach's  $\alpha$  values ( $> 0.70$ ). The first was carried out with volleyball players ( $20.75 \pm 1.94$  years old), reporting  $\alpha$ -values greater than 0.80 on the global scale and 0.90 for each dimension (Reynoso-Sánchez et al., 2016). The second assessed pre-, during, and post-competition in handball players ( $22.3 \pm 1.8$  years), with internal consistency coefficients greater than 0.85 for each time (Reynoso-Sánchez et al., 2017). The third was realized with endurance runners ( $20.1 \pm 2.7$  years), indicating values of  $\alpha$  above 0.70 (Hernández-Cruz et al., 2017). The fourth study was performed with soccer players using the Spanish version of RESTQ-Sport, obtaining a Cronbach's  $\alpha > 0.80$  (Lope and Solís, 2020). However, no other psychometric properties analyzing the validity of RESTQ-Sport have been reported.

### Profile of Mood States

To assess mood states, the POMS scale was applied (McNair et al., 1971). This instrument allows a multidimensional evaluation of mood states throughout adjectives related to different factors (Nässi et al., 2017). Participants answered a retrospective questionnaire of the last 3 days/nights from a five-point Likert scale (0 = nothing and 4 = very much). Originally, the POMS was structured by seven scales, but according to the analysis from Arce et al. (2000), the six-scales version has better reliability and validity indices for the application with athletes. Following this purpose, the 58 items grouped in the six-factor version were applied; five negatives: (a) tension, (b) depression, (c) anger, (d) fatigue, and (e) confusion; and one positive: (f) vigor (Arce et al., 2000).

### Procedure

The study procedure was conducted by two main phases: the first one to adapt the RESTQ-Sport to the contextual characteristics of the Spanish language in Mexico, and the second phase consisted of the process for the questionnaires' application during the National Championship. For the RESTQ-Sport adaptation to the Mexican context phase, the method proposed by Muñoz et al. (2013) was followed. Two translators with experience in adapting psychometric tests performed the English to Spanish translation and back to English. Subsequently, an English native language translator carried out the qualitative evaluation between questionnaires, the original and the translated versions (English–Spanish–English). Finally, a pilot test with 10 athletes was performed to assess the understanding of the questionnaire, obtaining a satisfactory evaluation.

Finally, to achieve the application phase, first, the authorization to apply both questionnaires (RESTQ-Sport and POMS) was requested to the organization of the National Youth Championship. Once permission was obtained, a team of 10 volunteers was recruited and trained for the correct application of the questionnaires. The application team was composed of psychology and physical activity and sport students. One day before the start of the application, the researchers and team had a meeting to explain the study's purpose and the specifications for application instructions of the questionnaires.

Each volunteer answered the questionnaire as a practical example to identify possible doubts and learn the correct way to solve them for athletes if necessary. The support from the directors of each delegation was solicited, and the participants' consent was requested. The researchers scheduled the date for the application of the questionnaires with the directors of each delegation before the competition start. The questionnaire was applied at the best possible relaxed and calm conditions at the hotel lobby where the athletes were staying. Volunteers and researchers supervised during the application of the questionnaires, asking athletes to respond to all items and answering their doubts. The entire application process followed the agreements of the Declaration of Helsinki (World Medical Association, 2013) to ensure an ethical approach with the participants and the treatment of the collected data.

## Statistical Analyses

Descriptive analysis for means ( $M$ ), standard deviation ( $SD$ ), skewness, and kurtosis was performed for the RESTQ-Sport and the POMS.  $A \pm 2$  for asymmetry and kurtosis was considered as acceptable normality ranges (Kim, 2013). The RESTQ-Sport scales were grouped into their respective dimensions and the POMS factors for the analysis of the differences in the perception of stress–recovery and mood states. Subsequently, a Student  $t$ -test for independent samples was performed, assuming the equality of the variance by sex (woman and man) and sport type (individual or team) as independent factors. Values of  $p < 0.05$  were considered as significant differences.

Based on the RESTQ-Sport theoretical postulate, we proceeded to confirmatory factor analysis, grouping the scales in each of the four corresponding theoretical dimensions. Due to the high number of items of the RESTQ-Sport in relation to the sample, according to the recommendations of Ruíz et al. (2010), the analysis by the scales had to be carried out. The maximum likelihood method was chosen for continuous variables of the normal distribution as an estimation procedure. The following goodness-of-fit statistics were considered for the validity of the instrument: relative chi-square ( $\chi^2/df$ ), values below five are considered acceptable (Wheaton et al., 1977); the square root of the approximation error and the standardized square root of the residual, which must be equal to or below 0.08 to be considered appropriate (Ruíz et al., 2010); the comparative fit index and the goodness-of-fit index, appropriate parameters when they are greater than or equal to 0.90 (Byrne, 2010); and the corrected goodness-of-fit index considering adequate values greater than 0.80 (Pérez-Gil et al., 2000).

The internal consistency for each dimension of the instrument was evaluated using Cronbach's alpha (Cronbach, 1951), McDonald's omega (McDonald, 1999) based on confirmatory factor analysis, and the average variance extracted (AVE). For Cronbach's alpha and McDonald's omega, values greater than 0.70 were considered acceptable (Hair et al., 2009). For the AVE, it is suggested that its value exceed 0.50 (Hair et al., 2009). To evaluate concurrent validity, a Pearson correlation analysis was performed between the RESTQ-Sport and the POMS scales. For the data analysis, the statistical packages SPSS and AMOS v. 22 were used.

## RESULTS

### Assessment Based on Sex and Sport Type

**Table 1** shows the  $M \pm SD$  of the RESTQ-Sport dimensions and the POMS factors. Regarding the analysis for recovery–stress level differences by sex, men show significantly higher levels in the GR [ $F(459) = 3.56$ ;  $p = 0.000$ ], SS [ $F(459) = 0.48$ ;  $p = 0.041$ ], and SR [ $F(459) = 7.11$ ;  $p = 0.006$ ] dimensions of the RESTQ-Sport, as well as a greater perception in vigor factor [ $F(459) = 2.68$ ;  $p = 0.000$ ] of the POMS. Although the analysis of variance by sport type revealed that individual sport athletes present according to RESTQ-Sport, more SS [ $F(459) = 0.029$ ;  $p = 0.014$ ] and less GR [ $F(459) = 7.79$ ;  $p = 0.034$ ], as well as a greater negative mood states perception, being higher for anger [ $F(459) = 8.45$ ;  $p = 0.047$ ], fatigue [ $F(459) = 17.63$ ;  $p = 0.000$ ], and depression [ $F(459) = 15.26$ ;  $p = 0.007$ ] POMS factors, opposed to the vigor factor [ $F(459) = 2.21$ ;  $p = 0.050$ ] in which the team athletes show a higher levels.

### Psychometric Properties of Recovery–Stress Questionnaire for Athletes in Mexican Context

The univariate statistics for the instrument dimensions indicated a normal distribution, as the asymmetry ranges were from  $-0.84$  to  $0.66$  and the kurtosis ranges from  $-0.57$  to  $0.60$ . GS dimension was the one that presented the highest internal consistency ( $\alpha = 0.89$ ;  $\omega = 0.90$ ; AVE = 0.56), followed by SR ( $\alpha = 0.87$ ;  $\omega = 0.88$ ; AVE = 0.65), SS ( $\alpha = 0.78$ ;  $\omega = 0.82$ ; AVE = 0.60), and GR ( $\alpha = 0.73$ ;  $\omega = 0.75$ ; AVE = 0.38). The internal consistency of the entire instrument ( $\alpha = 0.74$ ) was higher than the minimum acceptable parameters.

Through the confirmatory factor analysis, it was found that stress factors (GS and SS) and recovery factors (GR and SR) were positively correlated with each other, both with a coefficient of 0.80 (**Figure 1**). In the opposite way, GS and SS factors correlated negatively with GR and SR factors, which was in line with what was theoretically expected. The factorial loads for the scales in each dimension were found above the value 0.40 (Pérez and Medrano, 2010).

When reviewing the goodness-of-fit indexes of the model, it is possible to observe that, in general, they reflected a satisfactory fit, being the ( $\chi^2/df$ ) = 4.79, the root mean square error of approximation (0.09), standardized root mean residual (0.09), whereas the comparative fit index (0.90) and goodness-of-fit index (0.90) and adjusted goodness-of-fit index (0.80) are within the accepted ranges for the model fit.

### Correlations Between Questionnaires

Regarding the POMS scales analysis, the questionnaire showed acceptable univariate normality ranges ( $-0.36$  to  $1.37$  of asymmetry and  $-0.09$  to  $1.34$  of kurtosis) and values total internal consistency ( $\alpha = 0.82$ ). Finally, correlations between the scales of the questionnaires (**Table 2**) were observed. The five negative POMS factors correlated ( $p < 0.05$ ) positively with the stress scales and negatively with the recovery scales

**TABLE 1** | Means  $\pm$  SD and variance analysis of RESTQ-Sport and POMS.

	Sex			Sport type		
	Women	Men	<i>t</i>	Individual	Team	<i>t</i>
	<i>M</i> $\pm$ <i>SD</i>	<i>M</i> $\pm$ <i>SD</i>		<i>M</i> $\pm$ <i>SD</i>	<i>M</i> $\pm$ <i>SD</i>	
GS	2.00 $\pm$ 0.88	1.98 $\pm$ 0.86	0.07	1.96 $\pm$ 0.88	2.01 $\pm$ 0.87	0.09
GR	3.87 $\pm$ 0.76	4.16 $\pm$ 0.70	3.56**	3.88 $\pm$ 0.85	4.05 $\pm$ 0.69	7.79*
SS	2.22 $\pm$ 1.10	2.43 $\pm$ 1.05	0.48*	2.48 $\pm$ 1.09	2.21 $\pm$ 1.07	0.03**
SR	4.00 $\pm$ 1.01	4.24 $\pm$ 0.88	7.11**	4.06 $\pm$ 1.02	4.11 $\pm$ 0.94	0.84
RSB	1.83 $\pm$ 1.38	2.00 $\pm$ 1.33	1.30	1.75 $\pm$ 1.48	1.96 $\pm$ 1.29	8.04
Tension	1.41 $\pm$ 0.73	1.38 $\pm$ 0.63	4.75	1.37 $\pm$ 0.74	1.41 $\pm$ 0.67	2.58
Depression	0.64 $\pm$ 0.65	0.60 $\pm$ 0.63	0.01	0.74 $\pm$ 0.74	0.56 $\pm$ 0.57	15.26**
Anger	0.92 $\pm$ 0.75	0.93 $\pm$ 0.66	4.34	1.02 $\pm$ 0.80	0.88 $\pm$ 0.67	8.45*
Vigor	2.26 $\pm$ 0.66	2.56 $\pm$ 0.56	2.67**	2.29 $\pm$ 0.67	2.42 $\pm$ 0.62	2.21*
Fatigue	0.92 $\pm$ 0.77	0.89 $\pm$ 0.72	1.34	1.12 $\pm$ 0.85	0.80 $\pm$ 0.67	17.63**
Confusion	1.00 $\pm$ 0.66	1.00 $\pm$ 0.63	0.27	1.06 $\pm$ 0.69	0.97 $\pm$ 0.62	2.11

GS, general stress; GR, general recovery; SS, sport stress; SR, sport recovery; RSB, recovery–stress balance. \* $p < 0.05$ ; \*\* $p < 0.01$ .

of the RESTQ-Sport. In the opposite way, the positive factor (vigor) of the POMS presented positive associations ( $p < 0.05$ ) with the recovery scales of the RESTQ-Sport; however, only three stress scales correlated negatively with vigor and one of them (conflicts/pressure) positive. According to our results, it is possible to point out that the Mexican version of RESTQ-Sport shows concurrent validity with the POMS.

## DISCUSSION

The purpose of this study was to analyze the differences in the perceived recovery–stress state and the moods states based on sex and sports type on young Mexican athletes before a competition. According to the review carried out by the authors, this is the first study in Mexico with these characteristics, being one of the few that analyzes the differences in the behavior of the questionnaire by sex, in addition to being one of the studies with the largest sample that applies the RESTQ-Sport.

Based on sex results, it was possible to observe that women present lower levels of perceived GR and SR, as well as lower vigor compared with men. This coincides with what has already been reported in research that contrasted the stress–recovery behavior between female and male basketball players (Di Fronso et al., 2013) and rowers (Kellmann et al., 2001), as well as with the results referent to mood states reported by Brandt et al. (2017), which confirms the need for individualization for both, the loads proposed, and monitoring the internal training load on athletes, demanding more precise attention for female athletes to prevent poor training adaptations and overtraining syndrome.

Continuing with the comparisons by sex, a novel finding of the present investigation is that men report levels of SS significantly higher ( $p < 0.05$ ) than women, thus contrasting with other reports where women tended to present more stress (Kellmann et al., 2001; Di Fronso et al., 2013; Holden et al., 2019). Notwithstanding, the RSB was higher for men, which may be due

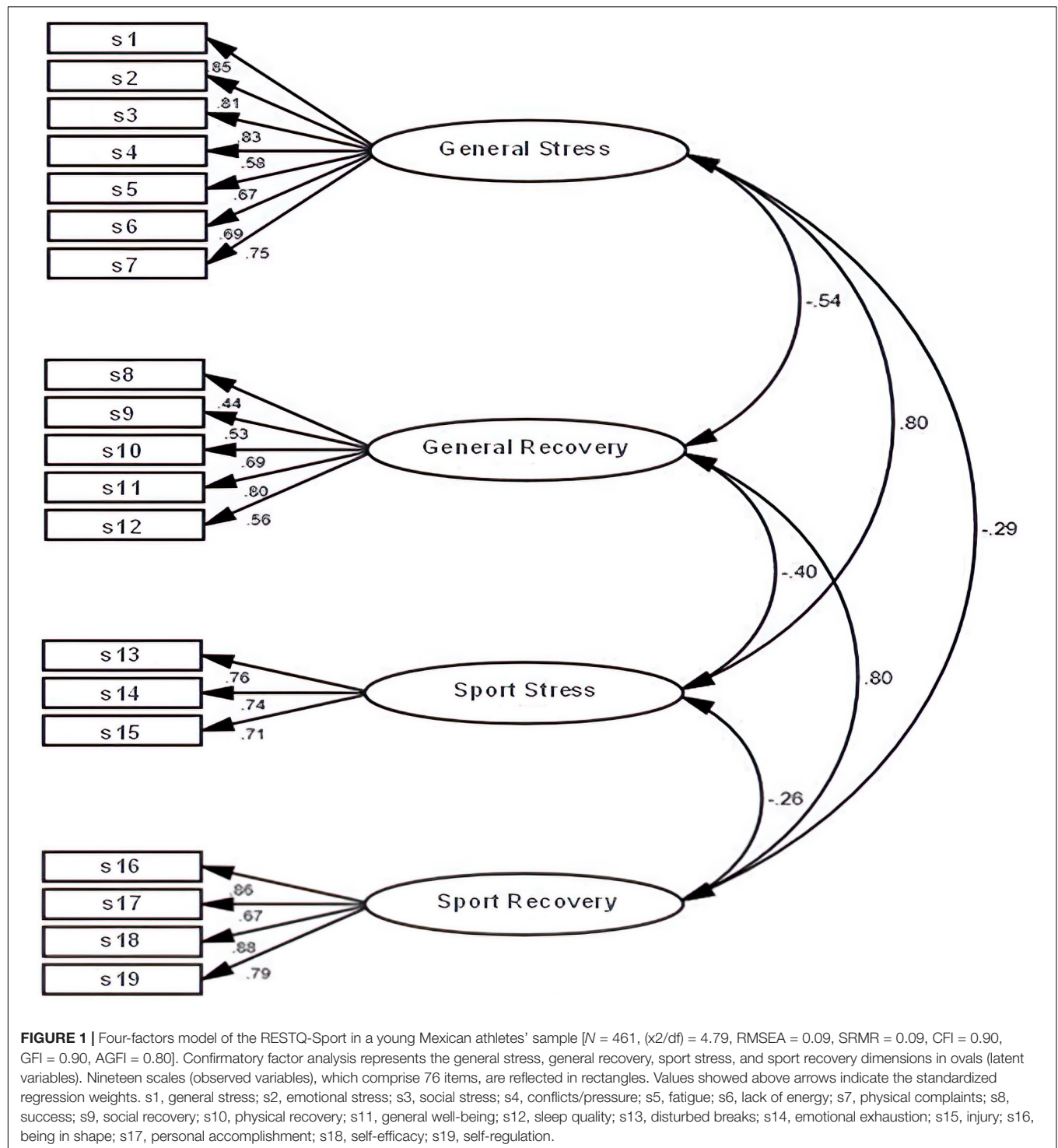
to the coping and strategies skills used by them to counteract the stress demands (Molinero et al., 2012).

Regarding the appraisal by sport type, our results coincide with what was reported in previous research (Nixdorf et al., 2016; Brandt et al., 2017; Garinger et al., 2018). Athletes who practice individual sports have higher SS levels and lower GR ( $p < 0.05$ ) and the presence of higher negative moods such as depression, anger, and fatigue, whereas vigor is lower. Some authors refer that the requirement for individual sports is reflected on the stress levels perceived by their athletes (Garinger et al., 2018); instead, the support of teammates and together problem solving allow those who participate in team sports to apperceive better recovery levels, and they are less likely to present symptoms related to excessive levels of stress and even depression (Nixdorf et al., 2016).

As a secondary research objective, an analysis of the properties of validity for adaptation of the RESTQ-Sport to the Mexican population was proposed. The analysis indicates that the instrument has adequate psychometric properties to be a valid measure. The Cronbach  $\alpha$  values indicate that the RESTQ-Sport is reliable both globally and divided into its four dimensions (GS, GR, SS, and SR), which coincides with the indexes reported in other languages being above 0.60 (Kellmann and Kallus, 2001, 2016; González-Boto et al., 2008; Nederhof et al., 2008), as well as was previously indicated in samples with Mexican athletes that obtained  $\alpha$ -values greater than 0.70 (Reynoso-Sánchez et al., 2016, 2017; Hernández-Cruz et al., 2017). On the other hand, this is because of the general scales from the RESTQ for the general population, which were taken as a basis for the RESTQ-Sports; likewise, diversity of the disciplines from the sample in our study constitutes factors that could affect the reliability coefficient, which has already been reported in previous research (González-Boto et al., 2008; Kellmann and Kallus, 2016).

Related to the model structure, results show the multidimensional nature for the constructs evaluated, both the dimensions associated with stress and the others to recovery.





This two-dimensionality has been empirically corroborated in several studies making the theoretical perspective adopted by Kellmann and Kallus increasingly robust (Kellmann and Kallus, 2001, 2016). Following the recommendations proposed by Bazán et al. (2006), the study was based on the previous empirical evidence and the researcher's criteria to contrast the structural model with four factors through confirmatory factor analysis.

The analysis of structural models was carried out following the authors' guidelines of the questionnaire. Four specific factors were grouped, two for stress and two for recovery. Correlations between GS and SS factors were positive and high, as well as between GR and SR, agreeing with what was reported by González-Boto et al. (2008). It was also observed that six goodness-of-fit indices of the confirmatory factor analysis



**TABLE 2 |** Pearson correlations between RESTQ-Sport Scales and POMS factors.

RESTQ-Sport	POMS					
	Tension	Depression	Anger	Vigor	Fatigue	Confusion
General stress	0.454**	0.569**	0.561**	−0.113*	0.504**	0.548**
Emotional stress	0.462**	0.439**	0.523**	−0.035	0.408**	0.431**
Social stress	0.418**	0.458**	0.531**	−0.073	0.428**	0.442**
Conflicts/ Pressure	0.424**	0.311**	0.299**	0.102*	0.352**	0.320**
Fatigue	0.344**	0.371**	0.367**	−0.003	0.546**	0.338**
Lack of energy	0.427**	0.408**	0.354**	−0.034	0.398**	0.474**
Physical complaints	0.433**	0.409**	0.389**	−0.042	0.490**	0.412**
Success	−0.138**	−0.210**	−0.130**	0.313**	−0.134**	−0.257**
Social recovery	−0.055	−0.175**	−0.107*	0.318**	−0.164**	−0.176**
Physical recovery	−0.272**	−0.296**	−0.206**	0.424**	−0.313**	−0.344**
General well-being	−0.293**	−0.395**	−0.352**	0.432**	−0.376**	−0.375**
Sleep quality	−0.351**	−0.328**	−0.295**	0.163**	−0.376**	−0.359**
Disturbed breaks	0.337**	0.352**	0.382**	−0.050	0.472**	0.395**
Emotional exhaustion	0.376**	0.497**	0.456**	−0.137**	0.541**	0.473**
Injury	0.372**	0.325**	0.354**	0.009	0.493**	0.330**
Being in shape	−0.267**	−0.273**	−0.184**	0.468**	−0.324**	−0.364**
Personal accomplishment	−0.186**	−0.213**	−0.155**	0.323**	−0.194**	−0.254**
Self-efficacy	−0.269**	−0.291**	−0.141**	0.454**	−0.261**	−0.345**
Self-regulation	−0.186**	−0.190**	−0.097*	0.396**	−0.207**	−0.288**

\* $p < 0.05$ ; \*\* $p < 0.01$ .

showed an adequate fit. Although the parameter ( $\chi^2/\text{df}$ ) received several criticisms due to its high sensitivity to sample sizes and is based on the central distribution of  $\chi^2$  (Byrne, 2010), it is convenient finding a model more accurately representing the underlying structure of the data. Therefore, future research should contrast these results and analyze in greater depth the psychometric characteristics of the questionnaire in the Mexican context. Perspectives, such as the item theory response or the analysis of the impact of the items, represent valuable approaches that could contribute both to the general study of the instrument and for each scale and its items.

The last objective of the study was to prove the concurrent validity of the RESTQ-Sport by comparing it with the POMS. Data show a positive correlation ( $p < 0.05$ ) between the RESTQ-Sport stress scales with POMS factors such as tension, depression, anger, fatigue, and confusion, whereas recovery scales did negatively with them, thus fulfilling what was theoretically expected (Kellmann and Kallus, 2001, 2016). The result coincides with the analysis reported by Nederhof et al. (2008) and González-Boto et al. (2009), who have applied this method to provide greater robustness to the constructs through the comparison between the instruments in another populations and languages, as well as with the results of Molinero et al. (2012).

## Limitations and Future Research Directions

The study has several limitations; the principal was the ages and sport level of the participants, which was limited only to youths who competed at the national championship. Due to the national championship nature, the authors limited the sample;

so, future research must be focused on older samples and more experienced sport level to analyze the recovery–stress behavior of Mexican athletes. Another research limitation is the cross-sectional collection of the data; participants were in a competitive situation, this for sure affected their moods and recovery–stress perception, showing only a situational state that could be altered by not controlled variables such a long travel to the event place, recent injuries, among other factors. More comparisons between sex and sport modalities should be carried on through longitudinal studies to enhance the knowledge over the recovery–stress states and their fluctuations during specific training or session periods in relation to sex or type of sports practice.

On the other hand, the goodness-of-fit indexes of the model for the RESTQ-Sport are on the limit for an adequate fit; this could be because of the size of the sample, being theoretically the minimum number of subjects for an item of the questionnaire. It is recommended for future research in Mexican athletes that the reliability analysis will carry on every application of the RESTQ-Sport to give more robustness to the instrument.

## Conclusion

According to the research results, it is possible to conclude that in the athletes of the present study, there are differences in the perception of recovery–stress state between men and women, demonstrating the need to focus on promoting more effective coping strategies for young female Mexican athletes that enable them to enhance the perception of recovery, both in general and at sports level. In the same way, implement training loads and recovery–stress balance monitoring to prevent negative psychological and physical symptoms caused by overtraining

syndrome or burnout. This assessment must be more precise for athletes who practice individual sports and for female Mexican athletes. Finally, the RESTQ-Sport questionnaire adaptation to the Mexican context proved to be a valid and reliable instrument and efficient and accurate for monitoring the recovery-stress state in young Mexican athletes, being a useful and economic tool to prevent and/or detect overtraining.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the Local Legislation and Institutional Requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

LR-S, JL-W, JZ, and GH-C: design of the work. LR-S and GH-C: investigation and project application. LR-S, GP-V, MC-S, JL-W,

and JZ: formal analysis and interpretation of the data for the work. LR-S, GP-V, and GH-C: writing—original draft preparation. JL-W, JZ, BR-C, and HM-H: writing—review and editing. JL-W, BR-C, and HM-H: funding acquisition. All authors have read and agreed to the published version of the manuscript.

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# Job Satisfaction of Fitness Professionals in Portugal: A Comparative Study of Gender, Age, Professional Experience, Professional Title, and Educational Qualifications

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This research characterizes and compares the job satisfaction of fitness professionals in Portugal between genders, ages, professional experience, professional title, and educational qualifications. A total of 401 fitness professionals answered the online questionnaire Job Satisfaction Scale, which has 16 factors rated on a Likert scale with seven levels. The statistical analysis comprises descriptive and statistical tests to compare the results of two (*t*-test) or more (ANOVA) groups. Overall, the results demonstrated that fitness professionals were moderately satisfied with their work. The lower degrees of job satisfaction were concerning salary, opportunities for promotion, and stability at work. The highest levels of job satisfaction were related to the freedom to choose their work method, their work colleagues, the physical conditions of their workplace, and the opportunity to use their competencies. There were no differences in job satisfaction in terms of gender and a few differences between professional title and between educational levels. Regarding age and professional experience, the results showed significant differences in almost all factors, suggesting that, as fitness professionals get older and more experienced, their job satisfaction is greater. The results of this study suggest that even though fitness professionals are, in general, moderately satisfied with their work, some aspects can be improved by employers to increase their satisfaction levels. Such findings would assist employers in guiding the job satisfaction of their employees with consequent enhancements in the services provided by fitness professionals, which can increase participants' retention in exercise fitness activities.

**Keywords:** fitness, fitness professionals, job satisfaction, Job Satisfaction Scale, comparative study



## INTRODUCTION

The fitness market has increased exponentially in recent decades, and in 2019, there were nearly 210,000 gyms/health clubs worldwide with approximately 184 million clients and a total income of US \$96.7 billion (International Health Racquet and Sportsclub Association, 2020). In Europe, there were 64.8 million fitness clients in 2019, attending almost 63,644 gyms/health clubs and generating incomes of around €28.2 billion (EuropeActive, 2020). Most of these European fitness clients stemmed from Germany, the United Kingdom, France, Spain, and Italy. These five countries represent 65% of the total European income in the fitness industry.

Portugal is no exception to the rise in the fitness industry; in 2019, nearly 688,210 fitness clients were attending 1,100 gyms/health clubs in Portugal [Association of Gyms and Academies of Portugal—PortugalActive (AGAP, 2020)]. The number of fitness professionals has grown, and in 2018, the Portuguese Institute of Sport and Youth (IPDJ, 2018) approximated that there were 14,000 fitness professionals in Portugal with a valid professional title, among which are technical directors (DTs) and physical exercise instructors (TEFs). In 2019, nearly 12,000 collaborators were working as fitness professionals in Portugal (AGAP, 2020). Fitness professionals' importance for the satisfaction and retention of clients has been reported in several studies to be essential for the growth of the sector (Papadimitriou and Karteroliotis, 2000; Murray and Howat, 2002; Makover, 2003; Theodorakis et al., 2004; Tsitskari et al., 2014; Campos et al., 2016).

Job satisfaction can be described as a person's general perception of various aspects of the work that they develop (Spector, 1997). Another more specific definition of job satisfaction relates to how the person feels about their work in the context of their previous experiences, expectations, and/or alternatives that are presented to them (Balzer et al., 1990). High levels of satisfaction at work may contribute to a person's healthy emotional and mental condition, thereby resulting in a positive attitude to the organization. On the other hand, a lack of satisfaction may result in an employee's worse performance and negatively affect the organization (Aziri, 2011).

Some issues inherent to fitness professional occupation seem to affect, in some studies, their job satisfaction as well as other factors, such as burnout and the intention to leave the organization. Issues related to excessive hours of physical exercise have been identified as one of the problems associated to these professionals, resulting in injuries and/or musculoskeletal pain (Malliou et al., 2014; Bratland-Sanda et al., 2015). The job stability is also an issue and revealed a positive correlation with job satisfaction in fitness professionals from Greece and Spain (Koustelios et al., 2003; Gil, 2013). The hours of work and the range of the working time, sometimes extended from the opening hours (e.g., 7 AM) to closing (e.g., 10 PM), can also be a problem for fitness professionals (Franco, 2020). Job satisfaction was also associated, in fitness professionals, with job security, absenteeism, productivity, and the business's turnover (Koustelios et al., 2003), as well as its organizational culture

(Macintosh and Doherty, 2010), organizational commitment (Culibrk et al., 2018), staff burnout (Gil, 2013), and an employee's autonomy at work (Terason, 2018; Sawang et al., 2020), among other factors.

This subject has already been the target of several studies, some of which have compared also sociodemographic and other characteristics that can affect fitness professionals' levels of job satisfaction. In Spain, a study with 631 fitness professionals found that its sample presented moderate levels of satisfaction at work, with no relationship found between their satisfaction levels and participants' gender or professional experience. The fitness professionals with higher ages and fewer educational qualifications were found to be more satisfied at work (Bernabé et al., 2017). In Brazil, a study with 497 fitness professionals verified that most of these professionals (88.9%) were satisfied at work (Bevilacqua et al., 2014). A Canadian study with 416 fitness professionals investigated the degree to which the organizational culture can influence an employee's satisfaction at work, along with their intention of leaving the organization. The organizational culture was found to justify 14.3% of the variance in their levels of satisfaction, while it influenced 50.5% of the professionals in their decision to leave the organization (Macintosh and Doherty, 2010). In Greece, a study into professional security and satisfaction at work investigated 97 fitness professionals and demonstrated a correlation between these two variables (Koustelios et al., 2003). A Thai study explored the influence of autonomy at work upon job satisfaction, finding that an employee's autonomy when performing tasks—mainly those that demanded more responsibility—was associated with greater professional satisfaction (Terason, 2018). In Portugal, a study from Oliveira (2017) was focused upon understanding the factors that promoted professional satisfaction for 53 fitness professionals of gyms/health clubs. The professional satisfaction of the managers/supervisors was found to be more influenced by the exercise programs offered by their organization (specifically if the programs were innovating), whereas their subordinate colleagues referred to the environment within the organization and the degree of sympathy between staff and clients as the most important factors linked to their job satisfaction.

However, when it comes to the job satisfaction of fitness professionals in Portugal with a professional title of TEF or DT, not much information was found. Taking into consideration the importance of these professionals within the industry, there is a gap in the existing research. Findings related to TEFs and DTs would be beneficial for identifying the critical factors of job satisfaction in those professionals. Higher levels of job satisfaction can prevent dropout and result in better service, and better service, in consequence, provide superior client satisfaction and retention, increasing the number of people that practice exercise and contributing to lower levels of physical inactivity in Portugal (European Opinion Research Group, and Special Eurobarometer 472, 2018).

Therefore, the aims of this study are to (1) verify the levels of job satisfaction of the fitness professionals in Portugal and (2) analyze and compare the fitness professionals' job satisfaction levels concerning gender, age, professional experience, professional title, and educational qualification.



## MATERIALS AND METHODS

### Sample

The sample comprised 401 individuals working as fitness professionals (**Table 1**), 58.1% with the professional title of TEF and 41.9% with the professional title of DT. Regarding their gender, 50.6% of participants were female and 49.4% were male. The average age of the sample was  $30.6 \pm 7.6$  years [mean ( $M$ )  $\pm$  standard deviation ( $SD$ )]. Most of the fitness professionals were between 18 and 29 years (55.9%), followed by the group of 30–44 years (37.9%), and the smallest group were between 45 and 65 years (6.2%). The average professional experience was  $8.9 \pm 6.6$  years ( $M \pm SD$ ), with 63.8% having less than 10 years of professional experience and 35.2% equal or more than 10 years. When it came to their educational qualifications, most of the fitness professionals (86.3%) had a bachelor's degree or higher qualification (i.e., a master's degree and/or a Ph.D.), and 13.7% have a high school level.

### Instruments and Procedures

Job Satisfaction Scale (Warr et al., 1979), translated and validated to Portuguese (Ramos et al., 2020), was employed to measure job satisfaction of the fitness professionals. The Job Satisfaction Scale is composed of 15 items based on various aspects of job satisfaction, along with a 16-item referring to job satisfaction as a whole. In the validation of Job Satisfaction Scale (JSS), the confirmatory analyses revealed that a unidimensional model (1 factor/16 items) exposed a best model adequacy coefficient (Ramos et al., 2020), so the results were analyzed considering this model. The respondents had a Likert scale with seven levels of response for each factor, ranging between 1 (extremely dissatisfied) and 7 (extremely satisfied). In addition to the JSS, questions of sociodemographic characterization were carried out. The questionnaire was conducted on an online platform, SurveyMonkey, between November 2019 and March 2020, before the coronavirus disease 2019 (COVID-19) pandemic.

The questionnaire was disseminated through social networks, higher education institutions, training providers, fitness sector associations, as well as at fitness events and conventions. Ethical approval was obtained from the ethics and scientific board of the University of Beira-Interior, Portugal.

### Statistical Analysis

First, descriptive statistics were conducted upon the measures of central tendency (mean) and dispersion (standard deviation) for all variables of the Job Satisfaction Scale. *t*-tests with independent sampling (comparing the means of two groups) were then carried out to verify the differences in job satisfaction concerning genders, educational qualifications, professional titles, and professional experiences. To compare the average numbers in more than two groups (in relation with age), an ANOVA (*F*-test) was employed, complemented with a *post hoc* Tukey's test (if the variances were found to be homogeneous according to a Levene's test) or a *post hoc* Games–Howell test (if the variances were not homogeneous) (Ho, 2014). The level of significance adopted was  $p < 0.05$ . All tests were conducted using SPSS 26.0.

## RESULTS

The results demonstrated that the job satisfaction of fitness professionals, based on the average of every factor in the study, was 4.88 on a scale of 1–7. This corresponds to “moderately satisfied” (**Table 2**). Through analysis, it was possible to verify that the fitness professionals held lower degrees of satisfaction concerning their salary, with satisfaction levels of  $4.1 \pm 1.5$  ( $M \pm SD$ ), their opportunities for promotion ( $4.2 \pm 1.6$ ), and their stability at work ( $4.3 \pm 1$ ). These three factors all registered a level close to 4, which corresponds to “neither satisfied nor unsatisfied.” On the other hand, the factors for which the fitness professionals held the highest levels of professional satisfaction were the freedom to choose their work method ( $5.6 \pm 1.4$ ), their work colleagues ( $5.6 \pm 1.2$ ), the physical conditions of their workplace ( $5.3 \pm 1.1$ ), and the opportunity to use their competencies ( $5.3 \pm 1.3$ ).

Concerning their age (**Table 2**), it was verified that the older fitness professionals were most satisfied, in general, with their career. In all factors as age increased, job satisfaction improved, with significant differences between age groups in 10 of the 16 factors analyzed.

Regarding their professional experiences (**Table 2**), job satisfaction was generally found to be higher among fitness professionals with 10 or more years of professional experience; there were significant differences between professional experience levels in 14 of the 16 job satisfaction factors analyzed.

There were no differences between genders (**Table 3**) in any job satisfaction factors, and the values obtained by each gender (female and male) were very similar.

Concerning their professional title (**Table 3**), the fitness professionals with a DT title demonstrated, on average, slightly higher levels of job satisfaction than those with the TEF title, but significant differences only were found in 2 of the 16 job

**TABLE 1** | Frequencies of the variables ( $n = 401$  fitness professionals).

Gender	Frequency (%)
Female	50.6
Male	49.4
Age	
Group 1: 18–29	55.9
Group 2: 30–44	37.9
Group 3: 45–65	6.2
Educational qualifications	
Secondary school	13.7
Higher degree	86.3
Professional title	
TEF	58.1
DT	41.9
Professional experience	
<10 years	63.8
$\geq 10$ years	35.2

**TABLE 2 |** General job satisfaction and comparison by age and professional experience.

Factors	General ( <i>M</i> ± <i>SD</i> )	Age ( <i>M</i> ± <i>SD</i> )			Age comparison <i>ANOVA (F-test)</i>	Professional experience ( <i>M</i> ± <i>SD</i> )		Professional experience comparison <i>T-test</i>
		Group 1 18–29 years	Group 2 30–44 years	Group 3 45–65 years		<10 years	≥10 years	
1. The physical work conditions	5.3 ± 1.2	5.2 ± 1.2	5.4 ± 1.2	5.7 ± 1.1	0.09	5.2 ± 1.3	5.6 ± 1.1	0.01*
2. The freedom to choose your own method of working	5.6 ± 1.4	5.4 ± 1.5	5.7 ± 1.4	6.2 ± 0.7	0.01* <sup>2,3</sup>	5.4 ± 1.5	5.8 ± 1.3	0.03*
3. Your fellow workers	5.6 ± 1.2	5.6 ± 1.2	5.6 ± 1.1	5.8 ± 0.8	0.62	5.6 ± 1.2	5.7 ± 1.1	0.33
4. The recognition you get for a good work	4.9 ± 1.5	4.8 ± 1.5	4.9 ± 1.5	5.7 ± 1.1	0.01* <sup>2,3</sup>	4.8 ± 1.5	5.1 ± 1.5	0.03*
5. Your immediate boss	4.9 ± 1.6	4.8 ± 1.6	5.0 ± 1.6	5.6 ± 1.1	0.04* <sup>2,3</sup>	4.8 ± 1.6	5.1 ± 1.5	0.04*
6. The amount of responsibility you are given	5.2 ± 1.3	5.1 ± 1.3	5.2 ± 1.4	6.0 ± 1.2	0.01* <sup>2,3</sup>	5.2 ± 1.3	5.4 ± 1.4	0.02*
7. Your rate of pay	4.1 ± 1.5	3.9 ± 1.5	4.4 ± 1.5	4.4 ± 1.7	0.01* <sup>1</sup>	3.9 ± 1.5	4.5 ± 1.4	0.01*
8. The opportunity to use your abilities	5.3 ± 1.3	5.2 ± 1.4	5.3 ± 1.3	5.9 ± 1.1	0.02* <sup>2</sup>	5.1 ± 1.4	5.6 ± 1.2	0.01*
9. The relations between management and workers in your organization	5.0 ± 1.5	4.9 ± 1.5	5.1 ± 1.4	5.3 ± 1.1	0.17	4.9 ± 1.5	5.3 ± 1.3	0.01*
10. Your chance of promotion	4.2 ± 1.6	4.0 ± 1.6	4.5 ± 1.5	4.7 ± 1.5	0.01* <sup>1</sup>	4.0 ± 1.6	4.7 ± 1.5	0.01*
11. The way your organization is managed	4.6 ± 1.5	4.5 ± 1.5	4.7 ± 1.5	5.4 ± 1.2	0.03* <sup>2</sup>	4.4 ± 1.5	5.0 ± 1.4	0.01*
12. The attention paid to suggestions you make	4.7 ± 1.4	4.6 ± 1.5	4.9 ± 1.4	5.0 ± 1.4	0.08	4.5 ± 1.5	5.1 ± 1.3	0.01*
13. Your hours of work	4.5 ± 1.5	4.3 ± 1.5	4.6 ± 1.6	5.2 ± 1.3	0.01* <sup>2</sup>	4.4 ± 1.5	4.6 ± 1.5	0.11
14. The amount of variety in your job	5.1 ± 1.3	5.0 ± 1.2	5.2 ± 1.3	5.3 ± 1.1	0.25	5.0 ± 1.3	5.3 ± 1.2	0.01*
15. Your job security	4.3 ± 1.8	4.1 ± 1.7	4.5 ± 1.8	4.8 ± 1.4	0.06	4.0 ± 1.7	4.7 ± 1.7	0.01*
16. Now, taking everything into consideration, how do you feel about your job as a whole?	5.1 ± 1.3	4.9 ± 1.3	5.1 ± 1.3	5.6 ± 1.1	0.03* <sup>2</sup>	4.9 ± 1.3	5.4 ± 1.3	0.00*
Mean	4.88	4.77	5.00	5.41		4.76	5.18	

1, extremely dissatisfied; 2, very dissatisfied; 3, moderately dissatisfied; 4, neither satisfied nor dissatisfied; 5, moderately satisfied; 6, very satisfied; 7, extremely satisfied.

\**p* ≤ 0.05.

<sup>1</sup>Differences between groups 1 and 2.

<sup>2</sup>Differences between groups 1 and 3.

<sup>3</sup>Differences between groups 2 and 3.

**TABLE 3 |** Comparison of job satisfaction by gender, professional title, and academic qualifications.

Factors	Gender ( <i>M</i> ± <i>SD</i> )		Gender comparison	Professional title ( <i>M</i> ± <i>SD</i> )		Professional title comparison	Educational qualifications ( <i>M</i> ± <i>SD</i> )		Educational qualifications comparison
	Female	Male	<i>T</i> -test	TEF	DT	<i>T</i> -test	Secondary school	Higher degree	<i>T</i> -test
1. The physical work conditions	5.3 ± 1.2	5.3 ± 1.3	0.92	5.2 ± 1.2	5.4 ± 1.2	0.16	5.1 ± 1.3	5.3 ± 1.2	0.17
2. The freedom to choose your own method of working	5.5 ± 1.4	5.6 ± 1.4	0.21	5.6 ± 1.4	5.6 ± 1.5	0.97	5.6 ± 1.5	5.6 ± 1.4	0.97
3. Your fellow workers	5.7 ± 1.1	5.6 ± 1.2	0.31	5.7 ± 1.1	5.6 ± 1.3	0.47	5.5 ± 1.2	5.6 ± 1.1	0.55
4. The recognition you get for a good work	4.8 ± 1.4	4.9 ± 1.6	0.57	4.9 ± 1.5	4.9 ± 1.6	0.97	5.1 ± 1.5	4.8 ± 1.5	0.27
5. Your immediate boss	5.0 ± 1.5	4.9 ± 1.7	0.42	4.9 ± 1.6	5.0 ± 1.5	0.87	4.8 ± 1.5	4.8 ± 1.8	0.43
6. The amount of responsibility you are given	5.2 ± 1.2	5.2 ± 1.4	0.91	5.2 ± 1.3	5.2 ± 1.4	0.77	5.0 ± 1.6	5.2 ± 1.3	0.25
7. Your rate of pay	4.1 ± 1.5	4.1 ± 1.5	0.70	4.0 ± 1.6	4.2 ± 1.5	0.09	3.8 ± 1.7	4.1 ± 1.5	0.11
8. The opportunity to use your abilities	5.2 ± 1.2	5.3 ± 1.5	0.33	5.2 ± 1.4	5.3 ± 1.3	0.53	5.0 ± 1.7	5.3 ± 1.3	0.13
9. The relations between management and workers in your organization	5.1 ± 1.3	4.9 ± 1.6	0.14	4.9 ± 1.4	5.1 ± 1.5	0.34	4.7 ± 1.6	5.0 ± 1.4	0.15
10. Your chance of promotion	4.2 ± 1.4	4.2 ± 1.8	0.93	4.0 ± 1.6	4.5 ± 1.6	0.01*	3.9 ± 1.7	4.3 ± 1.6	0.13
11. The way your organization is managed	4.6 ± 1.4	4.6 ± 1.6	0.93	4.5 ± 1.5	4.8 ± 1.5	0.12	4.5 ± 1.6	4.7 ± 1.5	0.49
12. The attention paid to suggestions you make	4.8 ± 1.3	4.7 ± 1.6	0.51	4.6 ± 1.4	4.9 ± 1.5	0.10	4.4 ± 1.6	4.8 ± 1.4	0.01*
13. Your hours of work	4.6 ± 1.5	4.4 ± 1.6	0.27	4.5 ± 1.5	4.5 ± 1.5	0.91	4.5 ± 1.4	4.5 ± 1.5	0.10
14. The amount of variety in your job	5.1 ± 1.2	5.1 ± 1.3	0.93	5.1 ± 1.4	5.1 ± 1.4	0.73	3.9 ± 1.9	4.4 ± 1.7	0.23
15. Your job security	4.4 ± 1.7	4.2 ± 1.8	0.44	4.1 ± 1.8	4.6 ± 1.7	0.01*	3.9 ± 1.9	4.4 ± 1.7	0.11
16. Now, taking everything into consideration, how do you feel about your job as a whole?	5.0 ± 1.2	5.1 ± 1.4	0.59	5.0 ± 1.3	5.1 ± 1.4	0.36	4.8 ± 1.5	5.1 ± 1.3	0.12
Mean	4.91	4.88		4.84	4.99		4.66	4.87	

1, extremely dissatisfied; 2, very dissatisfied; 3, moderately dissatisfied; 4, neither satisfied nor dissatisfied; 5, moderately satisfied; 6, very satisfied; 7, extremely satisfied.

\* $p \leq 0.05$ .

satisfaction factors, namely, in the factors opportunities for promotion and stability at work.

Regarding their educational qualifications, fitness professionals who did not have a degree were compared with professionals that had a bachelor's or higher degree (i.e., a master's degree and/or a Ph.D.). The professionals with a higher education degree exhibited slightly higher values of job satisfaction, in 12 of the 16 factors, although this difference was significant only in the factor attention paid to the suggestions that they make at work.

## DISCUSSION

The results of this study demonstrate that when it comes to their job satisfaction, the Portuguese fitness professionals present an average job satisfaction of 4.88, which corresponds to “moderately satisfied.” This finding is comparable with similar studies that have found fitness professionals to be “satisfied” with their work (Bevilacqua et al., 2014; Bernabé

et al., 2017). Based on an analysis of factors that affect job satisfaction, this study concludes that those who present higher levels of professional satisfaction were concerning the freedom to choose their work methodology (5.6) and regarding their work colleagues (5.6). These results correspond with others previously obtained for Spanish fitness professionals (Gonzalez et al., 2016; Bernabé et al., 2017), in which a higher degree of satisfaction at work has been related to work colleagues. On the other hand, the lowest levels of professional satisfaction were found in salary (4.1) and opportunities for promotion (4.2). The lower levels of job satisfaction in salary are in accordance with several studies from other countries such as Spain (Koustelios et al., 2003; Gonzalez et al., 2016; Bernabé et al., 2017), Greece, and Brazil (Bevilacqua et al., 2014). The low satisfaction at work in the item low opportunities for promotion has also been evidenced in other studies (Bernabé et al., 2017; Grimaldi-Puyana et al., 2018). It can be suggested that the lack of a proper career path for a fitness professional in Portugal, with career progression and with salaries that increase under experience or educational qualifications, could contribute to low

levels of job satisfaction in the item opportunities for promotion (Franco, 2020).

Concerning levels of job satisfaction and fitness professionals age groups, this study found that professionals with higher ages (i.e., between the ages 45 and 65) are more satisfied in all factors, being significantly different in 10 of the 16 factors, namely, the freedom to choose their work methods, the recognition of their good performance, their direct leadership, the amount of responsibility they are given, their salary, the opportunities to use their competencies, the way the organization is managed, their work schedule, and the work as a whole. Many of these factors are related to autonomy and the possibility for older professionals to work in the way that they intend with a higher degree of recognition and remuneration and a greater possibility of promotion. A study in Spain (Bernabé et al., 2017) also compare the age with job satisfaction of fitness professionals, verifying that there are differences in job satisfaction between professionals' ages. However, the findings of that study were not linear; the higher indices of job satisfaction were presented by professionals aged between 60 and 70 and 16 and 29. In that sense, the findings relating to age were different from this study, specifically in the job satisfaction of the younger professionals.

Regarding professional experience, as with age, the professionals in this study with 10 or more years of experience demonstrated higher levels of job satisfaction than their less experienced counterparts in every factor, with significant differences in 14 of the 16 factors. Another study that investigated this variable, conducted in Spain, did not find a significant difference in job satisfaction between different professional experience levels (Bernabé et al., 2017). Our results seem to indicate that, as the fitness professional has more experience, he has higher satisfaction levels in work autonomy, being able to use his skills and obtaining greater recognition for that, financial or related to, for example, career promotion. Those factors probably increase with job experience, which can result in greater job satisfaction.

When comparing job satisfaction between genders, it was verified there is no significant difference between genders. These results are in concordance with an existing Spanish study (Bernabé et al., 2017), although in a Brazilian study (Anversa et al., 2019), female fitness professionals presented lower levels of satisfaction than their male counterparts in some physiological needs (like sleeping and eating) and their safety at work. In a study made in Morocco, with 171 employees from a fitness company, no significant difference has been found in job satisfaction levels between genders (Göksu and Keskin, 2018).

Concerning professional titles, there is a significant difference only in the factor opportunities for promotion and in job stability; for both factors, DTs have higher job satisfaction compared to TEFs. It is suggested that this difference in job satisfaction reflects a difficulty for the TEF to ascend to the position of DT in a gym/health club, and Portuguese Law, 39/2012 only authorizes professionals with the title of DT to exercise this position, which implies having a higher educational level in sport/exercise, generally more connected to coordination/supervision tasks and seen as a career promotion.

Lastly, this study compares job satisfaction between different educational qualifications. The results of these two groups show that fitness professionals with higher qualifications have slightly higher values of satisfaction in 12 of the 16 factors analyzed, but the study only found a significant difference with regards to the factor attention given to the suggestions that fitness professionals make. In this regard, graduates are significantly more satisfied than those with only have high school qualifications or less. It seems that employers value more the opinion of the most qualified fitness professionals. This finding contrasts with a study on fitness professionals in Spain (Bernabé et al., 2017), which found that those with fewer qualifications were more satisfied, while those with a degree were less satisfied.

The limitations presented in this study were related mainly to the representativeness of the population that was intended to be studied. Even with all the dissemination of the study, stopped by the COVID-19 pandemic, the sample was obtained by convenience, not allowing to represent statistically the studied population.

More studies are needed to further explore the levels of job satisfaction of fitness professionals in Portugal, incorporating additional factors such as quality of life and burnout. It would also be interesting to compare job satisfaction concerning the type of place where professionals provide services (health club, fitness boutique, fitness club, gym belonging to a chain, or an individual gym) as well as knowing and comparing the organizational environment of employers and their job satisfaction. These variables were explored together with job satisfaction in studies about fitness professionals in other countries (Gil, 2013; Bevilacqua et al., 2014), and it would be interesting to see if there is a relationship between them in Portugal. It could also be interesting to understand the employers' opinion concerning aspects related to their employees' job satisfaction, checking if there are differences in the perception of employers and employees. Another study that would be interesting to carry out would be to understand if the pandemic caused by COVID-19 and the serious consequences it caused in the fitness industry and the professionals of the sector affected the job satisfaction of these professionals and in what factors it did.

## CONCLUSION

The results showed that fitness professionals in Portugal are moderately satisfied with their work, with no differences in satisfaction in terms of gender and a few differences between professional title and between educational levels. Regarding age and professional experience, the results showed significant differences in almost all factors, suggesting that as professionals get older and more experienced, their job satisfaction increase.

It is possible that, throughout their careers, fitness professionals with the lowest levels of job satisfaction have drop out of the profession. An understanding of job satisfaction can help employers manage the satisfaction of their employees, preventing the dropout of fitness professionals and providing a better service made by fitness professionals, with positive consequences for the growth of the fitness industry.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Beira Interior n°CE-UBI-Pk-2019-006:ID1126. The patients/participants provided their written informed consent to participate in this study.

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## AUTHOR CONTRIBUTIONS

LR wrote the sections of the manuscript. All authors contributed to the conception and design of the study, manuscript revision, and read and approved the submitted version.

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# Measuring Sports' Perceived Benefits and Aggression-Related Risks: Karate vs. Football

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Little is known about people's perceived benefits and risks of sports, despite their role in shaping people's intentions to engage in them. Here, we developed and tested a scale to measure perceived physical, emotional, cognitive, and social benefits as well as aggression-related risks of karate and football. Additionally, we compared these perceptions within and between these two sports, as well as among undergraduates with current/former participation in different types of physical activity (viz., martial artists, team sports players, participants in other types of physical activity, and non-participants). After a literature review, we created a 5-factor scale with 20 items administered to 184 undergraduates, along with questions about physical activity participation. After removing five items, confirmatory factor analyses supported the factor structure of the scale. Factor loadings and reliability indices were acceptable, though less than desirable results were found concerning the average variance extracted of all benefits dimensions and the reliability of the social benefits dimension. Analyses of variance showed that: (a) physical benefits were seen as the salient outcomes of karate and football, though martial artists perceived karate's physical, emotional, and social benefits to the same extent; (b) in comparison to football, karate was perceived to bring more emotional and cognitive benefits and to entail less aggressiveness risks; (c) karate and football perceptions varied as a function of participant's involvement in physical activity. This study presents a promising instrument to gather information on people's perceptions about karate and football, which can be used to foster people's engagement in them.

**Keywords:** karate, football, perceived aggressiveness risks, perceived benefits, sports

## INTRODUCTION

The benefits of physical activity (PA) – defined as “any bodily movement produced by skeletal muscles that results in energy expenditure” (Caspersen et al., 1985, p. 128), such as sports, conditioning activities, walking, active recreation, or play – are well established (U.S. Department of Health and Human Services, 2018). Evidence concerning the specific benefits of different sports is also growing (Bu et al., 2010; Oja et al., 2015). However, less is known about the degree to which people perceive those benefits. This was the goal of the present study, which compared undergraduates perceived benefits and aggressiveness risks in football vs. karate.

Based on a thorough literature review, the report “Designed to Move” – presented by American College of Sports Medicine (2012) on behalf of other organizations and experts – organized

PA benefits in six dimensions: physical capital, including physical health (e.g., motor skills, cardiorespiratory fitness, muscular strength, and bone/joint health) and prevention of diseases; emotional capital, encompassing psychological benefits related to satisfaction, self-esteem, and self-efficacy as well as prevention and treatment of depression and anxiety; individual capital, focusing on character-related elements (e.g., life skills, sportsmanship, time management, or commitment); social capital, including strengthening of social networks through trust, collaboration, or teamwork, as well as reduction of crime; intellectual capital, encompassing cognitive-related gains (e.g., executive functions, attention, academic achievement) and management of learning disabilities and cognitive decline; and financial capital, including job-related gains (e.g., productivity and income), as well as reduced costs of health care and absenteeism/presenteeism. It should, however, be noted that not all forms of PA deliver the same benefits. Given their multiple demands, sports, in particular open skill sports – characterized by constantly changing conditions, to which movements must be flexibly adapted – may result in maximized benefits. This is the case of team sports and martial arts.

The most popular team sport is football (or soccer). Several studies support the widespread benefits of football throughout the lifespan (Krustrup et al., 2010). A systematic review conducted by Oja et al. (2015) revealed that football was one of the most beneficial sports for adults in terms of cardiovascular and metabolic health (see also Zouhal et al., 2020). Psychological-related benefits have also been reported, mainly in cognitive dimensions. Verburgh et al. (2014) found that highly talented soccer players (aged 8–12) surpassed amateurs in motor inhibition and attentional skills. Chen et al. (2019) found that football improved visuo-spatial working memory in young adults without intellectual disabilities as well as sports motivation and attention in their disabled peers. These findings indicate that football requires more than athletic and tactical skills (Vestberg et al., 2012; Verburgh et al., 2014): as a complex and quickly changing context, football requires players to be able to rapidly adapt, change strategy, and inhibit responses; as a team sport, it requires players to socially interact, cooperate with teammates, and anticipate other players' behaviors and ball movements.

Karate, a recently Olympics-approved sport, is a very dynamic, holistic, and popular Japanese hard martial art (Nakayama, 1976), combining mental and spiritual development with physical strength, speed, and endurance to produce powerful, fast, and vigorous striking movements (Theeboom and Knop, 1999). The practice of hard martial arts, including karate, has been associated with physical health benefits, such as improvements in postural control, muscular strength and/or skeletal status, and cardiovascular fitness (Rios et al., 2018). Karate athletes were also found to be among the martial artists with the greatest intensity of health behaviors (Kotarska et al., 2019). The psychological benefits of karate are also becoming known. Elite karateka displayed better perceptual, visual, and attention skills than amateurs and non-practitioners (Russo and Ottoboni, 2019). Children with 3–5 years of karate experience displayed better executive functions than their peers (Alesi et al., 2014). The practice of karate also reduced anxiety and increased processing

speed and mental health in elders (Jansen et al., 2017), and improved socioemotional skills in children with autism spectrum disorders (Movahedi et al., 2013). The widespread benefits of karate might seem related to its multidimensional nature. Likely, karate cognitive benefits rely on its high motor and cognitive demands (Diamond, 2015), whereas socioemotional ones arise from karate focus on body awareness, dyadic interactions, and moral values (Vertonghen and Theeboom, 2010; Rassovsky et al., 2019).

Despite the benefits, the practice of sports is not devoid of risks (American College of Sports Medicine, 2014). A particularly controversial risk is the exhibition of aggressive behaviors (Wann, 2005). Aggressive actions among athletes can be seen as an integral part of many sports, needed for winning (Fitch and Marshall, 2001). This is evident in team contact sports – such as ice hockey, rugby, or football. Traclet et al. (2015) found a shared aggression norm in football, though to a lesser extent than in ice hockey. Though commonly labeled as “combat sports,” Eastern traditional martial arts, aimed at developing fighting skills as much as non-violent attitudes, lack such norm (Theeboom and Knop, 1999; Klimczak et al., 2014). Indeed, meta-analytic findings support an association between the practice of martial arts and a reduction in aggressive tendencies (Harwood et al., 2017). Moreover, Sofia and Cruz (2013) found that football players reported higher levels of aggressiveness and anger than kickboxing and self-defense athletes.

All in all, the benefits and aggression-related risks of sports in general, and of football and karate in particular, are coming to light. However, though empirical evidence showing these benefits or risks are certainly important, people's intentions to participate in sports mostly rely on their own beliefs.

According to the Theory of Planned Behavior (TPB), key antecedents of people's intentions to engage in a behavior are attitudes, subjective norms, and perceived behavioral control (Ajzen, 2012; Bosnjak et al., 2020). A meta-analysis found that, along with perceived behavioral control (i.e., people's beliefs about factors influencing their behavioral engagement), another powerful influence in forming intentions to participate in PA is people's attitudes, that is, their beliefs about the positive and negative consequences of practicing that activity (Hagger et al., 2002). Favorable attitudes are associated with stronger intentions to perform a behavior and, when the opportunity arises, to carry it out (Ajzen, 2012). Thus, in addition to other factors influencing intention to participate in PA, such as perceived behavioral control, people's perceptions of benefits and risks will influence their intention to participate in PA.

Past research already recognized the importance of measuring people's attitudes toward PA, but this can be characterized by a general measurement approach to both attitudes and PA (Macgregor et al., 2017). Grounded on the TPB (Hagger and Chatzisarantis, 2005), attitudes have been assessed through a set of 6-point semantic differential items about participation in PA from affective (e.g., enjoyable-unenjoyable) and instrumental (e.g., important-unimportant) stands. However, moving away from the typical TPB methodological approach, some researchers have narrowed the concept of attitudes to perceived benefits of PA participation and related this construct with effective

(rather than intended) participation in PA. These studies used either unidimensional scales combining physical and multiple psychological benefits (Booth et al., 2000; Dergance et al., 2003; Cardenas et al., 2009; King et al., 2014; Roth et al., 2019), or bidimensional scales splitting between the two (Patel et al., 2013). A handful of studies have focused on the perceived benefits of specific sports, mainly among athletes. Mason and Holt (2018) showed that adults with severe mental illness perceived both physical and psychological gains in football. Moreover, Barfield and Malone (2013) characterized the perceived benefits to exercise among power wheelchair soccer players, using a bidimensional scale tapping personal and environmental benefits. In the field of martial arts, studies on market demands used unidimensional scales targeting either psychological (Kim et al., 2009), or physical and psychological benefits (Kim and Zhang, 2019). Rogowska and Kuśnierz (2013) also used a measure combining cognitive, behavioral, and affective dimensions.

Despite their contribution to the field, the above-cited studies were limited in two ways. First, all studies failed to theoretically and/or statistically discriminate between different psychological benefits (e.g., social vs. emotional). The majority of these works performed preliminary factorial analyses that grouped together items tapping different types benefits (e.g., Booth et al., 2000; Cardenas et al., 2009; Kim et al., 2009; Patel et al., 2013). On the one hand, this can be explained by the inclusion of other dimensions besides benefits in the analysis. For example, Kim et al. (2009) conducted a confirmatory factor analysis with 17 latent factors, with perceived benefits being only one of them. On the other hand, it can be related to the reduced and/or unbalanced number of items tapping the different types of benefits. For instance, Cardenas et al. (2009) used a scale with 13 items mainly tapping physical benefits, with only four items targeting socio-emotional aspects. Second, the majority of these works left out well-known psychological benefits (typically, cognitive ones), raising questions about instruments' content validity. Even the study of Rogowska and Kuśnierz (2013), which included an instrument with a component labeled "cognitive," limited its focus to the measurement of respondents' perceptions of knowledge about martial arts. An exception to these studies, was the work of Lakes et al. (2016), who developed a scale to measure dancers' perceptions of the physical, cognitive, emotional, and social benefits of partnered dancing. Confirming the importance of discriminating among different benefits, authors reported that perceived benefits in these dimensions varied as a function of dancers' experience and commitment as well as length and frequency of participation.

Some of the previously cited studies also focused on barriers to participation related to PA negative outcomes (or risks), such as fear of injury (Booth et al., 2000; Dergance et al., 2003; Patel et al., 2013). Still, none of them identified aggression-related issues as barriers to either PA or sports participation. Only Rogowska and Kuśnierz (2013) found that negative or weak attitudes toward martial arts were present among people who saw brutality as the dominant feature of martial arts. A relevant study targeting perceived aggression in sports was that of Pedersen (2007), who asked 285 non-athletes college students to provide perceived aggressiveness ratings on 16 sports (excluding martial arts). In

ascending order, the top 5 were: wrestling, football, rugby, boxing, and hockey. Additionally, higher and lower perceived aggression was associated with lower and higher ratings in willingness to participate, respectively. These non-athletes' perceptions were aligned with those provided by competitive athletes (Maxwell, 2007). Overall, the study of perceived aggression associated with sports as received little research attention. However, to study these perceptions is particularly relevant, as they may represent a significant barrier to engagement in sports, in some cases, ungrounded. For example, despite the non-violent attitudes that lie at the heart of karate practice, if people perceive karateka as more prone to exhibit aggressive behaviors, not only inside but also outside the dojo, their intention to practice it may be reduced.

## PRESENT STUDY

This article focused on undergraduates perceived benefits and aggression-related risks of two widely practiced sports, known to bring widespread benefits to athletes: karate and football. Although the actual benefits (and some risks) of these sports are known, past works have neither compared people's perceptions about karate and football, nor examined how past/present participation in different forms of PA (including but not limited to sports) may shape them. Perceived benefits and risks are likely to vary across sports with different features, such as karate and football, which may, in turn, differently influence individuals' interests, values, and behaviors toward those sports. Information on karate and football perceptions can be used to boost involvement in these sport activities. This is even more relevant in younger adults, who will shortly make choices for their children.

This study was conducted with a twofold goal. First, we aimed to develop and examine the validity and reliability of a scale to measure perceived physical, emotional, cognitive, and social benefits as well as perceived aggression-related risks of karate and football. For that, we examined the factorial validity of the scales, inspected factors' reliability, and tested their convergent/discriminant validity. Second, we intended to compare perceived benefits and risks within and between karate and football, as well as among undergraduates with past/present involvement in different types of PA. Grounded on the previously surveyed literature, we expected to find differential perceptions between these sports and among undergraduates with different types of involvement in PA.

## MATERIALS AND METHODS

### Participants' Characterization

This study included a convenience sample of 184 undergraduate students in Psychology (86% females) with a mean age of 20.25 years ( $SD = 3.49$ , range = 17–47). Among these, 139 undergraduates reported a present or past participation in PA (hereafter referred as PA participants), whereas 45 did not (24%). The categorization and distribution of mentioned PA, including

average years of practice and training frequency is presented in **Table 1**. On average, each PA participant referred to have practiced two different activities for an average duration of 4.59 years. The training frequency of these PA was distributed as follows: 54% had low training frequency (1–2 days/week), 36% had moderate frequency (3–4 days/week), and 10% had high training frequency (5–7 days/week). Swimming was the most frequent PA, with 52% of the sample referring to have practiced this PA for an average of 5 years, followed by team sports (42%, average of 4 years of practice), dance (34%, average of 6 years of practice), and martial arts (27%, average of 3 years of practice). Among the undergraduates who have said to be involved in team sports ( $n = 59$ ) or martial arts ( $n = 37$ ), the most frequently mentioned type of sport was football ( $n = 23$ ; 59%) and karate ( $n = 16$ , 43%), respectively. Football was practiced for an average of 4 years, with 35% of football players reporting a low training frequency and 61% a moderate training frequency. Karate was practiced for an average of 3.5 years, with 75% of karateka reporting a low training frequency, 19% a moderate training frequency, and 6% a high training frequency.

## Perceived Benefits and Aggressiveness Risks Scale (PBAR Scale)

As recommended by Boateng et al. (2018), the development of the scale involved (1) *a priori* identification of the domains to be measured, which was based on a thorough literature review; and (2) generation of the items to measure each domain, which followed a deductive method and was grounded on the literature review used to identify the domains as well as on the inspection of comparable scales. Further details are provided below, separately for the benefits and aggressiveness-related risk factors.

Based on TPB, we defined perceived benefits as the positive consequences arising from practice (Ajzen, 2012). According to literature on PA benefits (for a review see American College of Sports Medicine, 2012), perceived benefits were organized into four domains: physical, cognitive, emotional, and social. Four items were generated for each domain, in line with

empirically based effects of sports in general and karate and football in particular, and inspired by other instruments, namely, the bi-dimensional scale of Kim and Zhang (2019) measuring psychological and physical benefits in martial arts; the uni-dimensional scale of Kim et al. (2009) tapping personal benefits in taekwondo; the multidimensional scale of Lakes et al. (2016) assessing physical, cognitive, emotional, and social benefits in partnered dancing; and the benefits sub-scale of the parent perceptions of PA developed by Lakes et al. (2019). Physical benefits focused on disease prevention as well as improvement of body posture, muscular strength, and motor coordination (Oja et al., 2015; Rios et al., 2018; Kotarska et al., 2019; Zouhal et al., 2020). Cognitive benefits included increases on learning skills, attention, and school/work achievement (Vestberg et al., 2012; Chen et al., 2019; Russo and Ottoboni, 2019). Emotional benefits targeted anxiety, emotional regulation, self-esteem, and well-being (Movahedi et al., 2013; Jansen et al., 2017; Chen et al., 2019). Social benefits tapped cooperation skills, respect for others, sense of belonging, and moral values (Movahedi et al., 2013; Rassovsky et al., 2019).

Given our interest in studying people's perception of aggression-related risks resulting from the practice of karate and football, a fifth domain targeting this (putative) negative outcome was created. This domain was defined as the use of physical or verbal violence to achieve goals (Arriaga et al., 2004). Based on past work on aggression in general and on aggression in sport (Fitch and Marshall, 2001; Wann, 2005; Tractlet et al., 2015), and the physical and verbal aggression sub-scales of the Aggression Questionnaire (Buss and Perry, 1992), we generated four items focused on physical and verbal aggressiveness, use of violence, and exaggerated competitive attitudes.

This procedure resulted in a 5-factor scale composed of 20 items, which were exactly the same for the karate and football versions. Although this study targeted undergraduates, language was formulated having in mind the possibility of testing and using this scale with youngsters in the future. The first Portuguese version of the PBAR scale was elaborated by the first author. This was then shared with a group of experts composed by

**TABLE 1 |** Characterization of the sample in terms of physical activity (PA) practiced ( $n = 139$ ).

Type of PA	Number and Percentage of Practitioners		Years of Practice	Training Frequency			
				Low	Moderate	High	No response
Swimming	72	51.80%	4.85	49	17	5	1
Team sports	59	42.45%	3.91	21	30	6	2
Dance	47	33.81%	5.95	26	16	5	0
Martial arts	37	26.62%	3.37	24	12	1	0
Racquet sports	17	12.23%	4.13	10	6	0	1
Gymnastics	16	11.51%	4.04	8	4	3	1
Gym workout routines	13	9.35%	2.68	2	9	2	0
Skating sports	11	7.91%	3.50	3	4	4	0
Horseback riding	8	5.76%	5.14	7	0	1	0
Yoga/Pilates	7	5.04%	4.08	4	3	0	0
Athletics	6	4.32%	3.83	3	2	1	0
Cycling	2	1.44%	23.00	0	1	1	0
Golf	1	0.72%	7.00	1	0	0	0



a 7th-dan karate sensei (second author), a football coach, and an educational psychologist. The group was presented with the overall goal of the scale and specific definitions of the targeted domains along with the items. Then, they were asked to rate from 1 (*not very well*) to 5 (*very well*) the degree to which the instrument was aligned with its goal, and the degree to which items were representative of the potential benefits or aggressive-related outcomes arising from sport practice in general, and karate and football in particular. Experts were also asked to accept, reject, or modify items in terms of their appropriateness to measure the respective domain and in terms of linguistic formulation. Confirming the scale's face and content validity, experts agreed that the scale was "very well" aligned with its purpose and that the items represented "very well" the targeted outcomes in each domain. Moreover, all items were accepted with minor suggestions concerning language. This input was used to fine-tune the PBAR scale and achieve its final version.

Examples of items taping karate/football perceived outcomes are: "Turns muscles stronger" (physical benefit); "Improves capacity for concentration and work" (cognitive benefit); "Promotes feelings of well-being and satisfaction with life" (emotional benefit); "Stimulates respect for other persons" (social benefit); and "Favors the use of violence to solve problems" (aggressiveness-related risk).

## Procedure

The sample was recruited during mandatory undergraduate Psychology classes. After a brief presentation of the study, undergraduates were told that participation in the study would take no more than 10 min, would be fully anonymous and voluntary, and no incentives would be offered. Undergraduates who accepted to collaborate were asked to fill in the PBAR in relation to karate and football in group. For that, they should indicate the degree to which they perceived a set of statements to represent consequences of the regular practice of karate and football, using a 5-point scale from 1 (*totally disagree*) to 5 (*totally agree*). Then, they were asked to indicate gender and age, and whether they practiced or were currently practicing any type of PA. If yes, participants should name the activity and indicate years of practice and training frequency. The study was approved by the ethical committee of the first author institution.

## Data Analysis Strategy

Before conducting the analyses, we checked evidence of common method bias using the Harman's single-factor test (Podsakoff et al., 2003). After loading all items into a common factor, we examined if the amount of explained variance was above 50%, which would be evidence of method bias. Results showed that the single component accounted for 16% of the covariance between all items, indicating that common method bias was not a concern in the present study.

### Goal 1: Test of PBAR's Karate and Football Versions

Two confirmatory factorial analyses (CFA) were conducted to examine the factorial structure of the karate and football versions of the PBAR scale, using the R system for statistical computing (R Development Core Team, 2018). Latent variables were scaled

by imposing unit of loading identification constraints. The variance of all latent factors was constrained to equal 1.0, so that all factor loadings could be freely estimated. Based on the recommendation from Kline (2016), we used the following indexes to evaluate model fit: chi-square statistic ( $\chi^2$ ) along with  $\chi^2/df$  statistic, confirmatory fit index (CFI), root-mean-square error of approximation (RMSEA), and standardized root mean residual (SRMR).  $\chi^2/df$  values < 2 and 3, CFI values > 0.95 and 0.90, RMSEA values < 0.06 and 0.10, and SRMR values < 0.06 and 0.09 are considered good and adequate fits, respectively (Hu and Bentler, 1999; Schermelleh-Engel et al., 2003). Additionally, we examined factor loadings, reliability coefficients (via the ordinal omega coefficient; see Revelle and Zinbarg, 2009; Dunn et al., 2014), and inter-item correlations for each factor. This information was analyzed for the karate and football versions and used to drop items not working as expected in both versions, so a single scale with the same items could be achieved. The same CFA and reliability analyses were then conducted to examine the adequacy of the reduced version.

Finally, we examined two forms of convergent and discriminant validity, namely, within and between the karate and football versions of the PBAR. First, for both versions separately, we made a stringent test of their internal structure by computing the average variance extracted (AVE), with values above 0.50 indicating good convergent validity for each factor; and we compared the AVE of each factor with the squared correlation of that with other factors, in which an higher AVE indicates good discriminant validity between factors (Hair et al., 2010). Second, we examined the degree to which there were higher associations between the same factors of the two versions than between different factors (Furr, 2011). For that, we correlated all factors of the karate and football versions (Pearson's correlations) and computed average correlations using the Fisher Z transformation.

### Goal 2: Test of PBAR's Karate and Football Versions

To examine differences between karate and football perceptions and among different types of PA participants, we conducted a 2 (Sport [karate, football])  $\times$  5 (Perceptions [physical benefits, emotional benefits, social benefits, cognitive benefits, aggressiveness risks])  $\times$  4 (PA participants [martial artists, team sports players, participants in other types of PA, and non-participants]) Analysis of Variance, with repeated measures in the first two factors. Significant interactions were examined with tests of simple effects. When significant, these were followed-up through pairwise comparisons with Bonferroni correction.

## RESULTS

### Goal 1: Test of PBAR's Karate and Football Versions

The CFA on the 20-item PBAR scale revealed an inadequate model fit for the karate version,  $\chi^2(160, N = 184) = 321.023$ ,  $\chi^2/df = 2.01$ , CFI = 0.767, RMSEA = 0.074, SRMR = 0.080, but an adequate (though with room for improvement) model fit for the football version,  $\chi^2(160, N = 184) = 241.442$ ,  $\chi^2/df = 1.51$ ,

CFI = 0.896, RMSEA = 0.053, SRMR = 0.065. Reliability estimates ranged from 0.54 to 0.76 and 0.60 and 0.78, respectively, in the karate and football versions. We then looked into each factor to identify the items with the lowest factor loadings and lowest inter-item correlations in both versions. Based on this scrutiny, we identified one item per factor that was working poorly in both versions. These items were removed and the 15-item PBAR scale was then examined.

CFA results concerning the shortened scale revealed adequate-to-good model fits for the karate,  $\chi^2(80, N = 184) = 119.937$ ,  $\chi^2/df = 1.49$ , CFI = 0.920, RMSEA = 0.052, SRMR = 0.063, and football versions,  $\chi^2(80, N = 184) = 126.936$ ,  $\chi^2/df = 1.59$ , CFI = 0.924, RMSEA = 0.056, SRMR = 0.061. **Table 2** presents descriptive statistics for all items and factors, including factor loadings. These ranged from 0.26 to 0.88 and 0.40 to 0.81, respectively, in the karate and football versions (all  $ps < 0.003$ ). Respectively, reliability estimates ( $\omega$ ) for the karate and football versions were: 0.69 and 0.71 for physical benefits, 0.64 and 0.68 for emotional benefits, 0.60 and 0.54 for social benefits, 0.60 and 0.63 for cognitive benefits, and 0.82 and 0.80 for risks. Despite the acceptable factor loadings, AVE was below 0.50 for all factors (range = 0.27–0.32 for the karate version and 0.25–0.40 for the football version), except for the aggression-risk factors, where AVE was 0.58 for both versions. Confirming good discriminant validity, the squared correlations between factors were below AVE values for each factor. Complete results are presented in **Table 3**.

Concerning the associations between factors of the two versions, also displayed in **Table 3**, results showed that correlations between karate factors ranged from 0.09 to 0.46, with an average of 0.27; and correlations between football factors

ranged from 0.17 to 0.53, with an average of 0.36. Correlations between the same karate and football factors ranged from 0.22 to 0.69, with an average of 0.49; whereas those between different karate and football factors ranged from 0.01 to 0.31, with an average of 0.14.

## Goal 2: Comparison of Karate and Football Perceptions

**Table 4** shows means and standard deviations for karate and football perceived benefits and risks by type of PA participant.

Results revealed a main effect of Perceptions,  $F(4,720) = 486.64$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.73$ , an interaction between Sport and Perceptions,  $F(4,720) = 124.81$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.41$ , and a three-way interaction,  $F(12,720) = 3.14$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.05$ . This latter is depicted in **Figure 1** and further detailed below.

### Differences Between Sports

Participants in other PA and non-participants perceived more physical benefits in football than in karate,  $F_s(1,180) > 3.90$ ,  $ps < 0.05$ ,  $\eta_p^2 > 0.02$ ; however, martial artists and team sports players perceived similar physical benefits in karate and football,  $F_s(1,180) < 2.42$ ,  $ps > 0.12$ ,  $\eta_p^2 < 0.02$ . Moreover, martial artists, team sports players, and participants other PA,  $F_s(1,180) > 3.79$ ,  $ps < 0.05$ ,  $\eta_p^2 > 0.02$ , but not non-participants,  $F(1,180) = 1.51$ ,  $p = 0.22$ ,  $\eta_p^2 = 0.01$ , perceived karate to have more social benefits than football. For the whole sample, karate was perceived to have more cognitive and emotional benefits as well as less aggression-related risks than football,  $F_s(1,180) > 10.12$ ,  $ps < 0.001$ ,  $\eta_p^2 > 0.05$ .

**TABLE 2 |** Descriptive statistics, including factor loadings, of the retained karate and football items.

	Karate							Football						
	Min.	Max.	M	SD	Sk	Ku	$\lambda$	Min.	Max.	M	SD	Sk	Ku	$\lambda$
Physical Benefits	3.00	5.00	4.52	0.47	-0.78	-0.14		3.33	5.00	4.61	0.43	-0.84	-0.28	
Item 6	1.00	5.00	4.35	0.80	-1.31	2.22	0.56	1.00	5.00	4.58	0.70	-2.26	7.20	0.42
Item 14	2.00	5.00	4.46	0.64	-1.04	1.11	0.50	3.00	5.00	4.62	0.53	-0.97	-0.19	0.49
Item 20	3.00	5.00	4.74	0.50	-1.79	2.40	0.49	2.00	5.00	4.64	0.60	-1.59	2.17	0.57
Cognitive Benefits	2.67	5.00	4.00	0.52	-0.15	-0.08		2.00	5.00	3.55	0.62	-0.09	-0.28	
Item 1	2.00	5.00	4.37	0.59	-0.63	1.31	0.44	1.00	5.00	3.65	0.83	-0.38	-0.04	0.55
Item 9	1.00	5.00	3.68	0.80	-0.16	-0.05	0.59	1.00	5.00	3.41	0.80	0.02	0.17	0.61
Item 16	2.00	5.00	3.93	0.74	-0.38	-0.02	0.59	1.00	5.00	3.59	0.82	-0.25	-0.11	0.67
Emotional Benefits	2.67	5.00	4.25	0.50	-0.41	-0.19		2.00	5.00	3.73	0.62	-0.30	-0.03	
Item 7	2.00	5.00	4.21	0.78	-0.80	0.34	0.52	1.00	5.00	3.04	0.92	0.22	-0.45	0.51
Item 15	2.00	5.00	4.26	0.67	-0.46	-0.31	0.59	1.00	5.00	3.98	0.83	-0.60	0.25	0.64
Item 19	3.00	5.00	4.28	0.61	-0.24	-0.60	0.53	2.00	5.00	4.18	0.69	-0.46	-0.09	0.73
Social Benefits	2.00	5.00	3.93	0.64	-0.56	0.21		1.67	5.00	3.65	0.65	-0.29	-0.05	
Item 2	2.00	5.00	4.20	0.77	-0.72	0.08	0.72	1.00	5.00	3.23	1.00	-0.05	-0.85	0.58
Item 10	1.00	5.00	3.54	1.04	-0.29	-0.65	0.26	1.00	5.00	4.51	0.67	-1.57	3.91	0.40
Item 13	1.00	5.00	4.06	0.94	-0.99	0.76	0.61	1.00	5.00	3.21	0.99	0.05	-0.59	0.67
Aggressiveness Risks	1.00	4.67	2.16	0.82	0.39	-0.18		1.00	5.00	3.23	0.92	0.06	-0.69	
Item 8	1.00	5.00	2.22	1.04	0.56	-0.34	0.79	1.00	5.00	2.60	1.10	0.26	-0.69	0.77
Item 11	1.00	5.00	2.27	1.05	0.72	0.04	0.88	1.00	5.00	2.40	1.00	0.34	-0.56	0.81
Item 18	1.00	4.00	1.98	0.85	0.47	-0.51	0.58	1.00	5.00	3.30	1.15	-0.38	-0.82	0.71

**TABLE 3 |** Bivariate correlations between karate and football perceived benefits and risks (same-factor correlations in bold).

PBAR Versions and Factors	AVE	MSV	Karate					Football			
			1	2	3	4	5	6	7	8	9
Karate											
(1) Physical Benefits	0.27	0.04									
(2) Cognitive Benefits	0.30	0.21	0.15*								
(3) Emotional Benefits	0.30	0.21	0.21**	0.46***							
(4) Social Benefits	0.32	0.19	0.21**	0.31***	0.44***						
(5) Aggressiveness Risks	0.58	0.13	−0.09	−0.16*	−0.30***	−0.36***					
Football											
(6) Physical Benefits	0.25	0.12	0.69***	0.23***	0.17*	0.16*	−0.01				
(7) Cognitive Benefits	0.37	0.28	0.24***	0.52***	0.18*	0.13	−0.02	0.31***			
(8) Emotional Benefits	0.40	0.26	0.31***	0.18*	0.49***	0.18*	−0.08	0.33***	0.40***		
(9) Social Benefits	0.32	0.26	0.23**	0.28***	0.14	0.22**	−0.02	0.34***	0.53***	0.51***	
(10) Aggressiveness Risks	0.58	0.16	0.20**	0.02	0.03	0.04	0.47**	0.17*	0.25***	0.40***	0.33***

AVE, average variance extracted. MSV, maximum shared variance (computed separately for each version). \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

**TABLE 4 |** Perceived benefits and aggressiveness risks of karate and football by type of participation in PA.

	Martial Artists <i>n</i> = 30		Team Sports Players <i>n</i> = 44		Participants in Other PA <i>n</i> = 65		Non-participants in PA <i>n</i> = 45	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<b>Karate</b>								
Physical Benefits	4.44	0.48	4.59	0.48	4.55	0.48	4.45	0.43
Cognitive Benefits	4.02	0.55	4.04	0.52	4.03	0.41	3.90	0.62
Emotional Benefits	4.34	0.47	4.26	0.49	4.31	0.49	4.07	0.52
Social Benefits	4.17	0.51	3.95	0.61	3.86	0.65	3.88	0.71
Aggressiveness Risks	1.83	0.74	2.01	0.92	2.23	0.81	2.42	0.70
<b>Football</b>								
Physical Benefits	4.48	0.48	4.67	0.44	4.64	0.40	4.61	0.42
Cognitive Benefits	3.39	0.64	3.64	0.72	3.58	0.56	3.52	0.59
Emotional Benefits	3.57	0.62	3.80	0.69	3.78	0.66	3.71	0.45
Social Benefits	3.33	0.52	3.72	0.78	3.74	0.70	3.65	0.45
Aggressiveness Risks	3.20	0.90	3.38	0.97	3.22	0.95	3.13	0.86

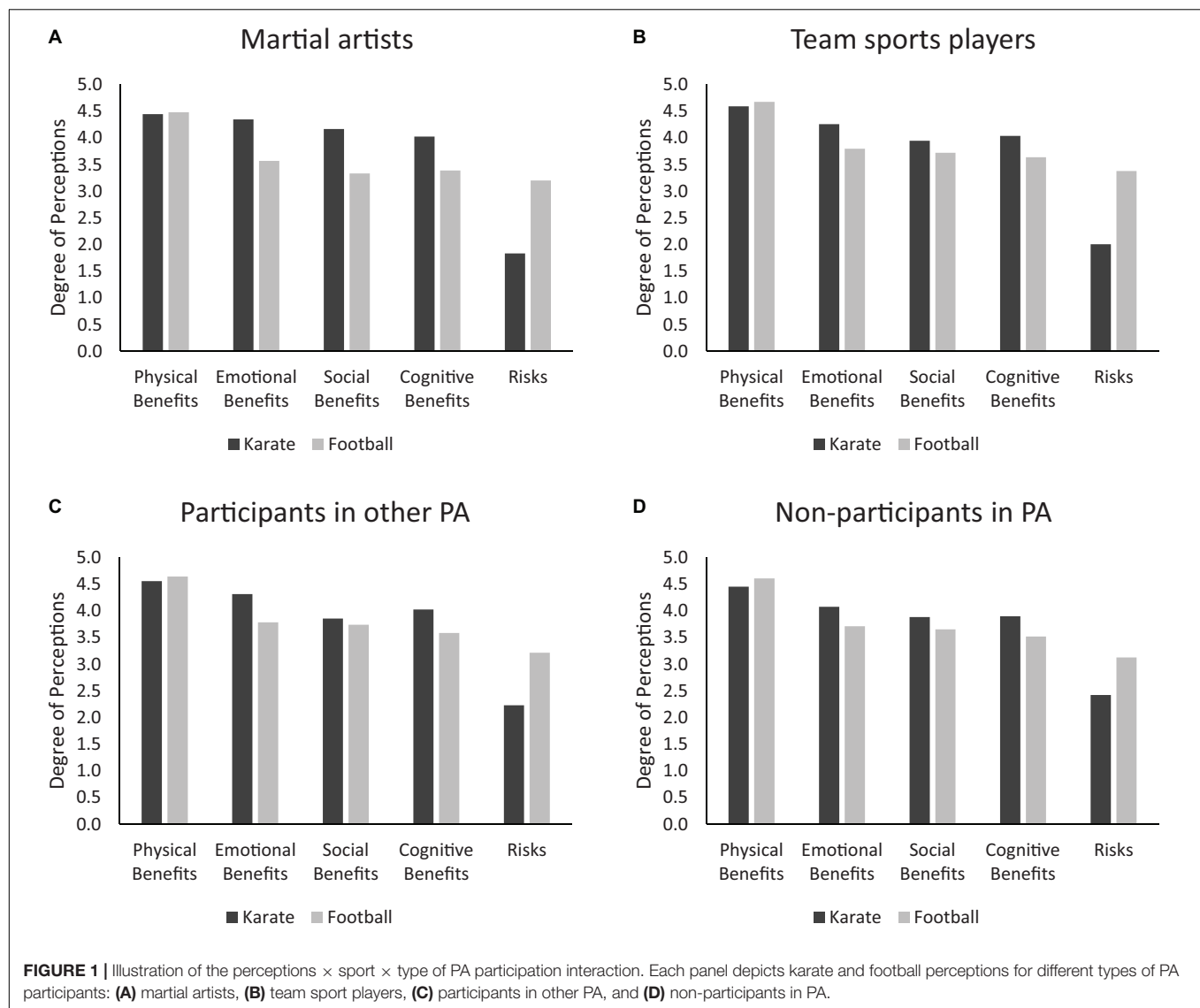
## Differences Between Perceptions

All types of PA participants saw differences between benefits/risks in karate as well as in football,  $F_{s(4,177)} > 32.29$ ,  $ps < 0.001$ ,  $\eta_p^2 > 0.42$ . Concerning karate: (a) martial artists perceived more physical than cognitive benefits ( $p = 0.004$ ), but similar physical, emotional, and social benefits ( $ps > 0.30$ ), whereas all others perceived physical benefits to surpass all other benefits ( $ps < 0.02$ ); (b) only martial artists and participants in other PA perceived more emotional than cognitive benefits ( $ps < 0.01$ ), and only team sports players and participants in other PA perceived more emotional than social benefits ( $ps < 0.01$ ); (c) the whole sample perceived aggression-related risks to be lower in comparison to benefits ( $ps < 0.001$ ). Regarding football: (a) the whole sample perceived physical benefits to be greater than all other benefits and risks ( $ps < 0.001$ ) and emotional benefits to be of the same extent as social and cognitive benefits ( $ps > 0.19$ ); (b) except participants in other PA ( $p = 0.03$ ), all others perceived similar cognitive benefits and aggressiveness risks ( $ps > 0.08$ ); (c) participants

in other PA and non-participants perceived emotional and social benefits to be higher than risks ( $ps < 0.002$ ), whereas team sports players perceived more emotional but not social benefits than risks ( $ps = 0.02$  and  $0.16$ , respectively); (d) martial artists perceived aggression-related risks to be of the same extent as emotional and social benefits ( $ps > 0.24$ ). Regardless of PA participants type, cognitive benefits were perceived to the same extent as social benefits, both in karate and football ( $ps > 0.46$ ).

## Differences Between Type of PA Participants

In general, perceived benefits and aggressiveness risks of karate and football were similar across all types of PA participants,  $F_{s(3,180)} < 2.62$ ,  $ps > 0.05$ ,  $\eta_p^2 < 0.04$ . There were however two exceptions concerning karate risks,  $F(3,180) = 3.96$ ,  $p = 0.01$ ,  $\eta_p^2 = 0.06$ , and football social benefits,  $F(3,180) = 3.02$ ,  $p = 0.03$ ,  $\eta_p^2 = 0.05$ . Specifically, martial artists perceived less aggression-related risks in karate than non-participants ( $p = 0.01$ ) and less social benefits in karate than participants in other PA ( $p = 0.03$ ).



## DISCUSSION

This study had two major goals: to develop and test a scale to measure perceived benefits and aggressiveness risks (PBAR scale), and to compare those perceptions between karate and football, and among participants in different types of PA.

### Goal 1: Test of PBAR Karate and Football Versions

Based on past works, we developed the PBAR scale to measure perceived physical, emotional, cognitive, and social benefits along with perceived aggression-related risks in karate and football. After dropping five items, we confirmed the factorial validity of the 15-item instrument. In both versions, we found acceptable factor loadings and reliability indices. Still, the Social Benefits factor worked poorer than the others, which should be kept in mind when interpreting current findings. More tests on the

instrument seem therefore needed, with particular attention to that factor, as it may require additional fine-tuning. It should additionally be noted that, except the aggression-related risk factors, all others failed to achieve satisfactory convergent validity ( $AVE < 0.50$ ). Even though our findings supported the factorial validity of both scales, these less than perfect AVE estimates should not be overlooked. They can be related to the heterogeneity of our sample, which included undergraduates with varying degrees of PA participation, who may have interpreted items differently, thus resulting in more error than explained variance. For example, though the majority of the sample reported a past or present involvement in PA, 24% of the surveyed undergraduates have no prior participation in any kind of PA. Future studies should test these scales with more homogeneous samples and inspect whether AVE-related issues disappear or if items modifications are warranted.

Findings were encouraging concerning the degree to which the different factors discriminated among different perceptions.



In line with the premise that gave rise to this study, perceived physical, emotional, cognitive, and social benefits were distinguishable outcomes of karate and football. Thus, for a fine-grained analyses of sports perceived benefits, it seems advisable to use multidimensional rather unidimensional scales, as done before (Kim et al., 2009; Barfield and Malone, 2013; Kim and Zhang, 2019). Further supporting this conclusion, results on the convergent/discriminant validity between the two versions of the PBAR karate and football versions were also as expected. Within each version, factors were generally correlated with each other. Across versions, there were higher correlations between the same factors, and lower correlations between different factors.

All in all, findings provided preliminary evidence on PBAR validity and reliability. However, further tests seem needed to gather more evidence on its psychometric properties. For instance, it would be important to examine the instrument stability over time (test-retest reliability), to study the degree to which it predicts intention to participate in the targeted sport (predictive validity), or to test the scale's ability to detect change, for example, after raising people's awareness of sports' real benefits/risks (responsiveness to change). These future tests should consider including larger samples, preferably estimated using *a priori* power analysis. This was not the case of the present study, even though observed power was above 0.80. Additionally, it would be important to test the karate and/or football versions of the PBAR with different populations and test for measurement invariance, for example, contrasting different age groups (e.g., adolescents vs. adults), types of athletes (e.g., karateka vs. footballers), or expertise levels (i.e., beginners vs. advanced). Finally, it could also be valuable to test the PBAR in the context of other sports, besides football and karate.

## Goal 2: Comparison of Karate and Football Perceptions

As anticipated, perceived benefits and aggression-related risks varied between and within the sports targeted, as well as across type of PA participant. Results showed that martial artists perceived karate to bring similar physical, emotional, and social benefits, whereas all others perceived physical benefits as the main outcome of karate. For the whole sample, physical benefits were recognized as the most salient benefit of football, with emotional, social, and cognitive benefits being perceived to the same extent. The general strongest perception of physical benefits in karate and football aligns with several studies reporting real health benefits of these modalities (Oja et al., 2015; Rios et al., 2018; Kotarska et al., 2019; Zouhal et al., 2020). The perceptions of martial artists were particularly interesting, as they recognized that karate brings as much physical as emotional and social benefits. The real socioemotional outcomes of martial arts, including karate, have already been reported (Movahedi et al., 2013; Jansen et al., 2017). Due to their own experience, martial artists may be more cognizant of these benefits than people who never tried any martial art and, likely, have a reduced knowledge about it. The result that cognitive benefits were not seen as a salient outcome of karate and football is surprising, given the increasing amount of research documenting the cognitive benefits of these sports (Alesi et al., 2014; Verburch et al., 2014;

Chen et al., 2019; Russo and Ottoboni, 2019). There seems to be a mismatch between real and perceived cognitive benefits in karate and football, which calls for more research attention.

This is the first study providing comparative data on football and karate perceptions. A main finding was that martial artists and team sports players saw similar physical benefits in these activities, whereas participants in other PA and non-participants perceived more physical benefits in football than karate. Martial artists and team sports players own experience with these or related sports, along with an eventual lack of knowledge among the others, may explain this difference (Lakes et al., 2016). In general, our sample perceived karate to bring more psychological-related benefits than football. This finding is not surprising as it may reflect the nature of karate. In addition to increasing physical skills (e.g., strength, speed, coordination), karate practice is aimed at developing karateka's mind and spirit (Theeboom and Knop, 1999; Vertonghen and Theeboom, 2010; Rassovsky et al., 2019). More than being a sport, as a traditional martial art, karate is a way of life. Karateka develop their ability to engage in states of awareness and openness to surrounding threats (*zanshi*) and states of flow totally focused on the activity (*mushin*), while following five moral principles (*dojo kun*): seek perfection of character, be faithful, endeavor to excel, respect others, and refrain from violent behavior (Nakayama, 1976). Though football may also positively affect some of these aspects, this may be more a by-product than the main goal of practice.

It is worth noticing that our study showed that perceived benefits of karate and football varied as a function of undergraduates' characteristics, specifically, their past/present engagement in different types of PA. This result is not new, as past studies already reported PA benefits to vary across participants gender, ethnicity, body size (Roth et al., 2019), degree of PA activity (Cardenas et al., 2009), or experience, commitment, and degree of participation in PA (Lakes et al., 2016). Further research is, however, needed to examine whether karate and football perceived benefits differ among athletes with varying expertise levels (e.g., beginning, intermediate, and advanced) and the factors underlying those differences (e.g., greater knowledge, personal experience, or biased perceptions toward a valued modality).

With respect to aggression-related risks, these were perceived to be lower in karate than in football. This finding is in line with past works that found higher levels of reported aggressiveness and anger among football players than athletes engaged in martial arts related activities, such as kickboxing and self-defense (Sofia and Cruz, 2013). Moreover, this finding extends the results of Pedersen (2007). Despite not including martial arts in their analysis, they found football to be among the sports with the highest perceived levels of aggressiveness among undergraduates. Our results also showed that the perceived benefits of karate clearly outweighed its aggressiveness risks. Karate does not seem to carry negative connotations, such as deeming this martial art as dangerous or instigator of aggressive behaviors. In line with TPB (Ajzen, 2012; Bosnjak et al., 2020), the lack of such connotation along with the benefits ascribed to karate is certainly a first step to have people engaged in this sport. This positive attitude among younger adults is particularly encouraging as it may not only be an incentive for themselves to get involved in karate, but also



a key driver to engaging their children. Given the documented benefits of this martial art, having youngsters practicing karate can be means to complement their education and build physically and mentally strong members of the society. Contrary to karate, the perceived psychological-related benefits of football did not clearly outweigh the perceived aggression-related risks of this modality. This is a curious finding because, despite its noticeable risks, which go beyond aggressiveness (see for example Schatz et al., 2020 on perceived concussion risks), football is the number one sport in the world, with 265 million active footballers in 2006 (Kunz, 2007).

Three caveats should, however, be kept in mind concerning our approach to the study of people's perception of aggression-related risks. First, we limited the aggression-related domain to instrumental aggression, in which harmful actions have a purpose, such as winning a game, or more broadly solving a problem. However, there is another type of aggression, hostile aggression, which includes harmful actions motivated by anger and aimed to harm someone (Wann, 2005). Future research should consider a fine-grained and comprehensive study of perceived aggression-related risks by tapping these two types of aggression. Second, aggression-related issues are not the unique risk typically associated with the practice of sports. Other negative outcomes have been identified, such as musculoskeletal injury and adverse cardiovascular events (American College of Sports Medicine, 2014), or bullying, hazing, and harassment in youth sports, which carry risks of both physical and mental harm (McMullen, 2014). Finally, it should also be noted that the line between risks and benefits is not always clear. For example, though weight loss is typically seen as major benefit of PA in general (King et al., 2014), for underweight people or even athletes practicing weight-class sports, weight loss may be seen as a risk (Turocy et al., 2011). Overall, the benefits and aggression-related risks examined in this paper provide a snapshot that we hope will contribute to the understanding of the bigger picture in sports' perceptions, clearly requiring further research attention.

## CONCLUSION

This work integrates a larger set of studies aimed to examine perceived benefits and aggression-related risks in sports. Findings provided preliminary validity and reliability evidence on the PBAR scale. Though requiring further testing with different populations and sports, this seems a promising tool to examine

and compare people's perceptions about different sports. Such examination is critical because more than the real benefits of a sport, it is the perceived outcomes that will influence individuals' intention to engage in it. Information on people's beliefs about sports outcomes can guide the design of strategies to maximize participation in sports that bring widespread benefits, such as football and karate.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Porto. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

TL designed the study (including the PBAR scale), oversaw the data collection and coding, analyzed and interpreted the data, and wrote the first version of the manuscript. ST contributed to the design of the study (including the PBAR scale) and reviewed the manuscript. Both authors contributed to the article and approved the submitted version.

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# Emotional Intelligence of Undergraduate Athletes: The Role of Sports Experience

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Sport is an emotional experience. Studies have shown that high emotional intelligence (EI) is associated with better sports performance, though different aspects of sports experience and their relationship with EI are still unclear. This study examined the possible relationships between sports experience and EI dimensions of undergraduate athletes. Likewise, according to the differences described in the literature between men and women, the secondary aim was to identify the possible relationship between EI and sports experience in both subgroups. A total of 1784 [712 men (39.9%), 1072 women (60.1%); mean age = 21.3 years, SD = 4.2] undergraduate athletes completed the Trait Meta Mood Scale and a sports experience questionnaire. Comparisons between groups were performed using Mann–Whitney–U and H-Kruskal–Wallis tests and correlations between variables were analyzed using Spearman correlation. We found that the number of different sports practiced and the number of years practicing sports were positively associated with emotional repair (ER). However, the number of years practicing sports was negatively associated with emotional attention (EA). Male athletes who trained more and had a higher competitive level were more likely to show higher ER. In any case, it is necessary to take into account that all the associations were weak. Our study suggested that athletes tend to attend to and value their feelings and use positive thinking to repair their negative moods.

**Keywords:** emotional intelligence, sports experience, undergraduate athletes, TMMS-24, sports

## INTRODUCTION

In recent years, researchers have shown a growing interest in emotional intelligence (EI) and its relation to sports (Laborde et al., 2016a; Ubago-Jiménez et al., 2019). The concept of EI has been studied as a trait, an ability (Petrides, 2011) and as a mixed model (Mayer et al., 2008). Trait EI (trait emotional self-efficacy) refers to emotional self-perception and is measured using self-reporting questionnaires. Ability EI (cognitive-emotional ability) refers to cognitive abilities and is assessed through maximum performance testing (Petrides, 2011). The mixed model considers EI as a broad concept, consisting of motivation, intrapersonal and interpersonal abilities, empathy, personality factors, and wellness. The mixed model is assessed using self-reporting questionnaires (Mayer et al., 2008).



Laborde et al. (2016a), in their systematic review of sports, physical activity, and EI, found that the majority of studies (33 of 36) used self-report tools to assess EI. In other words, in the sport context, EI has been studied as a trait or as a mixed model on most occasions. This may be due to the dependence of ability EI tests on inherently subjective emotional experience (Matthews et al., 2007). Trait EI has been defined as a constellation of emotional self-perceptions at the lower levels of personality hierarchies (Petrides et al., 2007). Similarly, Mayer and Salovey (1997) proposed that EI consists of three dimensions: emotional attention (EA), emotional clarity (EC), and emotional repair (ER).

Laborde et al. (2013) described an emotion within the context of sports as an organized, psychophysiological reaction evaluating ongoing contextual relationships. Sports experiences are inherently emotional. Winning and losing, surpassing yourself through performance or recovering from an injury, all give rise to different feelings. Emotions are inherent to competition and can significantly influence performance (Hanin, 2000, 2010; Lazarus, 2000; Jones, 2003; Campo et al., 2012; Arribas-Galarraga et al., 2017; Magrum et al., 2019). Thus, EI may be a predictor of sports performance (Crombie et al., 2009; Kopp and Jekauc, 2018), and various techniques have been developed in the field of sports psychology to determine the optimal level of EI among athletes (Robazza et al., 2004; Gould and Maynard, 2009; Lane et al., 2009, 2010). The practice of sports puts emotions into play and may be a possible mechanism for the development of EI (Campo et al., 2016) given that every athlete reacts differently to these experiences.

There have been a number of studies into the difference in EI among athletes and non-athletes (Costarelli and Stamou, 2009; Szabo and Urban, 2014; Lepir et al., 2018). These studies found that athletes have greater EI than non-athletes, specifically in terms of assertiveness, understanding their own emotions, appraising others, and controlling their emotions.

Research carried out specifically with athletes has studied the relationships between EI and other variables related to sports experience, finding positive relationships between EI and higher athletic prowess (Saies et al., 2014; Arribas-Galarraga et al., 2017; Vaughan et al., 2019). Studies have also analyzed differences according to the type of sports (individual vs. team sports) and their relationship to EI (Kajbafnezhad et al., 2011; Ghaderi and Ghasemi, 2012; Laborde et al., 2014, 2017). While these studies found no significant differences according to the type of sports (individual vs. team sports), another study (Castro-Sánchez et al., 2018a) found significant differences in emotional management depending on the type of sports. Athletes practicing team contact sports (i.e., football, basketball, or rugby) showed higher levels of emotional management compared to athletes practicing individual contact sports (i.e., martial arts, combat sports). Castro-Sánchez et al. (2018b) found that the levels of EI are higher in team sports than in individual sports. This may be due to the differing psychological requirements of individual and team sports (Laborde et al., 2016b).

Other types of sports may have important nuances (Durand, 1975). Outdoor sports under extreme conditions can induce intense emotions (Johnson et al., 2016). Levels of EI have been

studied in mountain/rock climbers (Ardahan, 2012; Marczak et al., 2017), mountain ultramarathon athletes (Nicolas et al., 2019), cyclists, and hikers (Ardahan, 2012), showing the importance of EI in outdoor sports performance. Studies of the association between EI and combat sports (Costarelli and Stamou, 2009; Szabo and Urban, 2014; Hyung et al., 2017; Merino et al., 2019, 2020) suggest that combat sports may also foster EI.

With regards to gender, sports and EI, various studies found no differences between male and female athletes (Laborde et al., 2014; Szabo and Urban, 2014; Castro-Sánchez et al., 2018a), neither in terms of their competitive level nor the type of sport (Laborde et al., 2016b, 2017). However, studies by Merino et al. (2019, 2020) found differing levels of EI among male and female athletes according to their competitive level; higher-level male athletes showed higher ER than the lower levels, but higher-level females athletes demonstrated increased EA and EC. It should be noted that higher EA scores are associated with excessive reactions to negative emotions (Yiend, 2009) and poorer emotional adjustment (Fernández-Berrocal et al., 2005). Another study with canoeists reported that men scored higher than women in emotional control and regulation (Arribas-Galarraga et al., 2017). Some studies suggest further lines of research in EI in the field of sports according to gender (Saies et al., 2014; Kopp and Jekauc, 2018).

Despite the existing research, various aspects of the relationship between sports experience and EI remain unclear (Costarelli and Stamou, 2009; Kajbafnezhad et al., 2011; Ghaderi and Ghasemi, 2012; Laborde et al., 2014, 2017; Saies et al., 2014; Szabo and Urban, 2014; Castro-Sánchez et al., 2018a,b; Lepir et al., 2018; Vaughan et al., 2019). The type of sport, time spent practicing (frequency days/week, years of practice), the number of different sports practiced, and the highest competitive level achieved are all characteristics of sports experience that may be related to EI. In contrast, some studies showed different results of EI within gender in the sport context (Laborde et al., 2014; Szabo and Urban, 2014; Castro-Sánchez et al., 2018a; Merino et al., 2019, 2020). Thus, this research aimed to analyze the association between different variables related to sports experience [type of sport (individual, team, outdoor, or combat), the number of years practicing sports, the training frequency, the number of different practiced sports and the level of competition achieved (not competitive, local/regional, or national/international)] and EI dimensions (EA, EC, and ER) of undergraduate athletes. The secondary aim was to describe the possible relationship between EI and sports experience in male and female athletes. Thus, the initial hypothesis is that there is a relationship between the sports experience and the EI of undergraduate athletes.

## MATERIALS AND METHODS

### Sample and Procedure

A descriptive and cross-sectional study was conducted to analyze the associations between EI and sports experience. The population of the study was university students from Madrid. Disproportionate stratified sampling was used according to the



type of university [public (79.1%) or private (20.9%)] and the subject areas of the students [social and legal sciences (41.2%), engineering and architecture (20.6%), arts and humanities (8%), and health sciences and science (25.8%)]. The sample consisted of 1784 [712 men (39.9%), 1072 women (60.1%); mean age = 21.3 years, SD = 4.2] undergraduate students from Madrid who claimed to be currently practicing at least one sport. Additionally, 58.7% reported practicing individual sports and 23.9% team sports; 55.3% of the students reported they trained more than 2 days/week while 39.5% reported training 1–2 days/week. The sample distribution data are presented in Table 1.

Participation was voluntary and confidential, and informed consent was obtained from participants before completing the survey. This study was approved by the Research Ethics Committee of Universidad Francisco de Vitoria (40/2018).

**TABLE 1 |** Sample distribution data.

Variables	Total	Male	Female
<b>Type of university</b>			
Public	1411 (79.1)	565 (79.4)	846 (78.9)
Private	373 (20.9)	147 (20.6)	226 (21.2)
<b>Year course of studies<sup>b</sup></b>			
First	459 (25.7)	196 (27.5)	263 (24.5)
Second	413 (23.2)	177 (24.9)	236 (22)
Third	384 (21.5)	144 (20.2)	240 (22.4)
Fourth	404 (22.6)	152 (21.3)	252 (23.5)
Fifth	83 (4.7)	31 (4.4)	52 (4.9)
Sixth	41 (2.3)	12 (1.7)	29 (2.7)
<b>Subject area</b>			
Arts and humanities	143 (8)	30 (4.2)	113 (10.5)
Sciences	77 (4.3)	37 (5.2)	40 (3.7)
Health sciences	461 (25.8)	175 (24.6)	286 (26.7)
Social and legal sciences	735 (41.2)	257 (36.1)	478 (44.6)
Engineering and architecture	368 (20.6)	213 (29.9)	155 (14.5)
Number of practiced sports <sup>a</sup>	1 (1–2)	2 (1–2)	1 (1–2)
Years practicing sports <sup>a</sup>	16 (8–18)	14 (7–18)	16 (10–19)
Starting age of sports practice <sup>a</sup>	4 (2–10)	6 (3–12.5)	3.75 (1.75–8)
<b>Training frequency<sup>b</sup></b>			
Seasonal	41 (2.3)	13 (1.8)	28 (2.6)
Less than 1 day/week	51 (2.9)	22 (3.1)	29 (2.7)
1–2 days/week	705 (39.5)	231 (32.4)	474 (44.2)
More than 2 days/week	987 (55.3)	446 (62.6)	541 (50.5)
<b>Type of sport<sup>b</sup></b>			
Individual	1048 (58.7)	301 (42.3)	747 (69.7)
Team	427 (23.9)	286 (40.2)	141 (13.2)
Combat	131 (7.3)	69 (9.7)	62 (5.8)
Outdoor	96 (5.4)	34 (4.8)	62 (5.8)
Others	82 (4.6)	22 (3.1)	60 (5.6)
<b>Competitive level<sup>b</sup></b>			
Not competitive	1109 (62.2)	327 (45.9)	782 (72.9)
Local/regional	469 (26.3)	279 (39.2)	190 (17.7)
National/international	206 (11.6)	106 (14.9)	100 (9.3)

Results are expressed in: <sup>a</sup>median (Quartile 1–Quartile 3); <sup>b</sup>frequency (percentage).

Participants were recruited by their lecturers, who sent them a Google Forms Questionnaire. Participants completed the sports experience survey and EI questionnaire. The sample was collected from April to December 2017 at Madrid universities.

## Measures

### Emotional Intelligence

Undergraduate students were assessed using the validated Spanish version of the Trait Meta-Mood Scale (TMMS-24) (Fernández-Berrocal et al., 2004) based on the original scale developed by Salovey et al. (1995). This self-reporting tool contains 24 items using a 5-point Likert scale from 1 (totally disagree) to 5 (totally agree). It is composed of three dimensions (eight items each dimension): (1) emotional attention (EA), evaluating how people attend to and value their feelings (item example: “I pay a lot of attention to my feelings”); (2) emotional clarity (EC), evaluating how people feel clearly rather than confusedly about their feelings (item example: “I can often define my feelings”), and (3) emotional repair (ER), evaluating how people use positive thinking to repair negative moods (item example: “Although sometimes I feel sad, I usually have an optimistic vision”). Our results demonstrate similar internal consistency in the three sub-scales: EA,  $\alpha = 0.89$ ; EC,  $\alpha = 0.90$ ; and ER,  $\alpha = 0.83$ .

### Sports Experience

The variables for sports experience were the number of different sports practiced, the number of years practicing sports, the training frequency, the type of sport practiced, and the maximum level of competition achieved in this sport. We assessed the training frequency by self-reporting on a Likert scale from 1 (less than 1 day/week) to 3 (more than 2 days/week); there was a 4th for seasonal sports. To evaluate the type of sport, the participants had to choose a sport from a list of 43 sports; the selected sports were then categorized into individual, team, combat, and outdoor sports following the classification by Durand (1975). The level of competition was assessed by self-reporting using three categories: 1 (not competitive), 2 (local and regional level), and 3 (national and international level). The questionnaire also asked for the number of different sports practiced and the number of years practicing sports.

## Data Analysis

The data is presented as a median and interquartile range. EI variables showed a non-normal distribution. Comparisons between groups were made using Mann–Whitney-U and H-Kruskal–Wallis tests. When necessary we performed Dunn–Bonferroni *post hoc* tests. Correlations between the variables were analyzed using Spearman correlation.

The data were analyzed using the Statistical Package for the Social Sciences (SPSS v21). Statistical significance was set at  $p < 0.05$ . However, as EI consists of three dimensions, the significance level was adjusted at  $p < 0.016$ . D-Cohen was used to interpret the effect size, defining small ( $d = 0.2$ ), medium ( $d = 0.5$ ), and large ( $d = 0.8$ ) values.

## RESULTS

For the EI dimensions median values were EA = 29 (25–33), EC = 28 (24–32), and ER = 29 (25–32). **Table 2** shows the associations between sports experience and EI dimensions. There was a significant positive association between the number of sports practiced and the ER ( $p < 0.001$ ). There was a significant negative association between the number of years practicing sports and EA ( $p = 0.002$ ) and a significant positive association with ER ( $p = 0.012$ ). The analysis showed significant differences among training frequency groups and ER ( $p < 0.001$ ), but there are no post-hoc differences between groups that were statistically identified. There were significant differences between the type of sports and EA ( $p < 0.001$ ). Individual sports showed higher EA than team sports ( $p < 0.001$ ). There were significant differences between the competitive level and EA ( $p < 0.001$ ). Participants who did not compete showed higher EA than participants who compete at local/regional level ( $p < 0.001$ ) and participants who compete at national/international level ( $p = 0.011$ ).

The median EI score for male athletes was 28 (9) in EA, 29 (8) in EC, and 29 (8) in ER. Among female athletes, scores were 30 (8) in EA, 28 (9) in EC, and 28 (8) in ER. Significant differences were found between male and female athletes in the three dimensions of emotional intelligence ( $p < 0.001$ ). Female athletes scored higher in EA while male athletes were higher in EC and ER. **Tables 3, 4** show the relationships between the profile of sports practice and the dimensions of EI according to gender.

For the male athlete group, our results showed relationships between ER and training frequency ( $p = 0.002$ ) and the competitive level ( $p = 0.013$ ); relationships were also found

between EA and the type of sport ( $p = 0.01$ ). Male athletes who do sports for more than 2 days/week had higher ER than those who do sport 1 or 2 days a week. Those that compete at a national or international level had better ER than those that compete at the local or regional level; male athletes who practice an individual sport had higher EA than male athletes who practice team sports (**Table 3**).

For female athletes, there was a relationship between EC and the age of starting practicing sports ( $p = 0.002$ ). Thus, female athletes who started sports later had higher outcomes in EC (**Table 4**).

## DISCUSSION

This study analyzed the possible associations between sports experience (the type of sport; the number of years participating in sports; the number of different sports practiced; the highest level achieved in competition) and dimensions of EI (EA, EC, and ER) among undergraduate athletes.

The findings suggest significantly higher EA among athletes practicing individual sports compared to team sports. However, this relationship was weak. Previous studies showed no significant differences between the team and individual sports (Kajbafnezhad et al., 2011; Ghaderi and Ghasemi, 2012; Laborde et al., 2014, 2017). Likewise, Castro-Sánchez et al. (2018a; 2018b) found that EI correlates more strongly with team sports than individual sports athletes, finding significant differences in emotional self-management (similar to ER, assessed using the Schutte Self Report Inventory). However, there was no

**TABLE 2 |** Associations and differences between emotional intelligence dimensions and sports experience.

	EA	EC	ER	p			d		
				EA	EC	ER	EA	EC	ER
<b>Number of practiced sports<sup>a</sup></b>	−0.038	0.035	0.076	0.11	0.142	<b>0.001</b>	0.08	0.07	0.15
<b>Years practicing sports<sup>a</sup></b>	−0.073	0.021	0.059	<b>0.002</b>	0.382	<b>0.012</b>	0.15	0.04	0.12
<b>Starting age of sports practice<sup>a</sup></b>	0.067	0.042	0.008	<b>0.004</b>	0.077	0.74	0.13	0.08	0.02
<b>Training frequency</b>									
Seasonal <sup>1</sup>	30 (25–35)	28 (23–31)	28 (23–30)	0.092	0.046	<b>&lt;0.001</b>	0.09	0.11	0.18
Less than 1 day/week <sup>2</sup>	29 (23–32)	28 (22–32)	29 (22.5–32)						
1–2 days/week <sup>3</sup>	30 (25–33)	28 (23–32)	28 (24–32)						
More than 2 days/week <sup>4</sup>	29 (24–33)	28 (24–32)	29 (25–33)						
<b>Type of sport</b>									
Individual <sup>1</sup>	30 (25–34) <sup>2</sup>	28 (24–32)	29 (25–33)	<b>&lt;0.001</b>	0.865	0.069	0.23	0.08	0.10
Team <sup>2</sup>	28 (24–32) <sup>1</sup>	28 (24–32)	28 (24–32)						
Combat <sup>3</sup>	29 (25–33)	28 (23–32)	29 (24–32)						
Outdoor <sup>4</sup>	29 (24.5–33)	28 (24–32)	29 (24.5–32)						
Others <sup>5</sup>	29.5 (25–34)	28 (23–32)	27 (23–31)						
<b>Competitive level</b>									
Not competitive <sup>1</sup>	30 (25–34) <sup>2,3</sup>	28 (24–32)	29 (25–32)	<b>&lt;0.001</b>	0.207	0.028	0.21	0.05	0.11
Local/regional <sup>2</sup>	28 (24–32) <sup>1</sup>	28 (23–32)	28 (24–32)						
National/international <sup>3</sup>	29 (25–32) <sup>1</sup>	28 (24–32)	30 (26–33)						

Results are expressed in median (Quartile 1–Quartile 3). <sup>a</sup>Results are Spearman correlation coefficients. EA, emotional attention; EC, emotional clarity; ER, emotional repair; p, p-value; d, d-Cohen. Superscript numbers reflect statistically significant differences between categories with Bonferroni adjustment in each EI dimensions. Bold values are statistically significant results ( $p < 0.016$ ).

**TABLE 3 |** Associations and differences between emotional intelligence dimensions and sports experience for male athletes.

	EA	EC	ER	p			d		
				EA	EC	ER	EA	EC	ER
<b>Number of practiced sports<sup>a</sup></b>	−0.001	0.008	0.065	0.98	0.823	0.085	<0.01	0.02	0.13
<b>Years practicing sports<sup>a</sup></b>	−0.089	0.017	0.039	0.018	0.646	0.299	0.18	0.03	0.08
<b>Starting age of sports practice<sup>a</sup></b>	0.079	0.01	−0.015	0.036	0.8	0.691	0.16	0.02	0.03
<b>Training frequency</b>									
Seasonal <sup>1</sup>	31 (30–36)	29 (24–33)	28 (23–30)						
Less than 1 day/week <sup>2</sup>	27.5 (22–32)	30 (24–32)	30.5 (24–32)	0.157	0.358	<b>0.002</b>	0.11	0.04	0.26
1–2 days/week <sup>3</sup>	28 (24–32)	28 (24–32)	28 (24–32) <sup>4</sup>						
More than 2 days/week <sup>4</sup>	27 (23–32)	29 (25–32)	30 (26–33) <sup>3</sup>						
<b>Type of sport</b>									
Individual <sup>1</sup>	28 (24–33) <sup>2</sup>	30 (25–32)	30 (25–33)	<b>0.010</b>	0.316	0.257	0.23	0.07	0.09
Team <sup>2</sup>	27 (22–31) <sup>1</sup>	28 (24–32)	28.5 (25–32)						
Combat <sup>3</sup>	30 (25–33)	29 (23–32)	29 (24–32)						
Outdoor <sup>4</sup>	26 (24–32)	30 (25–32)	29 (26–32)						
Others <sup>5</sup>	28.5 (25–31)	28 (24–31)	29.5 (26–34)						
<b>Competitive level</b>									
Not competitive <sup>1</sup>	28 (24–33)	29 (25–32)	29 (25–33)	0.162	0.375	<b>0.013</b>	0.10	0.02	0.20
Local/regional <sup>2</sup>	27 (22.5–32)	28 (24–32)	28 (24–32) <sup>3</sup>						
National/international <sup>3</sup>	28 (24–31)	29 (26–32)	30 (27–33) <sup>2</sup>						

Results are expressed in median (Quartile 1–Quartile 3). <sup>a</sup>Results are Spearman correlation coefficients. EA, emotional attention; EC, emotional clarity; ER, emotional repair; p, p-value; d, d-Cohen. Superscript numbers reflect statistically significant differences between categories with Bonferroni adjustment in each EI dimensions. Bold values are statistically significant results ( $p < 0.016$ ).

**TABLE 4 |** Associations and differences between emotional intelligence dimensions and sports experience for female athletes.

	EA	EC	ER	p			d		
				EA	EC	ER	EA	EC	ER
<b>Number of practiced sports<sup>a</sup></b>	−0.026	0.028	0.066	0.395	0.356	0.030	0.05	0.06	0.13
<b>Years practicing sports<sup>a</sup></b>	−0.009	−0.01	0.058	0.757	0.746	0.059	0.02	0.02	0.12
<b>Starting age of sports practice<sup>a</sup></b>	0.023	0.094	0.046	0.458	<b>0.002</b>	0.128	0.05	0.19	0.09
<b>Training frequency</b>									
Seasonal <sup>1</sup>	29.5 (25–33.5)	27 (22–31)	27.5 (23.5–31.5)						
Less than 1 day/week <sup>2</sup>	30 (25–36)	27 (22–32)	28 (22–30)	0.376	0.321	0.103	0.02	0.04	0.11
1–2 days/week <sup>3</sup>	30 (26–34)	27 (23–32)	28 (24–32)						
More than 2 days/week <sup>4</sup>	30 (25–34)	28 (24–32)	29 (25–32)						
<b>Type of sport</b>									
Individual <sup>1</sup>	30 (26–34)	28 (23–32)	29 (25–32)	0.107	0.463	0.044	0.12	0.04	0.15
Team <sup>2</sup>	30 (26–33)	27 (23–30)	28 (24–32)						
Combat <sup>3</sup>	29 (23–31)	27.5 (23–32)	28 (24–32)						
Outdoor <sup>4</sup>	30 (25–34)	27 (24–31)	28 (23–32)						
Others <sup>5</sup>	30.5 (25.5–34)	27.5 (22.5–32)	27 (22.5–30)						
<b>Competitive level</b>									
Not competitive <sup>1</sup>	30 (26–34)	28 (23–32)	29 (25–32)	0.064	0.056	0.579	0.11	0.12	0.06
Local/regional <sup>2</sup>	29 (25–33)	27 (22–31)	28 (24–32)						
National/international <sup>3</sup>	29 (26–33)	27 (24–31.5)	29 (25–34)						

Results are expressed in median (Quartile 1–Quartile 3). <sup>a</sup>Results are Spearman correlation coefficients. EA, emotional attention; EC, emotional clarity; ER, emotional repair; p, p-value; d, d-Cohen. Superscript numbers reflect statistically significant differences between categories with Bonferroni adjustment in each EI dimensions. Bold values are statistically significant results ( $p < 0.016$ ).

significant difference in emotional perception (similar to EA, assessed using the Schutte Self Report Inventory). Our results suggest that athletes practicing individual sports tend to observe and think about their feelings and moods more than

athletes of team sports. Those athletes who face the emotional demands of sports autonomously probably feel and express their emotions more easily than those who are subjected to the judgment of teams or leaders. This may be a problem

since higher EA is related to excessive reactions to negative emotions (Yiend, 2009) and poorer emotional adjustment (Fernández-Berrocal et al., 2005). Athletes practicing individual sports face their sporting experiences alone and, thus, some individual athletes tend to ruminate on their mistakes and criticized themselves, creating a loop of negative emotions. However, when team sport athletes make mistakes, the group can help their teammates into a better emotional state. This may be interesting for sports psychologist interventions depending on the type of sport. Furthermore, our results also suggest that the experience, measured in quantity (number of years practicing sports) and the quality of the experience (competition level), is related to a lower EA. Thus, experience and sporting prowess may be associated with better emotional adjustment (Fernández-Berrocal et al., 2005; Laborde et al., 2011). This may be because the demands of the sport lead the athlete to maintain an optimal emotional state for his performance. These results are in line with the findings showing that experts cope better with stress (Johnson et al., 2006; Laborde et al., 2013).

Our results showed that the number of years practicing sports is significantly and positively correlated to a higher ER, although the size effect was weak, similar to the majority of the associations found in our research. Laborde et al. (2014) found no correlation between total EI and the number of years of sports training. However, assuming that high-level athletes practice more than others, various studies have found that high-level athletes show higher ER than low-level athletes (Saies et al., 2014; Merino et al., 2019, 2020). This may be because strategies to regulate emotions become crucial in sports (Jones, 2003), and a number of techniques have been developed in sports psychology aimed to achieve optimal performance (Lane et al., 2010). These techniques may be learned by athletes to improve their performance pre, during, and post-competition (Robazza et al., 2004; Gould and Maynard, 2009). As seen in other articles (Saies et al., 2014; Merino et al., 2019), one could assume that a higher level of competition is associated with higher ER; however, our results have not been significant. This data is consistent because athletes who practice more years and different sports showed higher levels of ER. Furthermore, there is an association between ER and the ability to control intrusive and ruminative thoughts that, often, accompany stressful situations (Salovey et al., 1995). This could be crucial for sporting performance, as those athletes who recover from negative emotional states will perform better.

Regarding EC, no associations or relations were found with any studied variable. We should highlight that the results are within the reference values for all EI dimensions. These parameters were described by the TMMS-24 tool (Fernández-Berrocal et al., 2004). However, ER and EC could be improved to reach excellent values. It seems that, from a performance point of view, it is more interesting for athletes to attend to and value their feelings and use positive thoughts to repair negative moods, instead to feel their feelings clearly.

Due to the controversial results between sports experience and EI variables, more studies should be carried out to understand these relationships more deeply which could be of great use to sports psychologist and coaches even though previous studies

have demonstrated that EI training can be improved in the sports context (Lane et al., 2009; Campo et al., 2016).

The secondary aim of the present study was to describe the possible relationship between EI and sports experience in male and female athletes. The differences found between levels of EI is supported by previous studies (Laborde et al., 2014, 2016b, 2017; Castro-Sánchez et al., 2018a,b), and they encourage further study into the possible relationships between EI and sports experience manifested themselves in the subgroups (male and female athletes). Female athletes achieved higher scores in EA, which is in line with the findings of Merino et al. (2020) in combat sports. However, this study found no differences in EC and ER domains where our results showed that male athletes had significantly higher EC and ER than female athletes. Male athletes who trained more and had a higher competitive level are more likely to show higher ER. Thus, ER may be related to a higher sports performance than the other dimensions (EA and EC) for male athletes. These results are partly in line with the findings of Merino et al. (2020) in which athletes from the high-level group showed higher ER and EC than low-level athletes. Our results support the idea that different strategies according to gender should be considered in the context of sports to improve performance related EI skills (Hanin, 2000, 2010; Lazarus, 2000; Jones, 2003; Campo et al., 2012).

Our study has some limitations. The cross-sectional design means that we were unable to infer causal relationships among the analyzed variables. Longitudinal studies would be required to establish cause-effect relationships and track the changes in EI during sports practice. However, a methodological strength of the study is the use of TMMS-24 as a measurement instrument in a large sample of undergraduates in Madrid, which was representative in terms of academic disciplines. The statistical analyses were limited because of the difference between the compared groups. The data did not meet the assumptions to carry out parametric tests. These facts compromised the study of interactions, which could have been carried out with some types of factorial MANOVA or linear or polynomial regressions. So, we recommend taking these limitations into account to improve the design of future research. Furthermore, it should be noted that the effect sizes were low in all significant associations. Future research should study how different sports experience variables are related to EI dimensions and how these relationships can be module according to gender within large samples and specifically among sports modalities. Future studies should identify which EI dimensions are related to high performance among sports modalities. This information would be useful for coaches and sports psychologists who work with high-performance athletes because, under highly equitable technical and tactical circumstances, adequate emotional management could make the difference between winning or losing (Magrum et al., 2019).

Despite its limitations, the current study provides insight into the potential relationships between sports experience and EI. Our research did not find a close relationship but did find certain degrees of associations. Specifically, those athletes who play individual sports for fewer years and who do not compete show a higher EA, while ER was positively related to the number of years practicing sports and the number of



sports practiced. No associations were found between EC and sports experience. Regarding gender, EI scores showed significant differences. Female athletes showed higher EA and male athletes showed higher EC and ER. Furthermore, relationships between EI and sports experience in male athletes showed that men who trained more and had a higher competitive level were more likely to show higher ER. Therefore, it is likely that ER may be related to higher sports performance than the other EI dimensions (EA and EC) for male athletes. However, all of these relationships were found to be weak, and thus, the conclusions of the present study should be interpreted considering this premise. Consequently, more research is needed to understand how these relationships work.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Research Committee of Universidad Francisco de Vitoria (40/2018). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

GR-R, CB-G, and JA-S: conceptualization. ID-V: formal analysis. GR-R: funding acquisition and project administration. JA-S: investigation and supervision. ID-V, GR-R, and JA-S: methodology and writing – original draft. CB-G, ID-V, JA-S, and GR-R: writing – review and editing. All authors contributed to the article and approved the submitted version.



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# Psychological Profile and Competitive Performance in Group Aesthetic Gymnastics

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The objective of the research was to evaluate the perceptions about the psychological variables of cohesion and motivational climate that AGG gymnasts have about the context created by the coaches in their teams and to analyze in the different categories the optimism and competitive anxiety they face in competitive situations. In an attempt to clarify the psychosocial training patterns in this sport and the influence they have on the well-being of its practitioners, competitive anxiety, motivational climate, team cohesion and level of optimism were taken as dependent variables. The sample was made up of 98 national and international junior and senior athletes in the aesthetic gymnastics group aged 13 to 27 ( $M = 17.1$ ;  $SD = 2.8$ ). The Perceived Motivational Climate in Sport Questionnaire for motivational climate, the Sport Anxiety Scale-2 for competitive anxiety, the Group Environment Questionnaire for cohesion and the Revised Life Orientation Test for optimism were used in the evaluation. The results obtained show a positive and statistically significant correlation between anxiety and ego involvement, while, for task involvement, high levels of cohesion are associated with high levels of optimism ( $p = 0.005$ ). In conclusion, the data confirm that high levels of cohesion are associated with high levels of optimism, in addition high scores on task involvement show high scores on cohesion and optimism, however high scores on ego involvement are associated with low scores on cohesion and optimism.

**Keywords:** sport, competitive anxiety, optimism, motivational climate, cohesion

## INTRODUCTION

Sporting competition requires challenges and demands resilience from athletes, to adapt to change and overcome difficult situations. The Aesthetic Group Gymnastics (AGG) assists with the execution of the choreographies performed by groups of 6 to 12–14 gymnasts, depending on the category. The choreographies must include the mandatory elements (waves, swings, jumps, balances, and so forth) that are specified in the scoring regulations (IFAGG, 2017).

Sport generates high levels of stress and anxiety (Hanton et al., 2015). Practicing and employing a variety of psychological strategies to combat possible negative emotional states, such as sports-related anxiety, has become part of the training of athletes (Weinberg and Gould, 2015). Anxiety is a transient emotional state manifested by feelings of subjective tension and apprehension, which cause an increase in the autonomous nervous system activity linked to brain function and anchored to basic psychological processes, such as attention, perception, memory, emotion

and thought (Spielberger and Guerrero-Díaz, 2002). Understanding that competitive anxiety is a context-specific distress that would appear systematically before or during the competition, from a perspective of the Theory of self-determination, it should be considered an indicator of contextual distress (Ramis et al., 2017). The theory of drive proposes the relationship between performance and state anxiety as linear, with greater anxiety leading to better performance (Hull, 1943). Athletes tend to perceive stressful situations as challenges and opportunities for growth and development (García-Secades et al., 2014).

Anxiety is also related to sociodemographic variables such as age and gender in sports contexts, as it is multifactorial (González-Hernández et al., 2020). Less experienced athletes tend to have greater uncertainty due to the unknown, which generates higher levels of pre-competition anxiety (Vaca et al., 2017). Athletes with lower levels of anxiety perform better in competition while those with high levels of anxiety perform worse (Ngo et al., 2017). Other authors such as Woodman and Hardy (2003) indicate a significant negative association between anxiety and competitive performance. Rocha and Osório (2018) conclude from their meta-analysis that athletes with less competitive experience have higher levels of anxiety than those with more competitive experience.

In the field of sport, the concept of motivational climate reflects the structure of objectives and situations of the environment generated by important people (coaches, parents) accepting the predictive value for sport-related results (Harwood et al., 2015). Motivation is one of the most studied psychological factors in sports psychology and by sports performance researchers (Castro-Sánchez et al., 2019a,b). Studies agree that the type of climate that coaches create may be related to the perceptions of their athletes and the cohesion of the team (Heuze et al., 2006), although this factor depends to a large extent on the ages of the athletes, where older athletes appear to be more influenced by the model transmitted by the coach (Gardner et al., 1996). Already predicted by Duda (2001) is the climate-cohesion motivation relationship based on the structural components of the climate created by the coaches. This was later contrasted with substantial empirical evidence showing that perceptions of a climate involving tasks are associated with a more adaptive pattern of achievement (Duda and Balaguer, 2007). Heuze et al. (2006) demonstrated the existence of links between the motivational climate, perceived team cohesion and collective effectiveness. When the coach and the athlete work in a positive motivational climate, group cohesion also improves (Heuze et al., 2018).

The cohesion of a sports team is understood as a dynamic process reflected in the group's tendency to remain united in the search for an objective that meets the affective needs of the members (Carron et al., 1985). Cohesion involves both individual and group components, respecting individual differences and/or potentialities and perceptions concerning the team's task and commitment to social unity (Carron et al., 1985; Horn et al., 2012). Cohesion is often identified as a simple relationship of friendship, but in a group, it is important to verify the orientation of the task in order to achieve a determined and inspiring

goal shared by all team members (Di Onofrio et al., 2019). The findings of Prapavessis and Carron (1996) revealed that cohesion and anxiety were associated. Furthermore, Eys et al. (2003) indicate that being part of a cohesive group leads to greater group effectiveness. Cohesion has been shown to be a determining factor in collective sports such as football, basketball and handball (Galatti et al., 2015; Olmedilla et al., 2015; Ureña et al., 2015). In a group setting, one variable that is consistently related to perceptions of cohesion is the motivational climate (McLaren et al., 2017).

Some authors such as West et al. (2009) already indicated that it is necessary to identify relevant determinants for specific groups and goals (or outcomes), such as team optimism. The Psychology of Positive Emotions theory proposes that intelligent optimism is the ability to face adversity as a challenge and not a threat, thereby turning crises into opportunities (Avia and Vázquez, 1998). In terms of performance sport, it highlights two significant variables associated with successful athletes, namely optimism and competitiveness (García-Naveira and Díaz, 2010; De la Vega et al., 2012; Ortín et al., 2013). Seligman et al. (1990) investigated the relationship between optimism and athletic performance and found that optimistic people matched and even improved their performances after an unfavorable performance, and these results were strengthened in subsequent studies (Martin-Krumm et al., 2003; Ortín et al., 2011). Optimism is not only a cold cognition, but it is also motivational and motivating (Urrea, 2015). Athletes tend to exhibit greater mental strength than non-athletes, which contributes positively to optimism and sports resilience (Guillén and Laborde, 2014; Reche et al., 2014; Cowden et al., 2016). Mental strength is divided into three aspects: Physical (Physical Self-Concept), Emotional (Motivation and Sporting Commitment), and Mental (Resilience and Optimism) helping the athlete to develop their capabilities as a whole in order to achieve sporting success (Carr, 2010).

Most scientific studies on gymnastics, especially concerning the modalities of rhythmic gymnastics and artistic gymnastics, are based on anthropometric profiles and body composition (Carter and Heath, 1990; Carter and Ackland, 1994; Drinkwater and Mazza, 1994; Norton and Olds, 1996; Yústiz et al., 2015); type of complexion (Lisitskaya, 1995); technical-tactical and specific performance factors (Lisitskaya, 1995; Fasting et al., 2000; Fernández, 2001; Martínez-Gallego, 2004); energy requirements, limiting factors and fatigue associated with training and competition (Terrados et al., 2011); analyses of the effects of competition on retired rhythmic gymnasts (Mendizábal, 2000); burnout and optimism in rhythmic trainers (Saquero et al., 2018); nutritional, anthropometric, and psychological aspects of rhythmic gymnastics (San Mauro et al., 2016); case studies on psychological interventions in rhythmic gymnastics (Álvarez-Solves et al., 2013) and psychological training in elite sports gymnastics (Fournier et al., 2005).

From the psychosocial point of view of groups in the sporting context, numerous studies have been carried out that emphasize the importance of exploring and explaining the relationships established between group variables and how they affect individual performances and well-being within the team (Duda and Balaguer, 2007; Ortín et al., 2011; García-Naveira

et al., 2015; Suárez, 2018). However, within AGG, there are no studies, to the best of the authors' knowledge, that have analyzed all these variables.

This makes us consider the following objectives: (i) to know the psychological variables of cohesion and motivational climate of GGA gymnasts according to categories; (ii) analyze the optimism and competitive anxiety faced by gymnasts, according to marital status, educational level and different categories, in competitive situations; (iii) to determine the effect of the variables, category and years competing, as well as the motivational climate, group cohesion and optimism on competitive anxiety. This allows us to make the following hypotheses (h1) The lower the sports category, the greater the anxiety, (h2) The greater the optimism, the less the anxiety.

## MATERIALS AND METHODS

### Sample

Two-hundred twenty gymnasts who participated in the First Phase of the Spanish Group Aesthetic Gymnastics Cup (2018–2019) in the junior (13–16 years) and senior (>16 years) categories were considered for inclusion. The final sample consisted of 98 female gymnasts, aged between 13 and 27, with an average age of around 17 years old ( $M = 17.1$ ;  $ST = 2.8$ ). In this sample, 44.05% of the gymnasts were in the junior category (13–16 years), with the remainder, or 55.95%, in the senior category (>16 years). The gymnasts had been competing for an average of 8.7 years ( $SD = 3.4$ ). In addition, 86% of the gymnasts were single, and 14% were married. Just over half (51%) of the gymnasts had received a secondary education, 30.2% had received a primary education and 18.8% other qualifications. The number of hours that the gymnast trained was similar, namely 6–12 h per week, distributed across 4–6 sessions of 2.5 to 3 h in duration.

### Instruments

To measure the motivating climate level, we used the second version of the Perceived Motivational Climate in Sport Questionnaire (PMCSQ-2) prepared by Newton et al. (2000), which was validated in Spanish by Balaguer et al. (1997). It consists of two correlated variants that measure the degree to which athletes perceive that the coach creates a climate of involvement in the task or a climate of involvement in the ego. The PMCSQ-2 questionnaire for set sports consists of 29 items: 15 oriented toward the climate of involvement in the task, and 14 oriented toward ego involvement. The response format consists of a five-point Likert scale ranging from 0 for “strongly disagree” to 4 for “strongly agree.” Internal consistency analyses found 0.80 Alpha Cronbach ( $\alpha$ ) coefficients for both the climate scale involved in the task and for the climate scale involved in the ego.

To measure the anxiety-specific trait in sports competition, we used the Sport Anxiety Scale-2 (SAS-2) (Smith et al., 2006) adapted for Spanish by Ramis et al. (2010). The questionnaire has 15 items divided into three subscales with 5 items each: Somatic Anxiety (AS), Concern (P), and Deconcentration (D). Each item is answered with a score from a 4-point Likert scale ranging from 1 (nothing) to 4 (much). Total scores per subscale

are obtained from the sum of the scores of the items within the subscale and can range from 5 to 20, where, for example, a low anxiety score means that there is a low probability that a person will be anxious, and a high score indicates a tendency to become anxious in a competitive situation. The total score, which measures competitive sensitivity, is the sum of the scores for all items and ranges in value from 15 and 60. In terms of consistency, the  $\alpha$  for the somatic scale was 0.83, whereas it was 0.78 for the worry scale and 0.73 for the deconcentration scale.

To assess group cohesion in sports environments, the Spanish adaptation of the Group Environment Questionnaire (GEQ) (Carron et al., 1985) developed by García-Calvo (2006) was used. It consists of 12 positive elements, grouped into four factors with three items each: Social Group Attraction (AGS), Group Attraction to Task (AGT), Social Integration (IS) and Integration to the Task (IT). Total group cohesion is calculated with the sum of the scores of all items. Each item is measured on a 9-point Likert scale, ranging from strongly disagree (1) to totally agree (9). Both the dimensions and the global cohesion factor (GEQ) have  $\alpha$ 's above 0.70.

The Revised Life Orientation Test (LOT-R) developed by Scheier et al. (1994) was used to measure the level of dispositional optimism or widespread predisposition toward expectations of positive outcomes (Otero et al., 1998), validated by Ferrando et al. (2002) to the Spanish language. Composed of 10 items, in which subjects indicate the degree of agreement or disagreement with statements such as “in difficult times, I generally hope for the best,” it uses a scale of 5 points, where 0 corresponds to “strongly disagree,” and 4 corresponds to “strongly agree.” Four of the items are used for control or fill, three items are skewed positive (optimistic) and three are skewed negative (pessimistic). With regard to the correctness and interpretation of the test, there are two options (Ferrando et al., 2002): on the one hand, each skew can be measured separately; on the other hand, total optimism can be measured by reversing the scores of the items drafted with a negative skew. The coefficients of internal consistency were 0.75 for optimism and 0.69 for pessimism. Different works have supported working with two factors (Mroczek et al., 1993; Myers and Steed, 1999), an option we adopted.

### Procedure

The sample consisted of gymnasts from the junior and senior categories present in the First Phase of the Spanish Cup of AGG of the 2018–2019 season and was selected with authorization from the Spanish Association of Aesthetic Group Gymnastics (SAAGG). The participating clubs had been contacted prior to the cup with information on the objectives of the investigation, anonymity, confidentiality of the data and informed consent, so that minors could bring a consent form signed by their parents or legal guardians to the championship. All gymnasts who decided to participate brought or signed (if they were of legal age) their consent forms and answered the questionnaire on the day of the competition between 30 and 60 min after the competition. Everyone received the same information through the protocol designed for this purpose: they were exposed to the objectives, reminded of confidentiality and given instructions on how to complete the questionnaire. The organization sponsoring the



event arranged for a room attached to the competition zone to be used for the completion of the questionnaires. The questionnaires were administered by research personnel, who were trained for this purpose and present to explain the dynamics and answer any questions. The average time to complete the questionnaire was 10–15 min. The approval of the Research Ethics Committee of the University of Murcia was requested, which determined that the study, despite using human subjects, was observational and did not contain ethical aspects; therefore, it did not require the approval of the committee.

## Statistical Data Analysis

For the qualitative variables (marital status, educational level) the number of cases present in each category and their corresponding percentages were calculated. For the quantitative variables, the minimums, maximums, means, and standard deviations were computed. The Student's *t*-test was used for the comparison of the means between two groups after testing the assumption of normality with the Kolmogorov-Smirnov test and the assumption of variance homogeneity with the Levene test. The size of the effect was measured by *d* de Cohen, values below 0.2 indicate a small effect size, 0.5 of medium magnitude and 0.8 indicate a high effect size (Cohen, 1988). To study the possible relationship between two variables, Pearson's linear correlation coefficient (*r*) was calculated. The reliability of the scales was studied using the Cronbach *alpha* coefficient ( $\alpha$ ). A multiple linear regression model was developed to determine the possible effects of the demographic variables, competition category and years competing years and the scales of the motivating climate perceived in sport, total group cohesion and optimism on competitive anxiety. The statistical analyses were performed with the SPSS 25.0 program for Windows. The differences were considered statistically significant  $p < 0.05$ .

## RESULTS

**Table 1** describes the dimensions of the different scales used in the study and their reliability values  $\alpha$ . With regard to the motivating climate in both dimensions, the  $\alpha$  is  $>0.85$ , whereas the  $\alpha$ 's for competitive anxiety range from 0.84 to 0.88, with an  $\alpha$  of 0.88 for total team environment. Their respective dimensions range from 0.81 for social integration to 0.88 for integration with the task. The reliability of the scales is high, with values ranging from 0.81 and 0.88, with the highest consistency index being that of the Total Cohesion Equipment Environment scale ( $\alpha = 0.889$ ).

In terms of age and the different scales, the Pearson's linear correlation coefficient values showed a statistically significant negative relationship with ego involvement ( $r = -0.228$ ,  $p = 0.036$ ), meaning that the older the gymnast, the lower the involvement of the ego. On the competitive anxiety scale, age showed a negative and statistically significant relationship with concern ( $r = -0.221$ ,  $p = 0.038$ ); therefore, older gymnasts exhibit less concern. A negative and statistically significant relationship was shown with the pessimism of the LOT-R scale ( $r = -0.221$ ,  $p = 0.044$ ), indicating that older gymnasts have less pessimism. No statistically significant relationships were observed on all other scales and dimensions.

**TABLE 1 |** Descriptive and reliability of scales.

	Min.–Max.	Average (SD)	Alpha cronbach
<b>Motivating climate</b>			
Involvement in the task	43–88	66.38 (6.82)	0.855
Involvement in the ego	19–62	34.75 (9.25)	0.869
<b>Competitive anxiety</b>			
Total	19–120	61.22 (17.64)	0.846
Somatic anxiety	5–40	20.39 (7.54)	0.882
Concern	8–40	27.85 (6.87)	0.868
Deconcentration	5–40	12.98 (6.65)	0.84
<b>Team environment</b>			
TOTAL cohesion	46–120	98.63 (12.37)	0.889
Social group attraction	3–30	24.97 (4.13)	0.861
Group attraction task	12–30	24.38 (3.46)	0.843
Social integration	7–30	24.61 (3.74)	0.816
Task integration	12–30	24.67 (3.32)	0.883
<b>LOT-R optimism</b>			
Total	3–23	14.6 (4.17)	0.853
Optimism	1–15	8.07 (2.57)	0.888
Pessimism	0–15	5.51 (2.89)	0.819

In relation to the scores on the different scales according to marital status (single/married), as well as the results of the *t*-tests performed to compare the scores of single and married gymnasts, the results of the competitive anxiety scale showed that there are statistically significant competitive differences in the total score ( $p = 0.041$ ) and in the dimension of concern ( $p = 0.006$ ), resulting in the scores of the single gymnasts being significantly higher than those of the married gymnasts. No statistically significant differences were observed between single and married gymnasts on the rest of the scales and dimensions.

In relation to the categories the gymnasts were in, **Table 2** provides the descriptions of the scores for the scales by sports category, as well as the results of the *t*-tests performed to compare the scores of the junior (13–16 years) and senior ( $>16$  years) categories. For the competitive anxiety scale, the results showed that there are statistically significant differences in the total score ( $p = 0.021$ ) and in the dimensions of concern ( $p = 0.001$ ) and deconcentration ( $p = 0.052$ ), where the scores of junior athletes (13–16 years) were significantly higher than those of senior athletes ( $>16$  years). Considering that the effect size for ego involvement, total anxiety and worry is high and for deconcentration it is medium. No statistically significant differences between juniors and senior were observed for all other scales.

When examining the possible relationships between competition years and the different scales used in the research (PMCSQ-2, SAS-2, GEQ, LOT-R), it was found by applying Pearson's linear correlation coefficient; that for the competitive anxiety scale, competition years showed a negative and statistically significant relationship with deconcentration ( $r = -0.215$ ,  $p = 0.032$ ), meaning that the greater the number of years



**TABLE 2 |** Descriptive and comparative scores scales by category.

	Category		Average difference	t-Test		d
	Junior	Senior		t(38)	p-value	
<b>Motivating climate</b>						
Involvement in the task	66.12 (7.14)	66.52 (6.69)	−0.4	−0.273	0.786	−0.06
Involvement to the ego	39.03 (9.94)	32.44 (8.03)	6.59	3.323	<b>0.002</b>	0.75
<b>Competitive anxiety</b>						
Total	66.94 (17.72)	58.13 (16.95)	8.81	2.373	<b>0.021</b>	0.51
Somatic anxiety	21.32 (7.5)	19.89 (7.58)	1.43	0.896	0.374	0.19
Concern	30.68 (5.63)	26.32 (7.03)	4.36	3.326	<b>0.001</b>	0.66
Deconcentration	14.94 (7.78)	11.92 (5.74)	3.02	1.99	<b>0.052</b>	0.46
<b>Team environment</b>						
TOTAL cohesion	99 (9.78)	98.43 (13.64)	0.57	0.238	0.812	0.05
Social group attraction	25.56 (2.23)	24.65 (4.84)	0.91	1.261	0.21	0.22
Group attraction task	24.21 (3.23)	24.48 (3.6)	−0.27	−0.378	0.707	−0.08
Social integration	24.47 (3.38)	24.68 (3.95)	−0.21	−0.278	0.782	−0.06
Task integration	24.76 (2.94)	24.62 (3.53)	0.14	0.216	0.829	0.04
<b>LOT-R optimism</b>						
Total	14.2 (3.76)	14.79 (4.37)	−0.59	−0.674	0.503	−0.14
Optimism	7.94 (2.81)	8.14 (2.46)	−0.2	−0.353	0.726	−0.08
Pessimism	5.79 (2.9)	5.35 (2.9)	0.44	0.721	0.473	0.15

Data in bold indicate significant differences with  $p < 0.05$ .

**TABLE 3 |** Correlations between scales.

	Anxiety	Task involvement	Ego involvement	Cohesion	Optimism
Anxiety	1				
Task involvement	−0.063	1			
Ego involvement	0.348***	−0.084	1		
Cohesion	0.094	0.493***	−0.204*	1	
Optimism	−0.163	0.265**	−0.209*	0.263**	1
Pessimism	0.312**	−0.123	0.429***	−0.008	−0.135

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

of competition, the less deconcentration. On the other hand, the years of competition also had a statistically significant and negative relationship with the pessimism on the LOT-R scale ( $r = -0.207$ ,  $p = 0.038$ ), i.e., the more years of competition, the less pessimism. No statistically significant relationships were observed for all other scales and dimensions.

**Table 3** shows the Pearson's linear correlation values between the different scales of the study. Anxiety correlates positively and statistically significantly with ego involvement ( $p < 0.001$ ) and pessimism ( $p < 0.01$ ). With regard to the scale for the motivating climate perceived in sport, involvement in the task correlates positively and statistically significantly with cohesion ( $p < 0.001$ ) and optimism ( $p < 0.01$ ), so high scores on involvement in the task are associated with high scores on cohesion and optimism. On the contrary, the involvement of the ego correlates negatively and statistically significantly with cohesion ( $p = 0.032$ ) and

optimism ( $p = 0.034$ ), so high scores on ego involvement are associated with low scores on cohesion and optimism. Finally, cohesion correlates positively and statistically significantly with optimism, so high levels of cohesion are associated with high levels of optimism ( $p < 0.05$ ).

To determine the possible effects of the demographic variables, competition category and years competing, and the scales of the motivating climate perceived in sport, total cohesion of the group and optimism in competitive anxiety, a multivariate linear regression model was developed, as shown in **Table 4**. The model was statistically significant [ $F_{(7,89)} = 3.51$ ,  $p = 0.002$ ] and explained 21.7% of the variability in anxiety. The ego implication dimension of the perceived motivating climate scale in sport had a significant effect ( $p = 0.039$ ), meaning that high levels of ego involvement are associated with high levels of anxiety. The rest of the variables did not show statistically significant effects.

**TABLE 4 |** Linear regression.

	<b>B (ET)</b>	<b>Beta</b>	<b>T</b>	<b>p-value</b>
Category (senior vs. junior)	−4.30 (4.36)	−0.117	−0.987	0.326
Years competing	−0.16 (0.59)	−0.03	−0.262	0.794
Task involvement	−0.28 (0.29)	−0.109	−0.983	0.328
Ego involvement	0.46 (0.22)	0.242	2.09	<b>0.039</b>
Cohesion	0.31 (0.16)	0.22	1.945	0.055
Optimism	−0.82 (0.69)	−0.119	−1.18	0.241
Pessimism	0.99 (0.67)	0.162	1.472	0.145

*B, Non-standardized regression coefficient; ET, Typical error; Beta, standardized regression coefficient. Data in bold indicate significant differences with  $p < 0.05$ .*

## DISCUSSION

The objective of the research was to assess the perceptions about the psychological variables of cohesion and motivational climate that AGG gymnasts have about the context created by the coaches in their teams and to analyze in the different categories the optimism and competitive anxiety they face in competitive situations.

The lower the sports category, the greater the anxiety (h1). This is corroborated by previous studies by Hanton et al. (2008), Núñez and García (2017) and Mellalieu et al. (2004) Supported also by Pozo's (2007) study which assumes that athletes with greater competitive experience perceive anxiety as a facilitating factor. Presenting the highest (youth) scores on anxiety, according to a previous study by Hagan et al. (2017), this may be caused by the environment in which the athletes are immersed (i.e., a competitive environment). This is in contrast to Grossbard et al. (2009), who indicate that anxiety levels should be higher in the older categories compared to the younger ones, as the maturity and performance level is more demanding.

The greater the optimism, the less the anxiety (h2), is corroborated, supported by previous studies, as it has been shown by García-Naveira and Díaz (2010), that optimism is positively related to the performance of sportsmen and women, also in the line of Suárez (2018), indicating that optimism levels are inversely related to anxiety levels. This could be the case because the exposure to high stress stimuli such as competition generates more resilience for those sportsmen who present more optimism (Reche et al., 2014). Knowing that optimism is presented as a protective factor against anxiety [Pavez et al., 2012; Ortín et al. (2013)]. Since positive expectations about the future (optimism) increase efforts to achieve the goals (García-Naveira et al., 2015). Taking into account that optimism and the positive mood of the athlete are related to the effect of coping styles, which are the positive predictors of competition results (Wu and Dou, 2001; Qu et al., 2009).

The junior category in all dimensions reaches higher values than the data obtained in comparison with the senior category, since the novice or junior athletes, i.e., with less experience, tend to have more uncertainty caused by the unknown, which generates higher levels of anxiety before the competition (Vaca et al., 2017). Endorsed in previous studies with female athletes.

Patel et al. (2010) and in young competitive football players García-Mas et al. (2009). Junior athletes show higher cohesion values than senior ones, and the effect of group cohesion in teams depends on the type of task demanded by the sport performed (Canto and Hernández, 2005). For Leo et al. (2010) it seems obvious that cooperation favors cohesion, with cooperation in the GGA being a fundamental factor in obtaining results, although it is estimated that social cohesion can have a positive influence on team performance. Group cohesion is fostered by a collective evaluation of events, in which each player feels he has a useful role within the team, reconciled with a healthy attributional style in the experiences of failure (Pietro et al., 2016).

Involvement in the task correlated positively and statistically significantly with optimism. This could be because knowledge of the expectations of peers and coaches about gymnasts allows them to create more positive and controlled attitudes, decreasing the climate of ego involvement and increasing task orientation Fournier et al. (2005). Circumstance already contrasted in previous studies Cantón et al. (2013) with football players and in the line of Aranzana et al. (2016) in swimmers. Significant positive results have been obtained with regard to the involvement of gymnasts in their work and cohesion. In relation to that, perceptions of the motivational climate act as good predictors of cohesion, especially when a climate of task involvement is created, which provides greater attraction and integration in the group in both dimensions (Balaguer et al., 2003). Besides, in the studies by Duda and Balaguer (2007) and López-Walle et al. (2011), sportsmen show more adapted motivational patterns when they perceive a climate of involvement in the task, confirming the importance of the social context in the motivation of belonging to a sports team as Eccles et al. (2003). On the contrary, Avalos et al. (2015) show that despite the perception of a task-oriented motivational climate, sportsmen and women give more importance to the achievement of a result. This is in contrast to the results of Beal et al. (2003), who found no relationship between cohesion and task involvement.

On the contrary, high scores in ego involvement are associated with low scores in cohesion, a circumstance favored by the sociomotor space where the technical exercise in AGG takes place, limited in a small (13 × 13 m) and closed area, endorsed by previous studies Quested and Duda (2009), Iglesias et al. (2019). This aspect was highlighted in previous research, where basketball, volleyball, and handball are more socially cohesive than sports that take place in a large area such as rugby and football (Rusu (2020), as well as in Castro-Sánchez et al. (2019b) with judocas.

This research found that, at high levels of cohesion, gymnasts show high levels of optimism ( $p = 0.005$ ), finding no studies to ratify or refute this data. This circumstance is reinforced by the fact that cohesion is an emerging state that results from (and influences) other behavioral processes in which the team participates (McEwan and Beauchamp, 2014). This cohesion-optimism relationship is supported by the belief that the perceptions that individuals have about the cohesion of their team influence their behavior (Eys and Kim, 2017). This is highlighted in Bruner's et al. (2014) research where their findings

linked cohesion to different cognitive skills among others, as well as Kao (2019) who determines that team cohesion and performance constitute a circular relationship of social skills. Evaluations of previous thoughts and emotions induced by the stress element of a competition, can be interpreted as facilitating or weakening elements for the athlete. This interpretation depends on the athlete's belief in his/her ability to cope and will also influence the athlete's future behavior (Neil et al., 2011).

## Conclusions

Positive perceptions of psychological variables for group cohesion have been confirmed in terms of older gymnasts that have been competing for longer periods, as well as the orientation of activity to the task as a proactive working method.

Competitive anxiety is reduced as gymnasts increase in age, have been competing for more years, and change their marital status to maintain a more stable personal relationship.

Individual optimism is associated with higher levels of cohesion between the group and activities directed at the task.

The safety provided by training to gymnastic mastery stems from the positive correlation between task-oriented work as a better model for greater group cohesion and greater optimism, based on years of training and experience in sports competition.

With regard to the contributions of this study, it is worth noting the uniqueness of the sample. All the gymnasts were nationally and internationally competitive, having participated in national, European, and world championships. Therefore, these findings are of importance to technicians and coaches.

## Study Limitations

As for the limitations of the study, first of all, we can point out that the data were self-reported. This is a common practice in studies but can lead to biases in participants' responses, exacerbating the variability and artificially increasing the correlations between variables (Spector, 2006). Secondly, the competition featured Spanish gymnasts and had its own cultural characteristics; therefore, the results cannot be extrapolated to other samples. Thirdly, we have used a cross-cutting and correlated design that, although common in research, continues to pose drawbacks; for e.g., it is impossible to establish causal relationships.

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## Future Lines of Research

Training and competitive situations should be evaluated, and intervention programs that promote and improve the relationships within groups should be developed. The behaviors of, and models applied by, coaches in relation to their teams should be analyzed to generate training programs that indicate the importance and influence of their behavior in generating a motivational climate of involvement in the task. Studies on basic aesthetic gymnastics equipment should be deepened in order to adapt the practice to the characteristics of these age groups as well as enable the improvement of the relationships and interrelationships that are created within the team context. It would be interesting to carry out intercultural or transnational studies to see if the results of our work are similar to those of other countries.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

AM-M and CAM: conceptualization, validation, formal analysis, investigation, and supervision. FC-G and AD-S: methodology, resources, data curation, visualization and funding acquisition. AM-M: writing-original draft preparation and project administration. AM-M, CAM, FC-G, and AD-S: writing-review and editing. All authors: read and agreed to the published version of the manuscript.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Psychophysiological Benefits of Real-Time Heart Rate Feedback in Physical Education

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School physical education (PE) has the potential to contribute to public-health promotion and well-being, but oftentimes students' lack of motivation toward PE or physical activity in general, especially during adolescence, diminishes, or eradicates the positive effects associated with PE. Therefore, practical approaches are required that help teachers to increase or awake students intrinsic motivation toward PE, for which self-determination theory may provide the conceptual framework. In that regard, the purpose of the present study was to examine whether the use of real-time, heart rate feedback (as a method to support students' need for autonomy and competence) during regular PE lessons has the potential to increase students' autonomous motivation and physical effort. To achieve this, we had forty healthy adolescents between 16 and 17 years of age run for 30 min either with (experimental group, EG) or without (control group, CG) real-time, individualized heart rate feedback during a regular PE class and compared physical and perceived exertion as well as joy of running between the two groups. Participants were randomly assigned to the groups. Our data revealed that participants in the EG enjoyed running more than participants in the CG (joy of running was 3.20 in the EG vs. 2.63 in the CG,  $p = 0.03$ ) despite a higher physical (163 to 178 in EG vs. 141 to 156 beats per minute in the CG,  $p < 0.001$ ) and perceived exertion (rating of perceived exertion of 13.22 in the EG vs. 10.59 in the CG,  $p = 0.02$ ). That means, running with real-time, individualized heart rate feedback apparently increased participants' motivation to run and to enjoy running at higher levels of exertion. In that regard, real-time, individualized activity feedback should be implemented in regular PE classes systematically and repeatedly to create a controllable and attainable situation that allows students to actively adjust their own behavior to achieve appealing and realistic goals.

**Keywords:** self-determination theory, heart rate monitoring, motivation, biofeedback, school

## INTRODUCTION

Physical activity has long been known as a major, independent risk factor of individual and public health and well-being (World Health Organization, 2010; Hallal et al., 2012; Lee et al., 2012). As regular physical activity during childhood benefits all aspects of child development (Andersen et al., 2006; Reiner et al., 2013), it is recommended that children engage in 60 min of moderate (MPA) to vigorous aerobic physical activity (VPA; i.e., fast walking and running associated with elevated

heart rates) every day (Strong et al., 2005; Janssen and LeBlanc, 2010; World Health Organization, 2010). Depending on the criteria and model used (Epstein et al., 2001; Armstrong and Welsman, 2006; Brown et al., 2006; McManus et al., 2008; American College of Sports Medicine, 2014; Eckard et al., 2019), MPA is typically defined with heart rates above 64–70% of maximum heart rate, or heart rates ranging between 140 and 160 beats per minute (bpm); and VPA with heart rates above 76–85% of maximum heart rate or with heart rates above 160 bpm. Field observations, however, indicated that not even half of the children and adolescents comply with the recommended levels of physical activity (Ekelund et al., 2011; Van Hecke et al., 2016). Actual daily engagement in moderate to vigorous physical activity in school-aged children is (with about 14–20 min on average) well below the recommended 60 min per day (Biddle and Goudas, 1996; Sallis et al., 2000; McManus et al., 2008). Making things worse, it has been reported that moderate and vigorous physical activity declines dramatically with increasing age during adolescence (Armstrong et al., 2000; Parish and Treasure, 2003; McManus et al., 2008; Knuth and Hallal, 2009; Van Hecke et al., 2016). Hallal et al. (2012) reported that worldwide four out of five adolescents do not meet the physical activity recommendations.

Physical education (PE) in school may have the potential to contribute to public-health promotion (Fox and Harris, 2003; Standage and Gillison, 2007; Singh et al., 2012; Burns et al., 2017) as it is mandatory for almost all children and adolescents in the world. However, the recommendations for daily physical activity are usually not met by PE in school alone as it only covers 2–3 days of a week of the recommended daily 60 min of moderate to vigorous physical activity (given the intensity is high enough; cf. Stratton, 1996; Fröberg et al., 2017). Therefore, it is required that children engage in extracurricular physical activity to make up for the lack. PE appears to be the perfect place to build up children's motivation to engage in extracurricular physical activities as a central aim of PE in school is to encourage students to take on a physically active and healthy lifestyle. It is generally agreed upon that this can be achieved by growing children's understanding of the benefits of an active and healthy lifestyle and by letting them experience that physical activity can bring joy and inherent satisfaction (Ferrer-Caja and Weiss, 2000; Vallerand, 2007; Ryan and Deci, 2017). In particular, enjoyment of PE has been shown to have a considerable positive impact on children's extracurricular physical activity (Dishman et al., 2005; Cairney et al., 2007; Cox et al., 2008).

The Self-determination theory (SDT; Deci and Ryan, 2000; Ryan and Deci, 2000, 2007, 2017) provides a conceptual framework on how autonomous forms of motivation, which are typically accompanied by the feeling of enjoyment and inherent satisfaction, can be achieved. It describes different modes of regulation with external regulation being the least and intrinsic motivation being the most self-determined and autonomous

forms of regulation (Ryan and Deci, 2000; Deci and Ryan, 2002). With regard to PE (or school in general), children and adolescents often act for external reasons (Ntoumanis, 2001; Ntoumanis et al., 2004), which are usually associated with the expectation of reward and/or punishment (e.g., external pressure by parents of getting good or avoiding bad marks) and the avoidance of guilt associated with not partaking or underperforming (e.g., internal pressure based on perceived expectations of classmates). However, acting for internal reasons (i.e., intrinsic, identified, and introjected regulation) is typically associated with a higher engagement and a stronger feeling of enjoyment, interest and inherent satisfaction (e.g., partaking in PE because being physical active or a specific behavior itself has personal value or brings the student joy, not just the outcome) as compared to acting for external reasons (i.e., lower autonomous motivation) (Ryan and Deci, 2000, 2017; Spray et al., 2006; Vallerand, 2007; Bice et al., 2016).

SDT proposes that autonomous motivation can be achieved by promoting the satisfaction of three innate psychological needs: competence, autonomy and relatedness (Deci and Ryan, 2002; Standage and Gillison, 2007; Ryan and Deci, 2017). *Competence* describes one's feeling to be able (i.e., to have what it takes) to effectively adjust own behavior to achieve desired outcomes. Several studies have come to the conclusion that perceived competence might be the most important predictor for intrinsic motivation toward and enjoyment of PE (Standage et al., 2005; Hashim et al., 2008; Taylor et al., 2010; Gråstén et al., 2012; Ryan and Deci, 2017). *Autonomy* describes the need to self-endorse activities and the feeling to be able to handle situations on one's own. It has been shown that autonomy support provided by the teacher by actively supporting choice, initiation and understanding enhances motivation toward PE and extracurricular physical activity (Hagger et al., 2003; Standage et al., 2003, 2006; Reeve et al., 2004; Alderman et al., 2006). *Relatedness* describes the need to belong, to feel connected, accepted, and close to significant others. Relatedness appears not as important for enhancing and maintaining autonomous forms of motivation as autonomy and competence (Deci and Ryan, 2000; Standage and Gillison, 2007), but there is evidence to suggest that it supports maintaining motivated when acting for external reasons (Standage and Gillison, 2007). Satisfaction of the three psychological needs, especially competence and autonomy, in PE has been shown to be positively associated to autonomous forms of motivation toward PE (Standage et al., 2003, 2006; Ntoumanis, 2005; Standage and Gillison, 2007). Moreover, autonomous motivation toward PE has been positively associated to general self-esteem and psychological well-being (Hein and Hagger, 2007; Standage and Gillison, 2007) supporting the idea that (motivational processes within) PE has the potential to impact on self-perception and a healthy active lifestyle.

## The Present Study

Especially during adolescence, many students are only physically active in PE for external reasons (i.e., because they have to or to avoid bad marks) or are not being motivated to be physically active at all (Ntoumanis, 2001; Ntoumanis et al., 2004) resulting

**Abbreviations:** MPA, moderate physical activity; VPA, vigorous physical activity; bpm, beats per minute; PE, physical education; SDT, self-determination theory; EG, experimental group; CG, control group; BMI, body-mass index; RPE, rating of perceived exertion.



in low levels of physical activity during PE classes (Knuth and Hallal, 2009). That completely undermines the central aim of PE to encourage students to take on a physically active and healthy lifestyle and the recommendation to engage in at least 60 min per day of moderate to vigorous physical activity. Therefore, the purpose of the present study was to explore the effect of real-time activity feedback on adolescents' experience of intrinsic satisfaction of being physically active during PE (i.e., enjoying the activity due to the feeling of improvement and accomplishment; cf. Wankel and Kreisel, 1985; Vallerand, 2007; Bice et al., 2016). More specifically, we examined whether the use of immediate heart rate feedback during endurance training (i.e., running) in PE has the potential to increase students' joy of running and motivation to run as they may feel more in control of the situation and their own performance when being provided with immediate and individualized heart rate feedback.

During regular PE lessons, we asked forty adolescents between 16 and 17 years of age to run for 30 min at their maximum pace that would allow them to run for 30 min without any breaks. Participants were evenly and randomly assigned to either an experimental (EG) or a control group (CG). All participants wore heart rate monitors while running and were asked to report their perceived level of exertion and on whether they enjoyed running after the 30-min run. The groups only differed in the information provided about heart rate monitoring before running and the feedback given during running. Participants in the CG were just told that the heart rate monitor measures and records their hearts' bpm during the 30-min run. Participants in the EG were given additional information on what that means (i.e., information on how hard they push themselves while exercising) and how the heart rate feedback can be used during running (i.e., information on how to run in an optimal healthy heart rate zone to finish the 30-min run without breaks and to get better at running). Moreover, during running participants in the EG received real-time heart rate feedback (i.e., heart rate, percentage of their maximum heart rate and heart rate zone) displayed on a projector screen visible from all sides of the gym.

We hypothesized that participants in the EG enjoy running more than participants in the CG, and (willingly) push themselves harder while exercising. Based on previous work, the individualized activity feedback (i.e., based on each participant's level of exercise) in the EG should help participants to feel more competent (Ntoumanis, 2001; Alderman et al., 2006). Moreover, the possibility to actively adjust their running speed based on the heart rate feedback at all times (i.e., they had control over their running speed and exhaustion) should support the need for autonomy (i.e., reinforcing behavior by self-evaluation; self-endorsed adjustments to achieve goals; controllability of the situation) in the EG. Consequently, the satisfaction of the basic psychological needs for competence and autonomy by providing real-time, individualized heart rate feedback should result in an increase in autonomous motivation toward running (i.e., enjoy running) (Ntoumanis, 2001; Standage et al., 2005; Gråstén et al., 2012; Bice et al., 2016; Nation-Grainger, 2017).

## METHODS

### Participants

Forty healthy male adolescents (age range = 16–17 years, mean age =  $16.3 \pm 0.5$  years) from a 10th grade volunteered in this study, and were randomly allocated to an experimental group (EG) and a control group (CG) before any testing. On average, participants in EG and CG engaged in  $4.6 (\pm 3.5)$  and  $3.5 (\pm 2.6)$  h of recreational physical activity per week respectively, indicating that the sport engagement was similar between both groups ( $p = 0.30$ ). As body-mass index (BMI) was higher in the CG ( $22.9 \pm 4.5$ ) than in the EG ( $19.5 \pm 2.7$ ) ( $p = 0.01$ ), BMI was used as a co-variate in all analyses of exertion in the present study. All participants were free from any known musculoskeletal, neuromuscular, neurological, and/or mental disorders that may have had an impact on test performance, and had normal or corrected to normal vision. The study was approved by the local institutional review board and school authorities, and conformed to the declaration of Helsinki. Prior to participation, written informed consent was obtained from the parents of all participants.

### Procedure

All participants completed two 30-min runs (separated by 1 week) in groups of 10 within their respective groups (i.e., EG and CG) during regular physical education lessons in a standard gym: The first running session was used for familiarization (i.e., wearing the heart rate monitor during running) and to determine the target heart rate zone for the experimental group. The second running session was used to test for the effect of heart rate feedback on (perceived) exertion and motivation by providing real time heart rate feedback in the experimental group, but not in the control group. All sessions were run by an instructor who was asked to limit interaction with participants to a minimum.

Before any running, participants were asked (1) to report on whether they were looking forward to run or not (i.e., motivation), and (2) to put on a chest strap heart rate monitor (Polar H10). The experimenter always checked the correct position of the heart rate monitor and connected the respective heart rate monitor with the Polar Club App, which allowed real-time data recording and processing. Then, participants were asked to run for 30 min around a marked area ( $10 \text{ m} \times 20 \text{ m}$  rectangle) in the maximum speed that would still allow them to run for 30 min without any breaks. After completing the 30-min run, participants were asked to report their perceived exertion (Borg's scale of perceived exertion), and on whether they enjoyed running (i.e., joy and motivation). EG and CG only differed in the information provided about heart rate monitoring before running and the feedback given during running. While participants in the CG were just told that the heart rate monitor measures and records their heart beats per minute (bpm) during the 30-min run, participants in the EG were given additional information on what that means (i.e., information on how hard they push themselves while exercising) and how the heart rate feedback can be used during running (i.e., information on how to run in an optimal healthy heart rate zone to finish the 30-min run without breaks and to get better at running). Moreover, during

running participants in the EG received real-time heart rate feedback (i.e., heart rate in bpm, percentage of their maximum heart rate, and heart rate zone) displayed on a projector screen (120 inches) visible from all sides of the gym. Participants in the EG were instructed to always keep their heart rate between 80 and 90% (162/163 to 183/184 bpm; i.e., vigorous physical activity, American College of Sports Medicine, 2014) of the maximum heart rate (simplified as 220 bpm minus age; Fox et al., 1971), which was indicated by a yellow background color and the respective percentage on the projector screen (see **Figure 1**).

## Measures

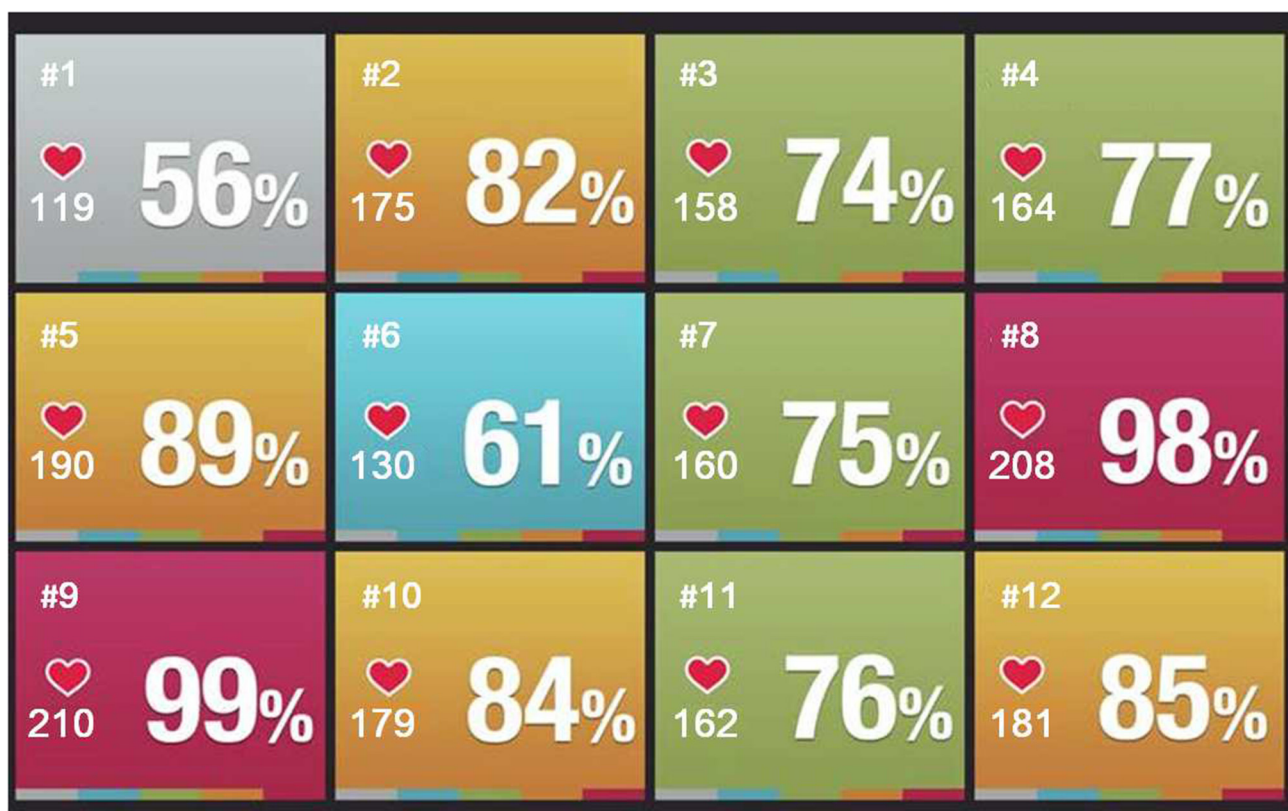
### Heart Rate Monitoring

Participants' heart rate data was collected using 10 Polar® H10 heart rate sensors attached to an adjustable chest strap with embedded electrodes to measure the heart's electrical signals. Previous studies provided evidence that chest strap monitors like the Polar H10 are (almost) as accurate as the current gold standard electrocardiography to obtain heart rates in sport settings (cf. Gilgen-Ammann et al., 2019). All data were transferred in real time via Bluetooth (with a maximum signal radius of about 35 m) to a 9.7" Apple iPad, on which all data was stored and further processed using the Polar® Club App. To

be able to match the simultaneously captured heart rate data of all participants within the EG and CG group to single subjects, we created individual accounts for all participants in the Polar® Club App and connected each participant's heart rate monitor with his or her account before any running started. Mean heart rate (in bpm) averaged over 30 min and time (in percent) in the five Polar® heart rate zones above 50% (i.e., 50–60% indicates very light, 60–70% light, 70–80% moderate, 80–90% intense, and 90–100% maximum intensity/exertion) were used as measures of physical exertion (i.e., how hard they push themselves during running). Following the guidelines of the American College of Sports Medicine (American College of Sports Medicine, 2014), moderate physical activity is associated with heart rates above 64% of maximum heart rate and vigorous physical activity with heart rates above 76% of maximum heart rate.

### Perceived Exertion

Perceived exertion was assessed using Borg's rating of perceived exertion (RPE; Borg, 1985, 1998), a valid measure of exercise intensity (Chen et al., 2002) ranging from "no exertion" (score of 6) over "light exertion" (score of 11) and "hard exertion" (score of 15) to "maximum exertion" (score of 20). Immediately after running, all participants were handed the Borg's RPE scale



**FIGURE 1 |** Heart-rate feedback as provided on the projector screen during running. Displayed are the number of the participant in the upper left corner, the real-time heart-rate in beats per minute in the lower left corner under a heart symbol, the respective percentage of their maximum heart-rate emphasized on the right side and the respective heart rate zone indicated by the background color. In the present example all information were provided for 12 participants at a time with participants being identified by their participant number.

showing scores, colors, smileys, and descriptions for each level of exertion (see **Supplementary Material**), and were asked to report their perceived level of exertion by making a cross at the respective number/description. Following the guidelines of the American College of Sports Medicine (American College of Sports Medicine, 2014), moderate physical activity is associated with RPE's of 12 to 13 and vigorous physical activity with RPE's of 14–17.

## Motivation

Participants' motivation was assessed using short questionnaires before and after running. Before running, participants were asked to indicate on a 5-point Likert scale whether they are looking forward to the upcoming 30-min run (i.e., agree) or not (i.e., disagree). After running, participants were asked to indicate on the same 5-point Likert scale whether they enjoyed running or not. All possible responses were accompanied by sad (disagree), neutral (neither agree nor disagree), and happy (agree) smileys (see **Supplementary Material**) to make it easier for the participants to choose from the five possible responses (e.g., based on their own mood with regard to the upcoming or just completed run). The anticipation before running and the joy of running were used as a measure of motivation (Wankel and Kreisel, 1985; cf. Bice et al., 2016). A change in score from before to after the run will be interpreted as a change in motivation due to the running session itself.

After all running was completed, participants were also asked to report on the 5-point Likert scale explained above whether they enjoy running in general and whether they enjoyed running with the heart rate monitor. Responses to the first question were used to control data for participants' general running motivation and responses to the second question were used as direct feedback on whether participants liked the implementation of this technical gadget.

## Data Analysis

Preliminary analyses were conducted on all relevant measures to check for normality, sphericity (Mauchly test) and outliers, with no serious violations noted. In order to study the effect of enriched heart rate feedback on participants' exertion we ran separate analyses of variances (ANOVA) for physical (bpm averaged over 30 min) and perceived exertion (Borg's RPE) with group (EG vs. CG) as between-subject factor and controlled for participants' BMI. To compare experimental and control groups' time (in percent) spend in the five Polar® heart rate zones, we ran a group (EG vs. CG)  $\times$  heart rate zone (1 through 5) ANOVA. Additionally we ran an ANOVA comparing the joy of running (controlled for the anticipation to run) between groups (EG vs. CG) to study the effect of enriched heart rate feedback on participants' motivation. Data are reported as mean (M) and 95% confidence interval of the mean (95% CI), as well as mean difference (MD) along with 95% CI. Partial eta-squared ( $\eta_p^2$ ) and adjusted Cohens  $d$  (due to the rather small sample size) based on Ezekiel's correction formula (Ezekiel, 1930; Ivarsson et al., 2013; Schweizer and Furley, 2016) along with 95% CI of the effect size are reported as measures of effect size. The level of significance

**TABLE 1 |** Demographic characteristics and descriptive statistics on raw data (means and standard deviation [in parentheses]) of physical and perceived exertion, anticipation to run, and joy of running of participants in the experimental and control groups.

	Experimental group (EG, $n = 20$ )	Control group (CG, $n = 20$ )
Boys, $n$ (%)	20 (100)	20 (100)
Age, years, Mean (SD)	16.35 (0.49)	16.20 (0.41)
Body mass index, Mean (SD)	19.49 (2.69)	22.85 (4.48)
Physical activity, h/week, Mean (SD)	4.55 (3.51)	3.53 (2.62)
Physical exertion, beats per minute, Mean (SD)	168.20 (9.64)	150.78 (19.93)
Intensity, % of the 30 min running time, Mean (SD)		
Very light (50–60%)	1.85 (4.70)	5.32 (10.25)
Light (60–70%)	3.35 (6.40)	33.73 (31.44)
Moderate (70–80%)	14.35 (19.79)	36.11 (29.98)
Intense (80–90%)	77.55 (25.21)	12.37 (17.82)
Maximum (>90%)	2.85 (6.67)	12.37 (22.64)
Perceived exertion, Borg's RPE, Mean (SD)	13.00 (2.13)	10.63 (3.70)
Anticipation to run, Mean (SD)	2.20 (1.15)	2.21 (0.92)
Joy of running, Mean (SD)	3.20 (0.95)	2.63 (0.96)

was set at  $p \leq 0.05$ . All analyses were performed using SPSS statistical package 25.0.

## RESULTS

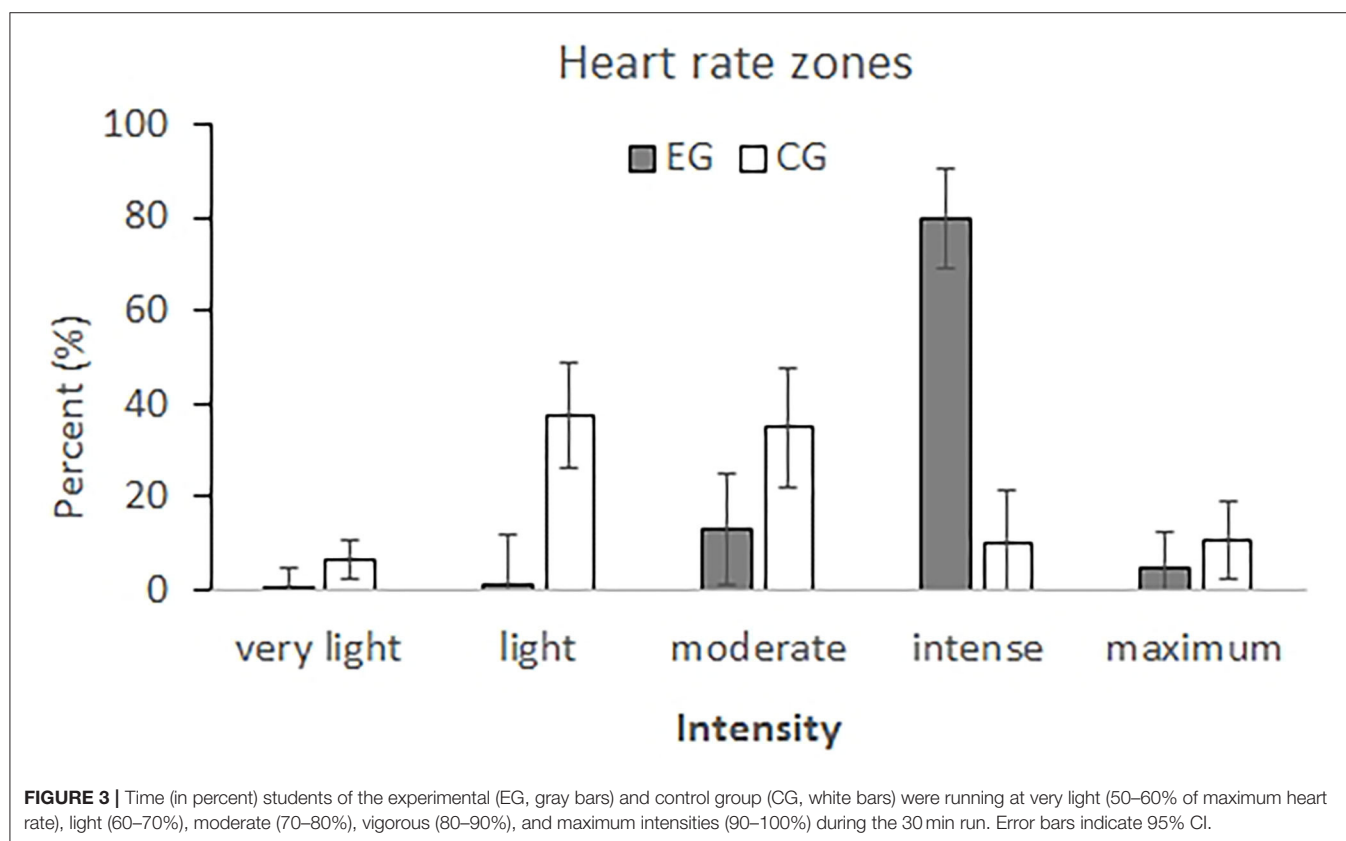
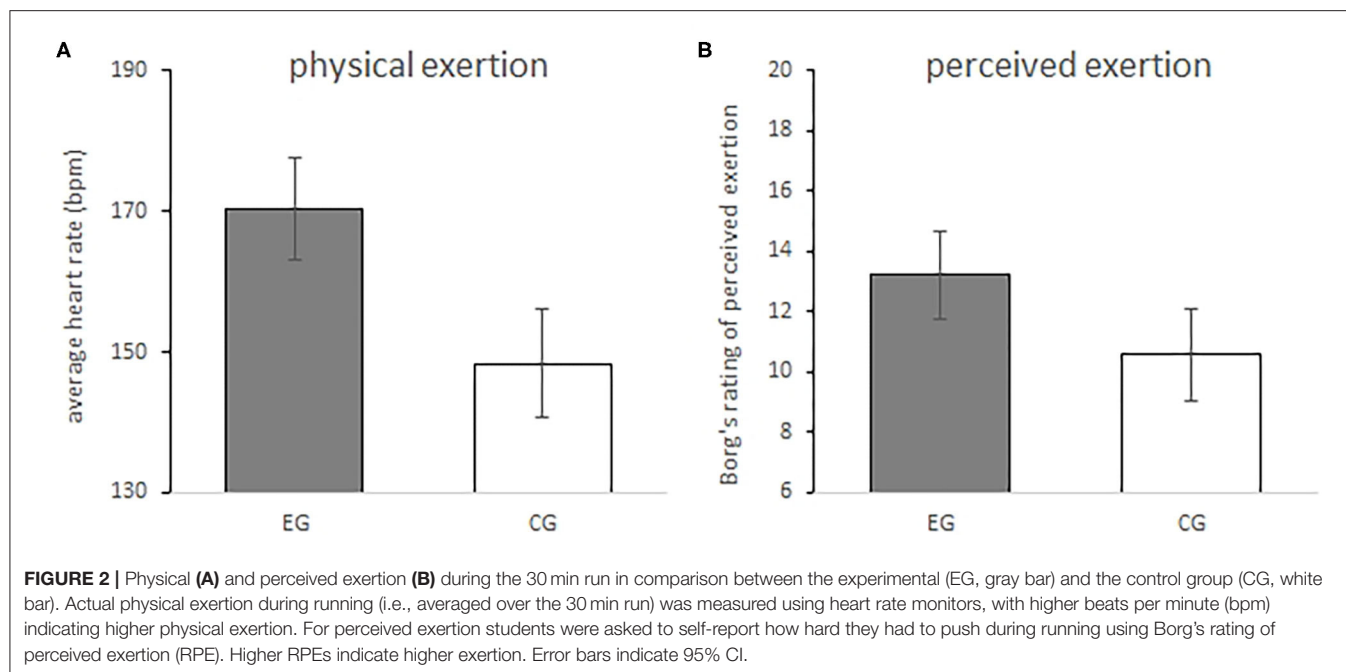
### Physical Exertion

Raw means and standard deviations for all measures of physical and perceived exertion as well as anticipation and joy of running are displayed in **Table 1**. Data analysis revealed a significant difference between groups,  $F_{(1,35)} = 15.89$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.31$ , with a higher physical exertion averaged over the 30 min of running in the EG ( $M = 170.34$  bpm, 95% CI = [163.11, 177.56]) as compared to the CG ( $M = 148.41$  bpm, 95% CI = [140.74, 156.08]) (adjusted Cohens  $d = 1.27$ , 95% CI = [0.54, 2.14]). The difference between EG and CG in physical exertion is shown in **Figure 2A**.

Analysis of time (in percent) spend in the five Polar® heart rate zones revealed a group  $\times$  heart rate zone interaction,  $F_{(4,140)} = 25.51$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.42$ . *Post-hoc* analysis revealed that participants of the EG spend more time in heart zone 4 ( $MD = 69.29\%$ , 95% CI = [52.72, 85.85],  $p = 0.001$ ), and less time in heart rate zone 2 ( $MD = -36.08\%$ , 95% CI = [-52.66, -19.50],  $p < 0.001$ ) and heart rate zone 3 ( $MD = -21.88\%$ , 95% CI = [-40.41, -3.35],  $p = 0.02$ ) than participants of the CG. The differences between EG and CG for the time spent in the five Polar® heart rate zones are presented in **Figure 3**.

### Perceived Exertion

Data analysis revealed a significant difference between groups,  $F_{(1,35)} = 5.77$ ,  $p = 0.02$ ,  $\eta_p^2 = 0.14$ , with a higher RPE in the



EG ( $M = 13.22$ , 95% CI = [11.78, 14.66]) as compared to the CG ( $M = 10.59$ , 95% CI = [9.06, 12.12]) (adjusted Cohen's  $d = 0.74$ , 95% CI = [0.06, 1.50]). Based on these means and 95% CIs of the mean, on average participants of the EG engaged in moderate to

vigorous physical activity, while participants of the CG engaged in light to moderate physical activity (American College of Sports Medicine, 2014). The difference between groups in perceived exertion is shown in **Figure 2B**. Correlation analysis revealed



that perceived exertion was positively related to physical exertion ( $r = 0.53, p = 0.001$ ).

## Motivation

Analysis of participants' motivation revealed a significant difference between groups,  $F_{(1,36)} = 5.26, p = 0.03, \eta_p^2 = 0.13$ . Data analysis revealed that participants in the EG ( $M = 3.20, 95\% CI = [2.85, 3.56]$ ) enjoyed running more than participants in the CG ( $M = 2.63, 95\% CI = [2.27, 2.99]$ ) (adjusted Cohen's  $d = 0.69, 95\% CI = [0.03, 1.43]$ ). Anticipation to run (i.e., motivation before any running) did not differ between groups ( $MD = -0.01, 95\% CI = [-0.69, 0.67]; p = 0.98$ ). The difference in motivation between the two groups is shown in **Figure 4**.

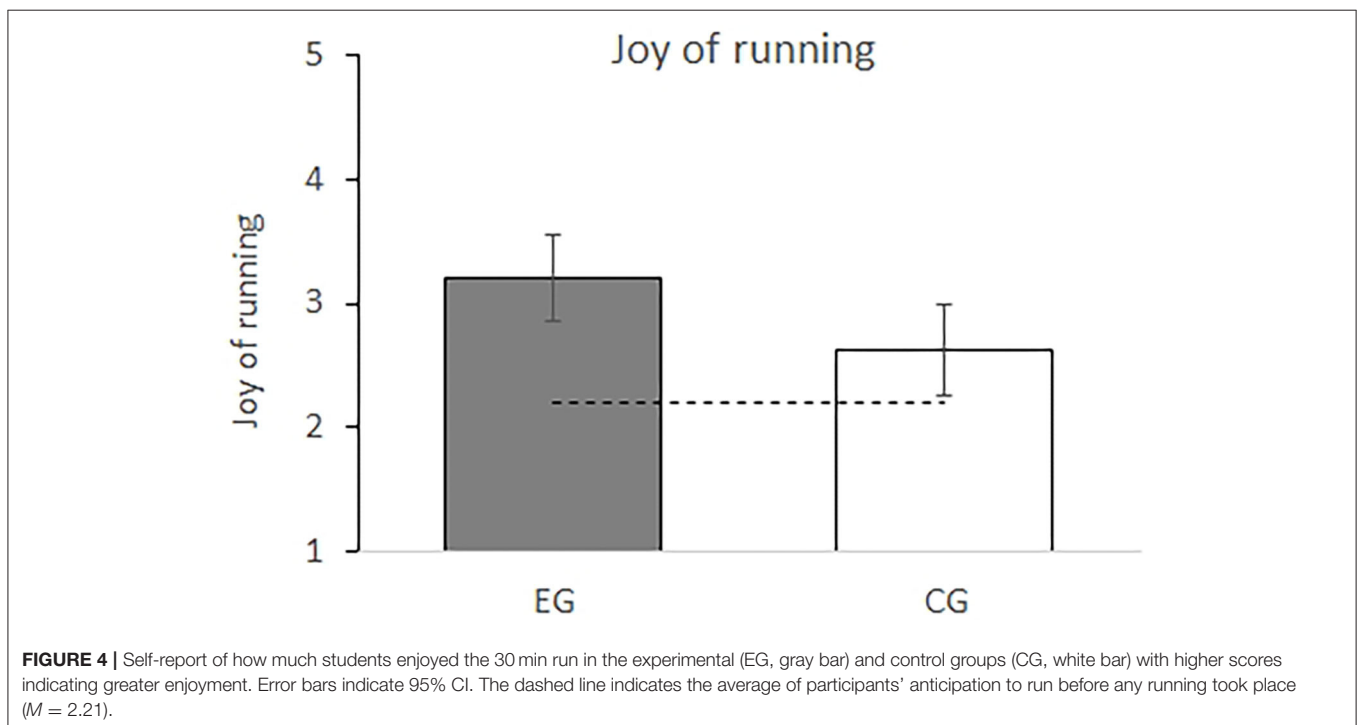
## DISCUSSION

The purpose of the present study was to examine whether the use of real-time, individualized heart rate feedback during PE has the potential to increase students' joy of running, which would be indicative of an increased autonomous motivation toward running. To achieve this, we had forty adolescents run for 30 min either with (EG) or without real-time, individualized heart rate feedback during PE and compared physical and perceived exertion as well as joy of running between the two groups. Our data revealed that participants in the EG enjoyed running more than participants in the CG despite a higher physical and perceived exertion.

In detail, we found that the level of physical exertion during the 30 min run was higher in the EG than in the CG. More specifically, students that were able to use the individualized, real-time heart rate feedback (EG) engaged in vigorous physical

activity (163–178 bpm) at an average of about 83% of their maximum heart rate, while students without access to real-time heart rate feedback (CG) engaged in moderate physical activity (141–156 bpm) at an average of about 73% of their maximum heart rate. Participants in the CG spend more time in heart rate zones associated to light (37.4% of the running time) or moderate intensities (35.1% of the running time) as opposed to participants in the EG who spend most of their 30 min run in heart rate zone 4 (79.5% of the running time) which is associated to vigorous physical activity. Thus, it appears that the use of individualized, real-time heart rate feedback helped students to push themselves harder and run at higher intensities over the course of the 30 min run (i.e., vigorous instead of light to moderate physical activity).

Of particular importance, our data suggests that students tend to (willingly) underperform (i.e., to run at light to moderate intensities) if not being provided with real-time, individualized feedback of their running performance. Ratings of perceived exertion indicated that the lower intensities in the CG are rather an intentional choice of the students (e.g., a lack of motivation) than a perceived limitation of own resources (i.e., physical capacities) as these students seem to be well aware of the low intensities. Participants in the CG rated their perceived level of exertion after the run as very light to light, while participants in the EG rated it as somewhat hard to hard. Ratings of perceived exertion thus indicate that adolescents in our study were not willing to push themselves hard while running (i.e., lack of motivation), unless they received real-time, individualized heart rate feedback which apparently gave them a reason to push themselves harder (i.e., being motivated due to feedback of goal attainment). This is in line with research indicating that (digital) individualized feedback of performance, learning



and goal attainment encourages students to put more effort into improving themselves and to keep them engaged with an activity (Alderman et al., 2006; Bice et al., 2016; Nation-Grainger, 2017). For example, Alderman et al. (2006) argued that (individualized) feedback of performance and learning (as opposed to outcome feedback) encourages students to test different solutions during skill acquisition (i.e., trial and error learning) and to put more effort into improving the skill. Bice et al. (2016) found that real-time, individualized activity tracking significantly increased participants' motivation toward physical activity. They argued that feedback and individual goal setting keeps participants engaged and motivated (i.e., provides a reason for them to perform).

Most important, participants in the EG enjoyed running more than those in the CG despite higher levels of physical and perceived exertion. Anticipation to run did not differ between both groups; on average neither group did really look forward to run. While that didn't change in the CG over the course of running, the EG reported a higher joy of running after the run as compared to their initial anticipation to run before the 30 min run. That means, running with real-time, individualized heart rate feedback apparently increased participants' motivation to run and to enjoy running at higher levels of exertion, which is in line with findings on the relation between physical activity and positive affect (Cameron et al., 2018; Ludwig and Rauch, 2018). In detail, students' may have experienced positive affects as they were in control of the situation (real-time adjustments possible) and felt competent (individualized feedback), which led to an increase in their effort to achieve their goals.

That said, the most intriguing finding of the present study was that students provided with real-time, individualized heart rate feedback enjoyed running more than those without such feedback, despite the fact that they pushed themselves harder during the 30-min run (as evidenced by significantly higher levels of physical and perceived exertion in the EG). Thus, real-time, individualized heart rate feedback apparently enhanced students' motivation toward running (i.e., toward a more internal form of regulation). Based on SDT (Deci and Ryan, 2000; Ryan and Deci, 2000, 2007, 2017), autonomous forms of motivation can be achieved by satisfaction of the three psychological needs competence, autonomy and relatedness. With regard to motivation toward PE and physical activity, especially the needs of competence and autonomy have been shown to be positively associated to autonomous forms of motivation (Standage et al., 2003, 2006; Ntoumanis, 2005; Standage and Gillison, 2007; Hashim et al., 2008; Taylor et al., 2010; Gråstén et al., 2012; Ryan and Deci, 2017). In a study by Ntoumanis (2001), students reported that individualized feedback made PE more interesting, they enjoyed it more and they wanted to improve more. Kalaja et al. (2009) found that adjusting task demands during PE to individual levels of exercise highly contributes to the feeling of perceived competence. Similarly, Alderman et al. (2006) argued that (individualized) feedback of performance and learning encourages students to put more effort into improving the skill as they feel more in control of their own performance. In that regard, it is very likely that the individualized activity feedback (i.e., based on each participant's level of exercise) in

the EG helped participants to feel more competent (Ntoumanis, 2001; Alderman et al., 2006; Bice et al., 2016) by being able to effectively adjust own behavior (i.e., running speed) to achieve an individualized (i.e., realistic) goal. Moreover, the possibility to actively adjust running speed based on self-monitoring of heart rates at all times (i.e., having control over their own performance in terms of effort, exhaustion, relaxation and goal attainment) probably supported the need for autonomy in the EG. Although relatedness appears not as important as autonomy and competence for enhancing and maintaining autonomous forms of motivation (Deci and Ryan, 2000; Standage and Gillison, 2007), the immediate visibility (and possibility to compare) of one's performance to others could have added an element of competition to the urge to achieve the predefined goal (for the group), i.e., supporting externally driven forms of regulation. That means, the "group pressure" (i.e., a kind of relatedness) might have helped those participants that could not build up any internal desire to run (i.e., students with low autonomous motivation toward PE).

There are some limitations to the current study, which may inform future directions in this line of research. First, we only tested adolescents of 16–17 years of age, an age group already known for a low motivation toward PE (Ntoumanis, 2001; Ntoumanis et al., 2004) and physical activity in general (Knuth and Hallal, 2009; Hallal et al., 2012; Van Hecke et al., 2016). While from a practical perspective this is surely the age group that needs motivation enhancing methods in PE the most, it is also the group for which largest motivation and performance changes can be expected as there is probably more room for improvements than in any other age group. In that regard, it might be worthwhile to study other age groups and see how the positive effects of immediate activity feedback change with increasing age and different forms of motivation toward PE and physical activity in general. Second, in order to be able to easily implement heart rate monitoring and feedback in regular PE classes a simplified approach to determine the individual maximum heart rate (220 bpm minus age; Fox et al., 1971) was chosen in the present study. While this makes sense from a practical point of view (i.e., feasibility in the school-setting), it does not sufficiently consider individual differences in maximum heart rate that have been found to greatly depend on individual physiology and environmental factors (Zhu et al., 2010; cf. Sarzynski et al., 2013). However, with the goal in mind to implement heart rate monitoring and feedback in the school-setting, it is probably the best compromise to start with the Fox formula (Fox et al., 1971), as it appears good enough to have a positive impact on students motivation toward PE, and adjust students' maximum heart rate measures based on experience when required (e.g., when observing marked differences between estimates and indicators of effort and exhaustion). However, given the nature of the measures (also regarding self-report data on anticipation and joy of running), the present results should be understood in context and interpreted with caution. Third, it's almost impossible to tease apart the social component of the intervention from the heart rate feedback. By nature of the intervention, there was more interaction with the instructor in the EG than in the CG even though the instructor was asked to limit the interaction to

the necessary information. This may indeed have facilitated the hypothesized response (i.e., increase in autonomy and physical effort) in the EG. However, even if immediate heart rate feedback only helped increase students' motivation toward PE due to the increased social interaction, its implementation in regular PE settings would still be beneficial and desired. Finally, participants in the present study were only confronted with heart rate monitoring and feedback on a single occasion. That means that based on the present data it is impossible to draw meaningful conclusions on whether the use of individualized, real-time heart rate feedback during PE classes affects students' motivation toward running, PE or physical activity in general, or in a long term. It could well be that the positive effects wear off the longer the method is used or that the positive effects for running during PE do not generalize to other forms of physical activity during PE or in general. McManus et al. (2008) for example found that heart rate feedback led to modest increases in daily time children spent above 140 bpm and percentage of time spent being vigorously active, however, these changes in behavior were not lasting when feedback was removed. In that regard, future studies should look into the long term and transfer effects of autonomy and competence supportive methods during PE, and real-time, individualized heart rate feedback in particular. Moreover, more studies are needed that inform practitioners (i.e., PE teachers, coaches, or instructors) about how such methods are applied in specific situations to guarantee maximum gain. For example, while it appears conclusive that introducing real-time, individualized activity feedback for the first time has immediate positive effects on motivation, future studies should tackle the question on how, when or how often such methods should be implemented to preserve or enlarge these positive effects.

Limitations notwithstanding, findings of the present study demonstrate that the use of immediate, individualized activity feedback during endurance training (i.e., running) in PE has the potential to increase students' joy of running (i.e., motivation to run) and effort during PE. This is of great importance since enjoyment of PE has been found to have a positive impact on children's extracurricular physical activity (Dishman et al., 2005; Cairney et al., 2007; Cox et al., 2008). That means, understanding the benefits and experiencing the satisfaction of physical activity will ultimately help children to develop an autonomous (i.e., intrinsic) motivation toward physical activity in general.

In that regard, real-time, individualized heart rate feedback or biofeedback in general (i.e., direct or indirect feedback of a physiological process given without interrupting the exercise) should be implemented in regular PE classes systematically and repeatedly (whenever required to increase autonomous forms of motivation toward physical activity during PE) to create a controllable (autonomy) and attainable (competence) situation

that allows *all* students to actively adjust (self-endorsed) their own behavior to achieve appealing and realistic goals. At the very least, the visibility of own (under)performance to self and others should help students to push harder while exercising. As especially heart rate sensors are becoming smaller, better, more reliable, and cheaper almost on a daily basis, and they are easy to use even in larger groups in the school setting, it is probably one of the technical gadgets that has the potential to provide for sustainable improvements of PE classes and become a regular measuring and feedback tool in the majority of PE classes worldwide in the future.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

TS and RG developed the study protocol. RG was responsible for data collection. Both authors equally contributed to the analysis and interpretation of the results, and to drafting the article. Both authors approved the final version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.651065/full#supplementary-material>

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# Effects of Commitment on Fear of Failure and Burnout in Teen Spanish Handball Players

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Under an observational, transversal, and descriptive design, the study analyze the degree of adjustment of the perceptions of fear of failure as a mediating variable of the estimated relationship between sporting commitment and the appearance of burnout in young handball players in a competitive context. The sample included a total of 479 youth category handball players (250 boys and 229 girls) selected to compete in the Spanish Regional Championships. The age range was 16 (40.1%)–17 (59.9%) years old ( $M = 16.60$ ;  $SD = 0.50$ ). With regard to the years of experience variable, 85.4% stated that they have more than 5 years of experience at the federated handball player level. The Spanish version of *Performance Failure Appraisal Inventory* (PFAI), *Inventory Athletes Burnout Revised* (IBD-R), and *Sport Commitment Questionnaire* (SCQE) were used to assess fear of failure. The correlation patterns evidence that commitment is negative and significantly associated with emotional exhaustion, depersonalization, and fear of failure and positively associated with reduced sense of personal accomplishment. In the standardized direct effect, negative and significant effects were observed between commitment and fear of failure, fear of failure with emotional exhaustion and depersonalization, and on the contrary, a negative and significant effect was observed between fear of failure and reduced sense of personal accomplishment. The evaluated athletes reflect a positive psychological disposition, show pride in having been selected by their territorial teams and reflect a high desire to show their sporting qualities. Despite the emergence of cognitive-emotional processes associated with fear of failure (e.g., shame, fear of criticism), this has been observed to protect the sense of self-fulfillment through sport effort, although it also has impacts on further emotional exhaustion and loss of value of sport effort.

**Keywords:** sport commitment, self-criticism, shame, young athletes, emotional exhausted, depersonalization, reduced social realization, handball

## INTRODUCTION

Fear of failure appears above all in a competitive sport environment, precisely because of the combination of the personal desire to achieve goals or tasks, and the cognitive uncertainty of being able to achieve them (Correia, 2018). Taking into account that most of the sport actions of young athletes are regularly evaluated under a performance and success criterion by external figures (Sagar et al., 2007), sport experience self-perception will be oriented toward the feeling of fear of making a mistake, when it is associated with the appearance of a feeling of shame (Gómez-López et al., 2019), ridicule (Eitzen, 2016), or embarrassment (Ellison and Partridge, 2012).

Due to this external evaluation and the excessive value that the player grants (especially during the game, and in the face of a decrease in performance), insecurity feelings, anxiety-stress, and avoidance behaviors will appear with more intensity (Moreno-Murcia and Conte, 2011). This fear of failure appears when the player focuses both attention and beliefs that others (e.g., peers, opponents) are responsible for controlling their behavior, seeking their approval, and/or fearing disapproval. According to Conroy et al. (2001) and Sagar et al. (2007), fear of failure emerges in childhood and increases with age. Therefore, failure itself would not have negative connotations if it were not for the cognitive over-evaluation (mainly of others) and aversive consequences that the athlete experiences toward his or her self-worth (Bélanger et al., 2013; Granz et al., 2019).

Surprisingly, fear has been associated with exhaustion on very few occasions in the scientific literature (Bicalho and Da Costa, 2018). Previous studies have highlighted that a high fear of failure is associated with higher levels of psychological suffering and a risk of burnout, supported mainly by avoidance of shame, embarrassment, or criticism (Lemyre et al., 2008). Fear of failure conceptualization as the tendency to evaluate the threat to the achievement of personal and significant goals contemplates that athletes have learned to associate failure with aversive consequences (Chen et al., 2008), making the aversive consequences grow after the anticipated failure (Correia, 2018), often coexisting with negative processes associated with anxiety and the gradual wearing out of their emotional response (Correia et al., 2016).

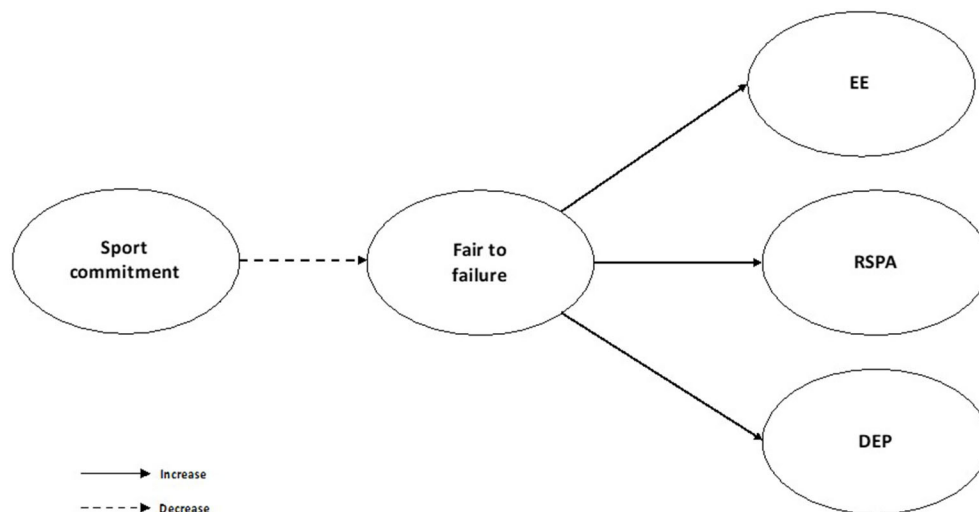
However, the multidimensional nature of both the psychological response to fear and sporting situations offers different interpretations as to the relationship of these variables (Gustafsson et al., 2016), taking into account the individual and not the contextual variables as a unit of analysis (Ruiz-Sánchez et al., 2017). From person-centered approaches (dynamic system of construction of the psychological response), it is understood that from personal stability, fear of failure (mainly fear of important others losing interest) is positively associated with greater emotional and physical suffering, although relationships are not as clear with indicators such as depersonalization (devaluation and withdrawal from sport) and reduced personal fulfillment (mainly, fear of experiencing shame and embarrassment; Gustafsson et al., 2017a). As we said, the interpretation as a constant negative reinforcement makes the fear of failure build a process of psychological hypersensitivity

that emotionally wears out the athlete from his cognitive (e.g., rumination or worry) and emotional (e.g., anxiety, anger, guilt, or shame) areas (Correia, 2018). In a social situation such as competing in team sports, when members of a given group share perceptions of certain stressful or distressing events and contexts, competition is perceived as group agonistic and with poor use of psychological resources (e.g., low self-efficacy; Kozusznik et al., 2015; Gómez-López et al., 2020).

The scientific literature considers sport commitment as a motivating force that reflects the desire and determination to continue the sport effort (Scanlan et al., 1993; Weiss, 2020). Described as a dynamic psychological state that varies over time, seasons, or the course of competitions, it influences the persistence and function of sporting behavior for the athlete (Carpenter and Scanlan, 1998; Scanlan et al., 2003). As any psychological process of an internal nature, it also maintains links with its conceptual references, through the motivational orientation (mainly toward performance tasks) that both coaches and partners exercise on the athlete (Torregrosa et al., 2011). On the other hand, commitment in sportsmen and women has been considered a health protection factor in case of disruptive responses such as burnout or sport abandonment (Raedeke, 1997; Sousa et al., 2007), in relation to the valuation made on the costs or investment of effort (temporary and learning; Williams, 2013), so that the higher the commitment to sport practiced, the higher the value associated to the enjoyment and personal investment made, while a low commitment is associated to an overvaluation of costs and new alternative efforts.

Psychological commitment also involves a sustained effort to identify what sport represents. It means expressing behavioral consequences associated with the motivated behavior (e.g., being persistent, maintaining an intensity of effort, strengthening the intention to carry out tasks to achieve results) as a part of themselves (Zahariadis et al., 2006). In that way, athletes who feel more committed suffer more intensely from this hypersensitivity, as they magnify their goals by pursuing much higher standards, build unrealistic expectations, or feel too identified with what sport represents to them (Olusoga and Kenttä, 2017). From a functional-dysfunctional point of view, fear of failure configures a response differentially subjected to performance devaluation for the athlete, infusing concerns in the perceptions of lack of achievements and success (Madigan et al., 2016; González-Hernández and Muñoz-Villena, 2019), that is why the psychological commitment could be altered and deteriorated in the absence of a compensatory response (e.g., social support, positive coping) that balances the mentioned motivational process.

With an observational and descriptive design of a transversal nature, the aim of this study was to analyze the degree of adjustment of the perceptions of the fear of failure as a mediating variable of the estimated relationship between sporting commitment and the appearance of burnout in young handball players in a competitive context, hoping to describe a hypothesized model (**Figure 1**) that reflected a negative effect of the devaluation of the fear of failure, capable of increasing the response of burnout in young athletes who show greater commitment. More specifically, the most committed athletes are



**FIGURE 1 |** Standardized individual parameters—hypothesized model. EE, emotional exhaustion; RSPA, reduced sense of personal accomplishment; DEP, depersonalization.

also expected to show low indicators of fear of failure, emotional exhaustion, depersonalization, and low self-realization.

## MATERIALS AND METHODS

### Participants

This study is part of the following project: Analysis of the factors implicit in the teaching-learning process of the handball player of the University of Murcia. Other Spanish universities such as Granada, Extremadura, and Almeria have collaborated in this project. It was developed with the consent of the Royal Spanish Handball Federation (RFEBM) and the Andalusian Handball Federation (FABM).

The sample included a total of 479 youth category handball players (250 boys and 229 girls) selected to compete in the Spanish Regional Championships (C.E.S.A.—Almeria 2016). These selected players are the best handball players in their regions. They are the regional selections (17 men's and 16 women's teams), and most of them, due to their age, have participated in more than two Spanish handball championships. The same study population was used in both this study and in the following paper: Alesi et al. (2019). These players were rated "high-performance players" by the Spanish Sports Council according to Royal Decree 971/2007, of 13 July, on high-level and high-performance players. The age range was 16 (40.1%)–17 (59.9%) years old ( $M = 16.60$ ;  $SD = 0.50$ ). With regard to the years of experience variable, 85.4% stated that they have more than 5 years of experience at the federated handball player level.

### Measurement Instruments

Performance Failure Appraisal Inventory (PFAI) (Conroy et al., 2002) adapted to Spanish language by Moreno-Murcia and Conte (2011) was used. The scale includes 25 items grouped in five first-order dimensions [Fear of Experiencing Shame and

Embarrassment (e.g., "When I am failing, it is embarrassing if others are there to see it."), Fear of Devaluing One's Self-estimate (e.g., "When I am failing, it is often because I am not smart enough to perform successfully"), Fear of Having an Uncertain Future (e.g., "When I am failing, I believe that my plans for the future will change"), Fear of Important Others Losing Interest (e.g., "When I am not succeeding, some people are not interested in me anymore"), and Fear of Upsetting Important Others (e.g., "When I am failing, important others are disappointed")] and one general dimension (fear to failure). All items were headed by the phrase "In my sports practice..." The answers were collected on a Likert-type scale ranging from do not believe at all (1) to believe 100% of the time (5). Here, the internal consistency analysis was satisfactory for the different subscales; Fear of Experiencing Shame and Embarrassment,  $\alpha = 0.85$ ; Fear of Devaluing One's Self-Esteem  $\alpha = 0.70$ ; Fear of Having an Uncertain Future,  $\alpha = 0.83$ ; Fear of Important Others Losing Interest,  $\alpha = 0.84$ ; Fear of Upsetting Important Others,  $\alpha = 0.81$ .

Sport Commitment Questionnaire (SCQ; Scanlan et al., 1993), in its version adapted and validated to Spanish by Sousa et al. (2007) was used. This questionnaire consists of 32 items, maintaining a structure of seven dimensions of first order [Sport Commitment (e.g., "I will continue to play this sport for as long as I can"), Sport Enjoyment (e.g., "I love to play this sport"), Involvement Alternatives (e.g., "I would like to do other activities instead of practicing sport"), Personal Investments (e.g., "The time I have spent in this sport makes it difficult to stop playing"), Social Constraints (e.g., "People who are important to me expect me to keep playing this sport"), and Involvement Opportunities (e.g., "I would really miss the things I learn in this sport if I didn't play")] and one general factor of second order. Each item is answered on a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). In this study, we



use a unique dimension commitment, showing a good internal reliability ( $\alpha = 0.82$ ).

Burnout Inventory for Athletes-Reduced (IBD-R; Garcés de Los Fayos et al., 2012). The IBD-R is a reduced version of Garcés de Los Fayos' 19-item IBD (1999), which comes from the Maslach Burnout Inventory (MBI; Maslach and Jackson, 1981). This Inventory evaluates burnout in athletes as a three-dimensional construct, characterized by Emotional Exhaustion (e.g., "Carrying out a work discipline in my sporting activity exhausts me"), Reduced Personal Realization (e.g., "I am effective in dealing with the problems of the people around me in the sporting environment"), and Depersonalization (e.g., "I don't really care what happens to the people around me in my sporting activity"). Each item is answered on a Likert-type scale ranging from 1 (I've never thought or felt it) to 5 (I think or feel it every day). To find the total score on each subscale, the scores of the items that make up that subscale are added together. The higher the score, the higher the level of burnout experienced by the athlete, except in the items of Reduced Personal Achievement which are formulated in the opposite direction: the lower the numerical response of the subject, the higher the degree of burnout experienced. In this study, the internal consistency values were: Emotional Exhaustion ( $\alpha = 0.74$ ), Reduced Personal Realization ( $\alpha = 0.76$ ), and Depersonalization ( $\alpha = 0.72$ ).

## Procedure

The study was carried out during the Spanish Championship of Autonomic Selections (CESA). The RFEBM, the FABM, and the coaches of the different regional selections all granted permission prior to our data collecting after reading a letter explaining the objectives of the study and the way it would be carried out. Prior to the administration of the questionnaires to the participants, and in accordance with the ethical guidelines of the American Psychological Association (APA), they were presented with an informed consent for ethical compliance and data protection, ensuring in this way, the rigor of the investigation and the privacy of the information obtained. The consent obtained from the players and their parents or tutors was both written and informed. A sample of the instrument was provided for them all. Data collection was carried out in Almería during the Spanish Championship C.E.S.A. 2016, at the hotels where the teams were staying during players' time off, in agreement with the coaches and in the presence of one of the researchers. Each participant had 20–30 min to complete the questionnaire, and they were all briefed on the objects of the study and on their rights as participants, on the voluntary nature of the study, and on the confidentiality of answers and data management. They were also informed that there were no correct or incorrect answers and were asked to give true and honest replies. Following data verification, the following variables were recorded: gender, year of birth, years of experience as a handball player, playing position, and the numbers of hours per week dedicated to training, as well as the times it was carried out. This study was carried out in accordance with the ethical guidelines of the APA. Protocol was approved by the Ethics Committee of the Universidad de Murcia

(ID: 1494/2017). All subjects gave written informed consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).

## Analysis Data

Descriptive statistics, including means and standard deviation, as well as bivariate correlations were performed for all studied variables. A two-step maximum likelihood (ML) approach was performed in AMOS 23.0 as suggested by Kline (2016). Confirmatory factor analysis (CFA) was conducted to verify the psychometric properties of the measurement model (i.e., purposed model). During this stage, composite reliability, through Raykov (1997) formula, was used to determine internal consistency, assuming 0.70 as a cut-off value, as suggested by Hair et al. (2014). In addition, convergent validity *via* average variance extracted, was performed, and values  $\geq 0.50$  were considered adjusted (Hair et al., 2014), while discriminant validity was established when the correlation coefficients were lower than the AVE for each construct that exceeded the squared correlations between that construct and any other (Fornell and Larcker, 1981).

A structural equation modeling (SEM) was made to test the purposed associations across different constructs. For both analyses, the traditional goodness-of-fit indexes were used: Comparative Fit Index (CFI), Normalized Fit Index (NFI), Standard Root Mean Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) with its Confidence Interval (CI: 90%). For these indices, scores of CFI and NFI  $\geq 0.90$  and SRMR and RMSEA  $\leq 0.8$  were considered acceptable, following several recommendations (e.g., Marsh et al., 2004; Byrne, 2010; Hair et al., 2014).

For mediation analysis, the direct and indirect effects among constructs on outcome variable were analyzed as suggested by Hair et al. (2014) and Hayes (2018). Bootstrap resampling procedure (1,000 samples) *via* AMOS 23.0 was performed through bias-corrected 95% CI to analyze the significance of direct and indirect effects. Indirect effect is considered significant ( $\leq 0.05$ ) when its confidence interval does not include zero (e.g., MacKinnon et al., 2004; Williams and MacKinnon, 2008; Hayes, 2018). Effect sizes were classified as trivial (0–0.19), small (0.20–0.49), medium (0.50–0.79), and large (0.80 and greater), as suggested by Cohen (1992).

## RESULTS

### Preliminary Analyses

No missing values or outliers (univariate or multivariate), as well as no univariate distribution violations were observed. Nevertheless, Mardia's coefficient form multivariate kurtosis has exceeded the recommended value ( $> 0.5$ ). Therefore, bootstrap Bollen-Stine (2,000 samples) was performed according to Nevitt and Hancock (2001). Additionally, variance inflation factor (VIF) was calculated to check the collinearity diagnosis. Results indicate that all VIF values were  $< 10$ , a recommended value suggested by Hair et al. (2014). Finally, a GPower 3.1 (Faul et al., 2009) was used to determine the required sample size (considering the following parameters: effect size  $f^2 = 0.1$ ;  $\alpha = 0.05$ ; statistical power = 0.95, and four predictors) pointing that the minimum

required size would be 176 subjects, which was respected in the present study.

## Measurement Model

Means, standard deviations, and bivariate correlations among all constructs are presented in **Table 1**. In general, athletes exhibit high levels of commitment ( $M = 2.74$ ;  $SD = 0.41$ ), reduced sense of personal accomplishment ( $M = 2.82$ ;  $SD = 0.45$ ), moderate values of fear of failure ( $M = 2.08$ ;  $SD = 0.79$ ), and depersonalization ( $M = 2.29$ ;  $SD = 0.78$ ). In contrast, athletes showed lower levels of emotional exhaustion ( $M = 1.07$ ;  $SD = 0.53$ ).

The correlation patterns evidence that commitment was negative and significantly associated with emotional exhaustion, depersonalization, and fear of failure. In contrast, commitment was positive and significantly associated with reduced sense of personal accomplishment. On the other hand, fear of failure was positive and significantly associated with both depersonalization and emotional exhaustion and negative and significantly associated with reduced sense of personal accomplishment. Regarding burnout constructs, results showed that depersonalization and emotional exhaustion are associated negatively and significantly with reduced sense of personal accomplishment while reduced sense of personal accomplishment is positive and significantly associated with emotional exhaustion.

Finally, it was possible to observe that all constructs present an adjusted value of composite reliability, since all of them are  $\geq 0.70$  (Hair et al., 2014). The test of measurement model included commitment, fear of failure, and burnout dimensions (i.e., depersonalization, reduced sense of personal accomplishment, and emotional exhaustion). Results shown that measurement model fit to the data [ $\chi^2 = 412.91$  (395);  $SRMR = 0.049$ ;  $B-Sp = <0.001$ ;  $RMSEA = 0.038$  (90% CI = 0.032, 0.045);  $TLI = 0.926$ ;  $CFI = 0.935$ ]. Additionally, measurement model revealed no problems in both convergent and discriminant validity, since the average variance extracted was  $\geq 0.50$  (Fornell and Larcker, 1981; Hair et al., 2014) and the square correlations among all constructs are less than the AVE of each factor (Fornell and Larcker, 1981).

## Structural Model

The structural model shown a good fit to the data [ $\chi^2 = 499.04$  (401);  $SRMR = 0.061$ ;  $B-Sp = <0.001$ ;  $RMSEA = 0.046$  (90% CI = 0.040, 0.052);  $TLI = 0.900$ ;  $CFI = 0.910$ ]. In the standardized direct effect (**Figure 2**), negative and significant effects were observed between commitment and fear of failure ( $\beta = -0.39$  [ $-0.485, -0.279$ ]). In addition, fear of failure showed a positive and significant effect with both emotional exhaustion ( $\beta = 0.75$  [ $0.663, 0.821$ ]) and depersonalization ( $\beta = 0.66$  [ $0.568, 0.738$ ]). In contrast, a negative and significant effect was observed between fear of failure and reduced sense of personal accomplishment ( $\beta = -0.27$  [ $-0.382, -0.143$ ]) (**Figure 2**).

Regarding mediation analysis between commitment, through fear of failure, on depersonalization, emotional exhaustion, and reduced sense of personal accomplishment, results show a negative and significant indirect effect between commitment in both depersonalization ( $\beta = -0.25$  [ $-0.335, -0.173$ ]) and emotional exhaustion ( $\beta = -0.29$  [ $-0.382, -0.196$ ]), and a positive and significant effect between commitment reduced sense of personal accomplishment ( $\beta = 0.10$  [ $0.052, 0.168$ ]) *via* fear of failure. In sum, the mediation analysis revealed that fear of failure mediates negatively the association between commitment in both depersonalization and emotional exhaustion. In contrast, fear of failure mediates positively the association between commitment and reduced sense of personal accomplishment.

## DISCUSSION

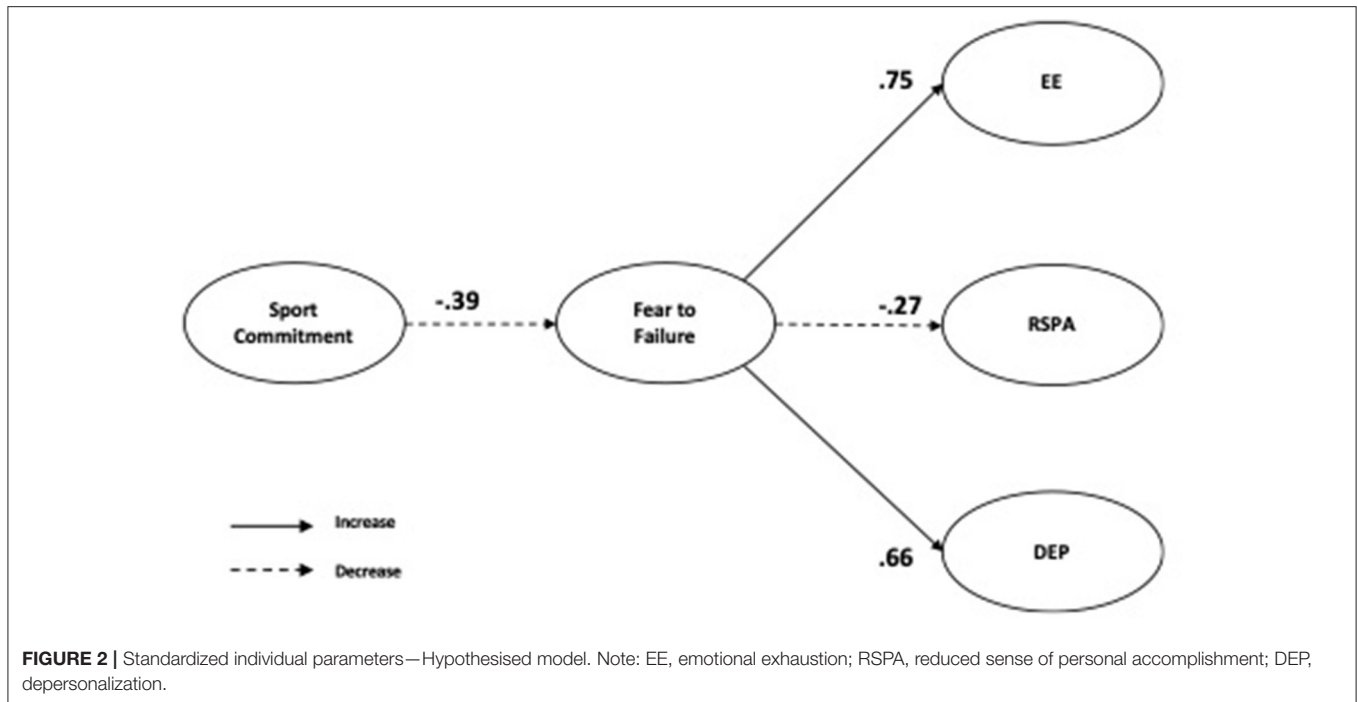
The aim of the study was to analyze the degree of adjustment of the perceptions of the fear of failure as a mediating variable in the estimated relationship between sporting commitment and the appearance of burnout in young handball players in a competitive context.

In the first instance, we sought to show the linear relationship between the variables under study, describing in the line of previous works that the protective value of sport commitment on the fear of failure (Bélanger et al., 2013) and burnout (Raedeke, 1997; Sousa et al., 2007; Williams, 2013). However, in a less expected way, as recent similar studies have pointed out (Woods et al., 2020), the commitment was positive and significantly associated with a lesser sense of self-fulfillment. As expected, fear

**TABLE 1 |** Descriptive and correlation analysis for all constructs and composite reliability.

Constructs	COM	FF	EE	DEP	RSPA
COM	—	—	—	—	—
FF	−0.33**	—	—	—	—
EE	−0.59**	0.76**	—	—	—
DEP	−0.29**	0.65**	0.79**	—	—
RSPA	0.46**	−0.27**	−0.27**	−0.21**	—
Mean	2.74	2.08	1.07	2.29	2.82
SD	0.41	0.79	0.53	0.78	0.45
CR	0.81	0.84	0.74	0.73	0.81

COM, commitment; FF, fear of failure; EE, emotional exhaustion; DEP, depersonalization; RSPA, reduced sense of personal accomplishment; CR, Composite reliability; SD, standard deviation; \*\* $p \leq 0.01$ .



of failure was positively related to burnout indicators (Lemyre et al., 2008; Correia et al., 2016; Gustafsson et al., 2016).

In the hope of reflecting the negative effect of cognitive devaluation caused by fear of failure on sporting commitment, and its corresponding orientation toward the occurrence of burnout, a model was tested which proposed the following sequence: sporting commitment, fear of failure, and consequences of burnout. As suggested in the literature reviewed (Chen et al., 2008; Bélanger et al., 2013; Correia et al., 2016), a clear reverse effect of commitment vs. burnout was shown through the emergence of fear of failure (Gustafsson et al., 2016). As expected, emotional and cognitive depreciation aimed at the negative consequences that accompany making mistakes increases the occurrence of both emotional exhaustion and depersonalization (Williams, 2013; Kozusznik et al., 2015). However, it has only been possible to partially fulfill the hypotheses put forward, as negative links have been observed between fear of failure and a reduced sense of accomplishment.

Different studies reflect that those athletes with a high level of sport commitment enjoy higher levels of motivation (Ryan and Deci, 2000; Pulido et al., 2018), increasing their enjoyment (Schmidt and Stein, 1991; Tamminen et al., 2016) and involvement (Funk et al., 2011) with sports practice. In addition, sportsmen and women with a high level of sporting commitment increase team performance (Gross et al., 2018), collective identity (Wann and Pierce, 2003), or the perception of task- and care-oriented climates among team members (Torregrosa et al., 2011; Hall et al., 2017). On the contrary, and in the same way as the results of the present work, engagement already in young athletes decreases the anxious perception of competitive situations (Pons et al., 2018) and enhances positive emotions (McCarthy, 2011; Friesen et al., 2013) in young athletes.

With regard to its links with burnout, sport commitment has maintained negative relationships with both emotional exhaustion, sports devaluation, and reduced personal fulfillment throughout most of the scientific literature (Gustafsson et al., 2017b; Bicalho and Da Costa, 2018) both in individual (Weiss et al., 2001) and team sports (Cresswell and Eklund, 2006; Curran et al., 2013) and in professional sports (Hill et al., 2008) or in lower categories (Harris and Watson, 2011; Pons et al., 2018). However, in team sports, it has been argued in recent studies that being committed to the team is linked to an increased deterioration in sporting self-fulfillment, essentially when the pride and honor associated with belonging to a team is present, often combined with a sense of responsibility and a desire to maintain standards of performance in order to contribute and be useful to the team (Woods et al., 2020).

Precisely, many of these elements associated with commitment, also linked to the paths that lead to focus on the fulfillment of objectives (e.g., wanting to show the group usefulness, playing the assigned role; Weiss, 2020), seem to have strong positive effects that cannot be limited by the appearance of fear of failure (Hughes and Hassan, 2015).

Research indicates how the enthusiasm and challenge with which one hopes to overcome a challenge, the pride in representing one's team or sport (e.g., national team), or the sacrifice required to identify with success (Lanter and Hawkins, 2013; Woods et al., 2020).

Apart from the fact that the study carried out offers an important contribution to the way in which the commitment generated in young sportsmen and women by a team sport such as handball can be linked, it is necessary to reflect some limitations with which to take into account the results obtained, mainly so that they can be taken into account in future similar

proposals. In the correlational study, relationships are established between the variables, and there is no causal relationship. Although, correlation analyses provide an explanatory model that allows a better and more comprehensive understanding of the relationship between sport commitment, fear of making mistakes, and burnout indicators. The resulting model, taking into account the problem of equivalent models presented by the structural equation technique (Hershberger and Marcoulides, 2006), is assumed to be one more of the possible models in this study. Although the sample size is considerable, it would be more conclusive with a larger sample that could also provide studies on invariance on some sociodemographic conditions (e.g., gender, age, etc.).

Aware of the limitations of descriptive studies, we assume the need to carry out more studies in this line that contrast the results obtained with other groups of athletes (e.g., individuals vs. team; different sports transitions) or from a cross-cultural perspective. In this way, it would be necessary to complement future studies with the analysis of the influence they exert (e.g., coaches, peers) on the relevance of sport commitment and the protective or risk value of fear of failure for burnout indicators. Another interesting aspect would be to contrast the perception that athletes have under the influence of different variables in which it has been evidenced that they maintain a link on their representation as athletes (e.g., perfectionism, impulsivity). Also, to explore the links that fear of failure, sporting commitment, and burnout maintain with internal variables of the condition of athletes (e.g., self-esteem, self-concept) or emotional response (e.g., anxiety, emotional intelligence) in terms of their experiences of success and failure. Finally, the proposal of new models that complement and complete the results obtained, will allow to configure an extended scientific background that offers more information for the resources applied in psychological training.

## CONCLUSIONS

Regarding the mediation analysis between commitment, fear of failure, depersonalization, emotional exhaustion, and reduced sense of personal accomplishment, results show a negative and significant indirect effect between commitment in both depersonalization and emotional exhaustion and a positive and significant effect between commitment-reduced senses of personal accomplishment, *via* fear of failure. In sum, the mediation analysis revealed that fear of failure mediates negatively the association between commitment in both depersonalization and emotional exhaustion. In contrast, fear of failure mediates positively the association between commitment and reduced sense of personal accomplishment.

The evaluated athletes reflect a positive psychological disposition, which is synonym with desire and decision to contribute to their teams, participating and adding to the competition (they are young people selected for their sporting talent to represent their territorial teams). Despite the appearance of cognitive-emotional processes associated with fear of failure (e.g., shame, fear of criticism), it has

been observed that this constitutes a way of protecting the sense of personal fulfillment through sporting effort. However, this same component, centered on the devaluation of the capacities for sporting action and the overestimation of the negative consequences of the mistake, becomes a risk factor for emotional exhaustion and the distancing/withdrawal of the sporting value.

From the perspective of sport commitment models, which are closely associated with achievement motivation, it is possible to link elements that facilitate positive adaptation (for example, the degree of enjoyment, the valuation of personal investments, or participation opportunities), committing personal efforts to a markedly successful path in the competitive environment. Young athletes who aspire to be elite, more susceptible, and ambitious to reach higher levels or to demonstrate their talent, place a high value on the styles of their coaches, on the links with their peers, and on the details that lead them to improve their sporting opportunities, while overstating those aspects that can lead them to make mistakes, dangerously linked to perceptions of failure (almost equally perceived).

It is of great relevance that professionals of sport training and sport psychology design possibilities to experience behaviors of fear of failure linked or inserted in positive coping strategies toward sport action. In this way, the adaptive process will focus on improving the perception of competence and personal (e.g., self-confidence) and psychosocial (e.g., leaning on others) resources to be put into action at every moment of sport performance. The prelude to success is the functional learning of “not afraid to fail.” Otherwise, as performance-oriented avoidance behavior that focuses on all the negative aspects of failure (e.g., external criticism, cognitive and emotional devaluation, medium- and long-term underperformance), it will make the sports experience an agony rather than an escape.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors if they are requested, and without undue reservation (jgonzalez@ugr.es).

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the Universidad de Murcia (ID: 1494/2017). Participants and participants' legal guardian/next of kin provided their written informed consent to participate in the study.

## AUTHOR CONTRIBUTIONS

JG-H and MG-L: conceptualization, data curation, and writing—review and editing. DM and CdS: methodology and formal analysis. MG-L: investigation. All authors writing-original draft preparation and supervision.



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# Physical Education Attitude of Adolescent Students in the Philippines: Importance of Curriculum and Teacher Sex and Behaviors

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The present study examined the attitudes of Filipino middle school students toward physical education (PE) and the associations between PE attitude and various personal and external correlates of PE. In total, 659 middle school students, aged between 12 and 19 years ( $M = 14.55$ ;  $SD = 1.14$ ), participated in the study. The Physical Education Attitude Scale (PEAS) was used to measure affective, cognitive, and motivational/behavioral attitudes of adolescent students toward PE. Results showed that middle school students had moderate general attitudes toward PE. Female students had more favorable attitudes toward PE when their teacher was male than female. When the teacher was female, male students were more satisfied with the PE curriculum than female students. When the teacher was male, female students were more comfortable with the PE curriculum than male students. Finally, students' PE attitude did not decrease as they got older, regardless of student sex. The findings provide a different perspective for the field and underscore the importance of not only the PE curriculum but also the student-teacher relationship. To prevent the decline in students' positive attitude and encourage positive behaviors toward PE and activities, teachers should be very considerate about their interactions with students of the same sex; school administrators (e.g., principal and PE department head), meanwhile, should focus at providing PE teachers with special training courses to enhance both their teaching and communication capabilities.

**Keywords:** Filipino students, student-teacher interaction, physical education, MODE model, physical education attitude scale

## INTRODUCTION

People's different views about a target object may affect how they respond to it; these views are often categorized as either positive or negative. In school, for instance, students can have a positive or negative attitude toward certain subjects, and this can occur owing to various reasons. Some students may have a positive attitude toward physical education (PE), for example, because they like the activities they play in the class (Luke and Sinclair, 1991), while others can have negative attitudes toward PE because they dislike the way the teacher manages the class or the activity itself

(Luke and Sinclair, 1991). These developed attitudes toward PE, in turn, can either be detrimental or favorable to students' current and future participation in PE, mainly because attitudes people have toward a particular object, person, or thing are said to influence behaviors (Ajzen, 1985, p. 11–39; Fazio and Olson, 2014, p. 155–171).

Based on the motivation and opportunity (MODE) model (Fazio and Olson, 2014, p. 155–171), attitude is defined as individuals' association of the “attitude object” and the overall evaluation of this attitude object that is stored in their memory. The evaluation of the attitude object depends on individuals' perceived views, feelings, and prior experiences, or even various combinations of these cognitive, emotional, and behavioral sources of information, all of which are elicited from individuals' memory. This evaluation may vary in valence (i.e., either positive or negative), and the strength of the association between the attitude object and its evaluation, especially a strong one, tends to be automatically activated from individuals' memory upon encountering the attitude object; this process eventually determines individuals' judgment and/or behavior in an immediate situation. To counter the direct influence of a strongly activated attitude, individuals should have the motivation and opportunity to deliberately process the attitude object.

Accordingly, students who have experienced enjoyable physical activities (PA) in the PE class are likely to have learned meaningful lessons and to have felt other pleasant events related to PE; these experiences and the resulting memories may yield a strong positive attitude toward PA and PE, and thereby, strong participation. The reverse may be true for students who have not found PA and PE enjoyable in the past. Thus, memory affects students' behavior in an ongoing way. Based on this understanding—which is backed up by the MODE model—we can deem as important the examination of students' attitudes toward PE and which aspects of PE classes they prefer or dislike, in order to revise those activities to improve their effectiveness at building positive memories and engaging students.

Students' attitude toward PE (or PE attitudes) have been shown to be associated with various personal and external factors. Regarding personal factors, some researchers have found female students to have more positive attitudes toward PE than male students (Zeng et al., 2011; Pereira et al., 2020), while others found opposite results (Koca and Demirhan, 2004; Koca et al., 2005; Mercier et al., 2017; Orlić et al., 2017), and other studies have found PE attitudes to be similar between sexes (Subramaniam and Silverman, 2007; Scrabis-Fletcher et al., 2016; Marttinen et al., 2018). Meanwhile, studies that examined the association between grade level and PE attitude showed a decline in students' positive attitudes toward PE as grade increased (Subramaniam and Silverman, 2007; Hu et al., 2014; Silverman, 2017; Pereira et al., 2020). Furthermore, extracurricular sports participation has also been shown to influence students' PE attitudes, with students involved in sports showing more positive attitudes than those not involved (Koca and Demirhan, 2004; Orlić et al., 2017; Pereira et al., 2020).

Regarding external factors, PE curriculum, class atmosphere, and teacher behaviors have all been shown to affect students'

PE attitude (Luke and Sinclair, 1991; Rikard and Banville, 2007; Subramaniam and Silverman, 2007). Exemplifying, curriculum content that promotes a fun and enjoyable atmosphere was shown to impact the development of positive attitudes among students (Rikard and Banville, 2007; Subramaniam and Silverman, 2007; Dismore and Bailey, 2011); however, curriculum content can also influence the formation of negative attitudes toward PE, particularly when it comprises long runs or repetitive and boring PE-related activities (Luke and Sinclair, 1991; Rikard and Banville, 2007). Furthermore, teachers' behaviors, especially their evaluation and decision-making methods, are found to highly impact students' negative attitudes toward PE (Luke and Sinclair, 1991).

While a plethora of studies regarding students' attitude toward PE and its correlates are available—as shown above—most previous studies focused on the affective and cognitive views of attitudes and on students with Western backgrounds. In particular, researchers who previously examined PE attitude of students utilized the Students' Attitudes toward Physical Education Questionnaire (SATPE; Subramaniam and Silverman, 2000) anchored on the affective and cognitive components of attitudes. While the instrument is widely accepted, others (Orlić et al., 2017) presented its limitations and developed the PE Attitude Scale (PEAS) as an alternative assessment tool that examines a broader spectrum of aspects of PE experiences within the affective, cognitive, as well as motivational/behavioral indicators of attitude. Furthermore, albeit studies found that teachers' behaviors greatly affected students' negative attitude toward PE, the influence of teacher sex was not considered (Luke and Sinclair, 1991); this variable can also be an influential factor on students' PE attitude. Correlatively, a study found that male students perceived that their female teachers provided more time/feedback/attention to them than to their female peers (Nicaise et al., 2007). Thus, further investigation is warranted regarding students' attitude toward PE with consideration to motivational/behavioral indicators of attitude and teacher sex as dependent and independent variables, respectively.

In the Philippines, a country in Southeast Asia, empirical findings about students' PE attitude are almost nonexistent. Concomitantly, Filipino students have recently been found to have the second highest prevalence of insufficient PA among school-aged adolescents worldwide (World Health Organization, 2019). Thus, extending the scientific setting to this country seems important because identifying Filipino students' PE attitude and its associated factors can provide valuable insights; specifically, Filipino stakeholders on the development of enhanced policies and curricula that can promote PE as a positive academic subject can make good use of such knowledge for their endeavors. In doing so, Filipino students may incur in better outcomes regarding their participation in sports and other PAs, thereby decreasing their risks of future health problems.

For that reason, this study aimed to examine Filipino middle school students' attitude toward PE and the associations between their PE attitudes and various personal and external correlates of PE. Particularly, we analyzed the correlates of PE and their individual relative contributions to PE attitude by sex. We also examined students' PE attitude differences by sex, grade level, PA



**TABLE 1** | Overall PE attitude and dimensions of PE scores based on student sex, teacher, sex, grade level, and physical activity outside school.

		Satisfaction		Comfort		Activity		Teacher		PE Attitude	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<b>Overall</b>		3.93	0.57	3.70	0.56	3.92	0.55	3.70	0.59	3.82	0.48
<b>Student sex</b>											
Male students		3.89	0.62	3.70	0.60	3.94	0.58	3.71	0.63	3.82	0.52
Female students		3.96	0.53	3.70	0.53	3.91	0.52	3.69	0.56	3.83	0.44
<b>Grade level</b>											
8		3.82	0.55	3.61	0.55	3.84	0.52	3.56	0.62	3.72	0.44
9		3.89	0.53	3.67	0.53	3.89	0.53	3.66	0.56	3.79	0.45
10		4.19	0.59	3.91	0.59	4.12	0.58	4.00	0.50	4.06	0.50
<b>PA outside school</b>											
With		3.94	0.54	3.71	0.54	3.92	0.54	3.69	0.58	3.82	0.46
Without		3.89	0.58	3.64	0.57	3.92	0.55	3.68	0.61	3.79	0.47
<b>Student sex</b>	<b>Teacher sex</b>										
Male students	Male	3.89	0.60	3.72	0.61	3.99	0.56	3.83	0.57	3.86	0.52
	Female	3.89	0.64	3.67	0.58	3.88	0.61	3.56	0.67	3.77	0.51
Female students	Male	4.08	0.54	3.84	0.52	3.99	0.50	3.80	0.51	3.94	0.44
	Female	3.87	0.51	3.60	0.53	3.85	0.53	3.61	0.58	3.74	0.43

PE, physical education; PA, physical activity.

outside school, and PE teacher sex. Accordingly, we put forward the following hypotheses:

- Hypothesis 1: Filipino middle school students will report a moderately positive attitude toward PE;
- Hypothesis 2: Various known correlates of PE will have significant relationships with PE attitude;
- Hypothesis 3: PE attitude levels will differ by student sex;
- Hypothesis 4: Students with pre-existing PA outside school will show more positive attitudes toward PE than those with no such experience;
- Hypothesis 5: Students' attitude toward PE will decrease as grade level increases; and, based on existing literature,
- Hypothesis 6: PE teacher sex will influence students' attitude toward PE positively or negatively.

## MATERIALS AND METHODS

### Participants

In total, 659 middle school students, aged between 12 and 19 years ( $M = 14.55$ ;  $SD = 1.14$ ), partook in this study. The sample is composed of 37.5% grade 8, 29% grade 9, and 22% grade 10 students. There were 43.6% male and 56.4% female students. Moreover, 48.5% and 51.5% of the sample students had either male or female teacher, respectively. Through a non-probabilistic convenience sampling method, participants were recruited from six classes in grade 8, 7 classes in grade 9, and 5 classes in grade 10. All participants studied in a public national high school in an urban city in the Philippines.

### Instrument

The Physical Education Attitude Scale (PEAS) was used to measure adolescent students' attitude toward PE (Orlić et al.,

2017). It comprises 43 items that measure a wide array of experiences regarding PE and are rated on a five-point Likert scale (1, *strongly disagree*; 5, *strongly agree*). It is divided into the following four subscales: *satisfaction* (12 items; e.g., "I like to attend PE classes"), relating to general emotions about PE experiences; *comfort* (12 items; e.g., "I feel uncomfortable in PE classes"), relating to specific feelings about PE; *activity* (11 items; e.g., "I like to show what I know in PE classes"), relating to motivational processes when participating in PE classes; and *teacher* (8 items; e.g., "PE teacher encourages me in class"), relating to perceptions about the PE teacher. The psychometric properties and construct and external validity of the PEAS were supported (Orlić et al., 2017). In this study, its overall Cronbach's  $\alpha$  was of 0.92; that for its subscales was 0.83, 0.76, 0.81, and 0.73, in the order of satisfaction, comfort, activity, and teacher, respectively. The principal component correlations in this study ranged from 0.350 to 0.555.

### Data Collection Procedure

Prior to data collection, we obtained approval from the school principal and PE teachers; specifically, the researchers conducted a session with all PE teachers to explain the objectives and procedures of the study. The main researcher read and explained each item in the questionnaire to PE teachers and provided clarifications to any questions about any aspect of the study or its questionnaire. Then, 15–20 min during the beginning of the scheduled PE class, the PE teachers informed their students about the research and explained its objectives. Students were briefed about participation being purely voluntary and that anonymity would be ensured. After, PE teachers distributed the questionnaires to their respective students and performed the same instruction protocol as previously

**TABLE 2 |** Hierarchical multiple regression predicting PE attitude.

Variable	Cumulative		Simultaneous	
	R <sup>2</sup> change	F change	β	p
<b>Male students</b>				
Block 1	0.034	F <sub>(3,256)</sub> = 3.02*		
Teacher sex			−0.001	0.222
Age			0.000	0.296
PA-POS			0.000	0.233
Block 2	0.966	F <sub>(4,252)</sub> = 1,493,540.89**		
Teacher			0.237	<0.001**
Activity			0.294	<0.001**
Comfort			0.324	<0.001**
Satisfaction			0.328	<0.001**
<b>Female students</b>				
Block 1	0.047	F <sub>(3,338)</sub> = 5.58**		
Teacher sex			0.000	0.883
Age			−0.001	0.215
PA-POS			0.001	0.025*
Block 2	0.953	F <sub>(4,334)</sub> = 1,360,480.20**		
Teacher			0.235	<0.001**
Activity			0.303	<0.001**
Comfort			0.336	<0.001**
Satisfaction			0.338	<0.001**

Teacher sex: 1 = male, 2 = female; PA-POS, Physical Activity Participation Outside School: 1 = with physical activity, 2 = without physical activity; β = standardized beta coefficient; p = significance value of all predictors in the final model; \*p < 0.05, \*\*p < 0.001.

directed by the researcher. In addition to their own informed consent, students were also requested, if considered minors, to obtain written approval from their parents/guardians prior to answering the questionnaire. To encourage honest and truthful responses, students were notified that their answers would be strictly confidential and the results would only be used for academic purposes. Students were given 1 week to return the questionnaires. Submitted survey forms were sorted and checked for incomplete responses. The procedures of this study followed both the ethical principles put forward by the Declaration of Helsinki regarding human participants and those of the national psychological association of the Philippines where the research was conducted.

## Data Analysis

Data were encoded via Microsoft Excel and were cross-checked for errors in encoding or missing values. Data were discarded if the following occurred: relevant information in the questionnaire was missing or incomplete; statements were not properly answered; and/or showed straightforward responses. The data were then exported to SPSS for further data screening tests (e.g., tests for normality and outliers). From the original 664 samples, data from 659 students were qualified for statistical analysis.

To examine the influence of student sex, grade level, and the interactions between student and teacher sex on PE attitudes, we conducted multivariate analysis of variance (MANOVA).

Upon the appearance of significant differences between factor levels, we conducted *post hoc* analysis; to compare the main and interaction effects, we conducted pairwise *t*-tests with Bonferroni adjustments. Last, to predict students' general PE attitude based on correlates of PE, as well as the relative contribution of each correlate by student sex, we conducted hierarchical linear regression analysis. All significance levels were set to a *p* < 0.05.

## RESULTS

### Descriptive Analysis

Overall, (see Table 1) middle school students reported moderately positive attitudes toward PE ( $3.82 \pm 0.48$ ). Male and female students had similar average scores for PE attitude. Likewise, grade 8 and grade 9 students expressed moderately positive attitudes toward PE; however, grade 10 students reported very strong positive attitudes toward PE ( $4.06 \pm 0.50$ ).

Moreover, 75.5% of the students were involved in PA outside school. However, students had similar favorable attitudes toward PE regardless of PA outside school status. Furthermore, students' PE attitudes for male (48.5%) and female (51.5%) PE teachers were favorable and almost alike (average range:  $3.74\text{--}3.94 \pm 0.43\text{--}0.52$ ).

### Effects of Personal and External Factors on PE Attitude

Results of MANOVA showed a statistically significant univariate effect of grade level on PE attitude [Pillai's Trace = 0.047,  $F_{(5,581)} = 2.78$ ,  $p < 0.002$ ; partial  $\eta^2 = 0.023$ ]. However, PA outside school, student sex, and teacher sex did not influence PE attitude.

A discriminant analysis for grade level showed differences for general PE attitude [ $F_{(2,585)} = 6.40$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.021$ ] and in the dimensions of satisfaction [ $F_{(2,585)} = 6.97$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.023$ ], activity [ $F_{(2,585)} = 3.82$ ,  $p < 0.05$ ; partial  $\eta^2 = 0.013$ ], and teacher [ $F_{(2,585)} = 5.67$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.019$ ]. Multiple comparisons between grade levels showed that the mean scores for general PE attitude (4.13 vs. 3.72/3.79), satisfaction (4.25 vs. 3.78/3.90), activity (4.21 vs. 3.86/3.89), and teacher (4.07 vs. 3.56/3.67) were statistically significant between grade 10 and grades 8 and 9. The mean score for the comfort dimension was non-significantly higher in grade 10 than in the other two grades, whereas the mean scores for all variables between grades 9 and 8 were not statistically different.

The interaction effects between the independent variables and PE attitude did not show any statistical significance, except for the interaction between student and teacher sex [Pillai's Trace = 0.020,  $F_{(5,581)} = 2.37$ ,  $p < 0.05$ ; partial  $\eta^2 = 0.020$ ]. A discriminant analysis for the interaction between student and teacher sex showed differences in general PE attitude [ $F_{(1,585)} = 6.04$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.010$ ] and in the dimensions of satisfaction [ $F_{(1,585)} = 7.11$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.012$ ] and comfort [ $F_{(1,585)} = 7.84$ ,  $p < 0.01$ ; partial  $\eta^2 = 0.013$ ]. Multiple pairwise comparisons showed that, when the teacher was male, the scores for general PE attitude (3.90 vs. 3.74) and the comfort dimension (3.84 vs. 3.60) were substantially higher in female than in male students. When the teacher was female, the satisfaction

score of male students was statistically higher than that of female students (4.11 vs. 3.85).

## Regression Analyses for the Predictors of PE Attitude by Student Sex

For the hierarchical regression analyses, Block 1 included age (representing grade level), teacher sex, PA outside school; Block 2 also included the PE dimensions (see Table 2).

Concerning male students, the regression model generally explained all the variability in PE attitude [ $R^2 = 1.00$ ,  $F_{(7,252)} = 883,676.365$ ,  $p < 0.001$ ]. Teacher sex, age, and PA outside school predicted ~3.4% of the variance in PE attitude, but were not found to be significant predictors of PE attitude in the final model. After controlling for these factors, the variables introduced in Block 2 were shown to predict ~96.6% of the variance in PE attitude; specifically, all PE dimensions significantly predicted PE attitude, in that higher scores for satisfaction ( $\beta = 0.33$ ), comfort ( $\beta = 0.32$ ), activity ( $\beta = 0.29$ ), and teacher ( $\beta = 0.24$ ) were associated with a more positive attitude toward PE.

Concerning female students, the regression model generally explained all the variability in PE attitude [ $R^2 = 1.00$ ,  $F_{(7,334)} = 815,938.716$ ,  $p < 0.001$ ]. Teacher sex, age, and PA outside school predicted ~4.7% of the variance in PE attitude, but only PA outside school was a significant predictor in the final model; specifically, students with no PA outside school had a more positive attitude toward PE. After controlling for the factors in Block 1, the variables introduced in Block 2 were shown to predict ~95.3% of the variance in PE attitude; particularly, all PE dimensions significantly predicted PE attitude, in that higher scores for satisfaction ( $\beta = 0.34$ ), comfort ( $\beta = 0.31$ ), activity ( $\beta = 0.29$ ), and teacher ( $\beta = 0.24$ ) were associated with a more positive attitude toward PE.

After analyzing potential multicollinearity for the study variables, we found that issues regarding this topic were not a concern; the VIF scores were lower than the recommended limit of 10 (Myers, 1990).

## DISCUSSION

This study aimed to investigate Filipino middle school students' attitude toward PE and the associations between PE attitude and various personal and external correlates of PE. In particular, we analyzed the correlates of PE and their individual relative contribution to PE attitude by student sex. We also examined the influences of sex, grade level, PA outside school, and teacher sex on students' attitude toward PE.

The mean scores of PE attitude and its dimensions ranged from 3.70 to 3.93 in our sample, indicating that students had moderate positive attitudes toward PE. This result confirms our hypothesis 1, suggesting that Filipino students generally have pleasant experiences and feelings toward PE and perceive the subject as valuable. These findings corroborate Orlić et al. (2017)'s research, who examined PE attitude of Serbian students using PEAS; they found that the mean scores for PE attitude (3.81) and the dimensions of satisfaction (3.82), activity (3.64), and

teacher (3.55) were moderately positively high. Nonetheless, in their study, the comfort dimension showed a higher score (mean score of 4.14). In a review of meaningful experiences in PE and youth sports (Beni et al., 2017), social interaction, fun, and challenge were considered as important contributors of meaningful experiences in PE. Thus, the difference between our results and those of Orlić et al. (2017) regarding the comfort dimension (i.e., moderate vs. high) may be due to Serbian students being able to experience more pleasant social interactions and to have more fun and/or more challenging activities in their PE class; this could have made them feel more relaxed and less anxious, leading to the higher positive attitude in the comfort dimension than that of our sample.

In another study that used PEAS to measure PE attitude (Orlić et al., 2018), the result showed that PE attitude of students was very high (4.21). This difference in results may be attributed to the characteristics of the students who likely experienced and enjoyed better PE class and thereby reported higher positive attitude in all dimensions of PE yielding a higher overall evaluation compared to our findings. However, specific scores of each PE dimension were not reported; thus, it is difficult to distinguish the source(s) that contributed to students' positive evaluation toward PE. Nevertheless, PE attitudes of students in our study were still positively similar to previous findings. While literatures about PE attitude are available, studies that examine PE attitude using PEAS are still limited. Hence, more studies are suggested, utilizing this instrument tool in assessing PE attitude to further understand general and specific information in the development of positive or negative attitude toward PE class.

## Influence of Student and Teacher Sex, Grade Level, and PA Outside School on PE Attitudes

The findings based on grade level revealed that PE attitude of grade 10 students was significantly more positive than those of grade 8 and 9 students. Furthermore, students' positive attitudes toward PE did not decline as grade level increased, but rather showed an increasing trend. These findings refuted hypothesis 5 and contrasted previous works (Subramaniam and Silverman, 2007; Hu et al., 2014; Silverman, 2017; Pereira et al., 2020). The questionnaire we used to assess PE attitude may have contributed to these differences with prior research: although the PEAS questionnaire (Orlić et al., 2017) generally assesses teacher behaviors and the curriculum content in a manner that is similar to how the Student Attitude Toward PE scale (Subramaniam and Silverman, 2007; Hu et al., 2014; Silverman, 2017; Pereira et al., 2020) does, the latter focuses on the cognitive and affective components of PE attitude, whereas the PEAS also delves into the motivational/behavioral aspects of PE attitude. Thus, the increase in positive attitude toward PE that we found may have been explained by this comprehensive consideration of the four dimensions of PE attitude, which incorporate sources of information derived from students' feelings, beliefs, motivations, previous behaviors, and experiences stored in students' memory about the subject.

Moreover, in the Philippines, the PE curriculum comprises fitness concepts, games, sports, rhythms, and dance strands, with various topics divided into four quarters throughout the academic year (Department of Education, 2016). Thus, it is possible that, during the time of data collection (in the third quarter of the academic year), students were able to access more extensive memories regarding their recent lessons, activities, and the behaviors of teachers who provided them with these classes. In the data collection period, grade 10 Filipino students were having lessons about lifestyle, weight management, and dance activities (e.g., hip hop and cheer dance); grade 9 students were studying community fitness and ballroom dances; and grade 8 students were studying PA training guidelines and team sports. Since grade 10 students had higher mean scores for PE attitude, we can infer that they may have enjoyed their specific activities more than did students in the other two grades we analyzed. This noteworthy finding suggests that students' PE attitude tend to increase upon having a curriculum that is satisfying, interesting, and enjoyable for them; based on prior research, we infer that these feelings may be evoked when PE activities are challenging, useful, less arduous, and interactive, and the teacher is encouraging and friendly toward students. However, further studies are warranted to better understand why such a trend occurred.

The results of the analyses by student sex and PA outside school showed no statistically significant differences in the mean scores for general PE attitude and dimensions, thereby refuting hypotheses 3 and 4. The findings confirm some in previous studies (Subramaniam and Silverman, 2007; Scrabis-Fletcher et al., 2016; Marttinen et al., 2018), which found no sex differences in PE attitudes. However, the current results also contradict other studies, which revealed that female students (Zeng et al., 2011; Pereira et al., 2020) or male students (Koca and Demirhan, 2004; Koca et al., 2005; Mercier et al., 2017; Orlić et al., 2017) had more positive attitudes toward PE compared with their counterparts. Furthermore, our findings did not support the findings of studies that reported that students with PA outside school had more positive attitudes toward PE than those who did not (Orlić et al., 2017, 2018; Pereira et al., 2020).

The lack of significant differences for PE attitude by student sex and PA outside school may be attributed to students having experienced numerous PE lessons that were perceived as fun, meaningful, and engaging, and these interesting activities may even have been experienced outside school. Based on students' reports for this study, their PA outside school were mostly badminton, volleyball, running/jogging, and dancing (i.e., street dance and Zumba), which are all part of the PE curriculum in the Philippines and were likely to have been experienced in their PE classes. Summarizing, our results indicate that student sex and PA outside school may not be significant determinants of PE attitude and that both female and male Filipino students, regardless of PA activities outside school, viewed PE in a favorable way and at similar degrees.

Generally, while attitude scores for male teachers were more positive compared with those for female teacher, there were no significant differences in students' PE attitude by teacher sex, refuting our hypothesis 6. However, we did find a significant

interaction between student sex and teacher sex: when their teacher was male, female students had a more favorable attitude toward PE than when the teacher was female; when the teacher was female, male students had a higher PE attitude than female students. Moreover, when the teacher was female, male students' satisfaction with PE was higher than that of female students, while when the teacher was male, female students' comfort in PE was higher than that of male students.

The significant findings may be explained by the gendering processes in PE (Berg and Lahelma, 2010; Lima et al., 2020) such as gender order (Connell, 1987), which creates power relation patterns between men and women in society and gender system (Hirdman, 1990) that categorizes males and females according to their differences in all aspects of life and follows a hierarchy based on male norms. Perhaps due to the physiological differences between male and female, wherein the former tends to be stronger, male PE teachers were likely to place lower expectations and demands on performances of female students and thereby provided more verbal interactions (Davis and Nicaise, 2011) and adjusted male-preferred activities to accommodate females. Accordingly, these behaviors of male PE teachers were perceived by female students to be helpful and encouraging that led to their increased positive attitude and comfort in PE. Conversely, following the male standard in PE, that is, students are expected to achieve certain performance levels comparable or exceeding the male model. In this case, female PE teachers could have provided more feedback and interaction to male students than females and led to the latter's lower satisfaction and positive attitude toward PE. This notion confirms a previous study (Nicaise et al., 2007) that showed female students perceived receiving less positive feedback compared with male students from female PE teachers despite their efforts and good performance. Nonetheless, these findings, therefore, highlight that student and teacher sex are factors that together, rather than independently, influence PE attitude. However, further explorations are warranted as to why this interaction pattern occurred.

To strengthen students' positive attitudes toward PE, PE teachers should consider how they interact with students of the same and different sex. Particularly, and based on the significant findings for the satisfaction and comfort dimensions of PE, female PE teachers should strive not to decrease the satisfaction level of female students during PE by striving to make the class fun and interesting and creating an atmosphere that facilitates social interactions, harmonious teacher–student relationships via positive feedback and technical information, and skill mastery. On the other hand, male teachers, when dealing with male students, should focus on making the class more comfortable through the proposal of less tiring and competition-focused activities and avoiding verbal and non-verbal criticisms. For school administrators, investing in new and modern equipment that are interesting for students and securing spaces both in and outside the vicinity of the school are noteworthy projects. Furthermore, providing a separate changing/dressing area where students can comfortably use is suggested since 58% and 60% of male and female students, respectively, reported being too uncomfortable to change clothes



in front of others. Implementing these recommendations may support the formation of students' positive attitudes toward PE and promote more student engagement.

## Relationships Between PE Attitude and PE Dimensions

Results of the hierarchical regression showed that all dimensions of PE (i.e., satisfaction, comfort, activity, and teacher) were significant predictors of PE attitude in male students; thus, when PE lessons are motivating, satisfying, and stress-free, and when PE teachers display supportive and friendly behaviors, male students' positive attitude toward PE tends to increase. In female students, all PE dimensions and PA outside school were significant contributors to PE attitude; however, the contribution of PA outside school was negligible. Thus, female students tend to develop a negative attitude toward PE when they have no PA outside school, teachers who lack the skills to teach PE and display unsupportive behaviors, and/or a PE curriculum that is too stressful and too focused on competition.

These remarks underscore the importance of these variables for the development of both positive and negative attitudes toward PE for students of both sexes, confirming hypothesis 2; these results also concur with other reports on how curriculum and teacher behavior can impact students' PE attitude (Luke and Sinclair, 1991; Silverman, 2017). However, more explorations are needed to identify the factors influencing PE attitude outside these dimensions, such as students' psychological status, facilities, PE equipment, and specific behaviors of teachers (e.g., feedback and attention), all of which have been shown to relate to PE attitude (Luke and Sinclair, 1991; Nicaise et al., 2007; Silverman, 2017) but were not covered in this study.

Summarizing, our results showed that demographic factors accounted for <5% of the variance in predicting PE attitude, while the remaining 95% was significantly and uniquely explained by factors related to PE dimensions, which mostly comprised various affective, cognitive, and motivational components of the PE program and teacher behaviors.

## LIMITATIONS

The collected data were provided by students from one public school, in one city, in a metropolitan area in the Philippines; this implies difficulties regarding the generalization of our results to other areas (vs. rural) or school types (vs. private), suggesting the need for inclusion of these variables (school location and type) in future studies. Such future examinations will not only provide knowledge on students' attitude toward PE in rural and private schools but also highlight the influence of these factors on PE attitude. The large sample size and implementation of a standard curriculum content across major public schools in the city highlight the value of these findings.

Furthermore, our participants were only middle school students, meaning that the results are exclusive to this population. Future researchers should replicate this study with the inclusion of other grade levels (e.g., grades 11 and 12), as this will allow for examinations regarding the longitudinal trend of PE

attitude (i.e., if the positive trend we observed would perpetuate). We would like to highlight the importance of further studying the topic in the Philippines.

## STRENGTHS

Albeit we included influencing factors of PE attitude that have been commonly found in past literature (i.e., sex, grade level, PA outside school/sport participation), our study expanded prior research by the addition of teacher sex as a potential influencing factor. Previous studies were not able to examine this aspect (Zeng et al., 2011; Hu et al., 2014; Orlić et al., 2017; Pereira et al., 2020). Accordingly, we found that teacher sex moderated the relationship between student sex and PE attitude, providing a novel insight for the literature on the topic. However, more research is needed to examine whether the influence of teacher sex on PE attitude is direct or indirect, especially while considering teacher gender identity. We also examined various correlates of PE attitude by looking at their relative contribution in predicting PE attitude, something that was not analyzed in previous studies (Subramaniam and Silverman, 2007; Zeng et al., 2011; Hu et al., 2014; Orlić et al., 2017; Pereira et al., 2020).

Based on the MODE model, attitude refers to the overall association between the beliefs toward a target object and the degree of evaluations related to a target attitude object that are stored in memory, and these guide judgment and behavior when the strong attitude object is spontaneously accessed from one's memory. Hence, Filipino students' attitude toward PE may have come from their general and specific emotional experiences about and motivations to participate in PE, and their personal views about the teacher. By analyzing these sources of information, we found that Filipino students had a positive and relatively high attitude toward PE. Accordingly, if these strong and positive attitudes toward PE are accessed from memory, students may feel more likely to participate in PE and PA in and outside school when presented with this kind of immediate situation. The opposite is likely to occur for students with negative attitude toward PE; therefore, to avoid this undesirable response, students with such negative attitudes should be further motivated and given opportunity to engage in PE.

## IMPLICATIONS

To encourage students' continuous and active involvement in PE, particularly for those with strong and favorable attitudes, PE teachers are suggested to strive to have the following behaviors: be creative in their pedagogical strategies, resourceful and enthusiastic when introducing new sports and PAs, and passionate about the values and benefits of PE and PAs to their students. Such behaviors may allow for students to experience pleasant situations during PE, subsequently allowing for them to more easily and spontaneously recall such pleasantness related to PE.

Furthermore, for students who tend to instinctively avoid PE and PA, possibly owing to intense and unfavorable attitudes toward them, we recommend PE teachers to strive to be as

considerate as possible when interacting with their students. For male students, teachers should focus on providing satisfying general emotional experiences (i.e., satisfaction dimension), giving them the opportunity to choose the PE activities that are interesting and enjoyable for them and ample time to play with their peers. For female students, teachers should consider improving their interactions with and overall presence by displaying proper behaviors related to health and fitness and providing ample feedback and encouragement when teaching. This is especially important for female students because the teacher dimension for this group yielded the lowest score among all dimensions of PE (mean = 1.50).

Further, students with a strong negative attitude toward PE should receive more efforts related to motivation to engage in PE and opportunities to deliberately experience and process new positive experiences; these may eventually turn into beliefs and change students' perceptions about PE for the better—consequently leading them to attempt to partake in PE once more. Finally, we recommend for school administrators to provide PE teachers with special training courses to enhance both their teaching and communication capabilities; doing so may allow for them to create a better PE curriculum and better connect with their students, thereby supporting the development of better attitudes toward PE in students.

## CONCLUSIONS

We found that students' PE attitude did not decrease as they got older, regardless of student sex. To our knowledge, this is the first study with this kind of result, providing a new perspective toward understanding PE attitude. Moreover, the study provides new insights into the role of teacher sex as a moderator in the

relationship between student sex and PE attitude, and highlights the importance of PE curriculum—particularly the affective components of attitude—in predicting students' PE attitude.

Overall, Filipino middle high school students had strong positive views about their PE curriculum and their PE teachers, deeming them as valuable, enjoyable, and motivating. Teachers and school administrators should, therefore, create curricula and policies that do not let these positive attitudes decline; based on prior evidence, we can infer that the maintenance of these strong positive attitudes toward PE can lead students to healthy PA behaviors in the near future.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

AC, MK, and H-DK developed and designed the research project. AC collected the data and wrote the manuscript. H-DK and MK analyzed the data and made revisions in the manuscript. All authors contributed to the article and approved the submitted version.

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# Shifting the Paradigm: A Constructivist Analysis of Agency and Structure in Sustained Youth Sport Participation

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To examine the impact of the relationship between agency and structure on sustained participation in youth sport, semi-structured interviews were conducted with male college soccer players. The participants' accounts ( $N = 20$ ) of their youth careers were analyzed through the lens of Structuration Theory (ST) framed in a constructivist paradigm. ST supports the significance of the recursive relationship between agent and structure in-context in the co-construction of experiences, and provides a framework for analyzing effects of compounding experiences gained across time and space as they influence sport continuation. Clarity of expectations imposed in-context and the athlete's perceived impact on the structure evidenced, through deductive thematic analysis, as the most salient determinants of the perceived valence of the youth sport environment. The agent's perceived holding of authoritative resources across time and contexts was a critical dimension of the participants' continuation in youth sport, substantiating ST as a theoretical lens, situated in a constructivist paradigm, that might add depth to understanding patterns in participation and attrition.

**Keywords:** Structuration Theory, youth sport, participation, attrition, resources, agency, structure

## INTRODUCTION

Sport participation during the school age and adolescent child development stages is purported to promote higher self-esteem, higher self-confidence, increased self and social awareness, improved social interaction, and improved physical development and trans-contextual fitness habits (Gould, 2019; Howie et al., 2020). Additionally, sport participation has shown to support the opportunity to build cultural and social capital –antecedents to social mobility (Coakley, 2017; Howie et al., 2020). Despite the overwhelming evidence of the positive impact sport participation might have on the individual, trends in youth sport have evidenced a decline in participation rates and an increase in attrition rates (Balish et al., 2014; Turner et al., 2015; Aspen Institute, 2019).

The decrease in participation rates is a convoluted and multifaceted issue because the foundational constructs present as paradigmatic for researchers—the increased risk of obesity and health-related illness for those who do not participate are quantifiable (Turner et al., 2015; Witt and Dangi, 2018; Gould, 2019); however, the opportunity cost of decreased participation manifests in the loss of psychological, psychosocial, and fitness habit development, which are more difficult constructs to measure (Fraser-Thomas et al., 2005; Turner et al., 2015; Witt and Dangi, 2018; Gould, 2019). Of those populations that have seen the greatest decrease in participation rates (low SES and



Black and Latinx children), access and opportunity to participate are identified as limiting factors (Aspen Institute, 2019; Gould, 2019).

Exacerbating the urgency around social issues in youth sport, participation and attrition patterns are of particular concern coming out of an unprecedented pandemic era in which youth sport opportunities might be increasingly consolidated into privatized organizations and structures (Coakley, 2017; Farrey, 2021). While attrition rates have historically been highest in the adolescent years, macro-level research indicates that attrition rates among adolescents have been exacerbated by elevated competitive intensity, exclusivity, and early immersion in youth sport environments (Witt and Dangi, 2018; Aspen Institute, 2019). In contrast, motivation research, generally positioned in a post-positivist research paradigm, has generated a body of knowledge around how a youth sport climate in which the objectives of winning and early success supersede objectives around age-appropriate psychological, psychosocial, and physical development detract from youths' motivation to sustain participation (Petitpas et al., 2005; Wendling et al., 2018; Bateman et al., 2020).

The rich body of knowledge on youth sport participation patterns is overwhelmingly situated in a post-positivist paradigm in which motivation is purported as the principal determinant of sustained participation and where frameworks designed to support findings about motivation operate in a context-specific snapshot (Balaguer et al., 2017; Bateman et al., 2020). In order to develop novel insights and potential research veins to disrupt the reliably bleak youth sport participation trends, participation and the processes of continuation is framed here through a constructivist lens, which operates on the co-construction of the experience, both in-context and across time and space (Home and Jary, 2004; Elliott et al., 2020).

The objective of this study was to explore the conceptual contrasts athletes made between motivation and perceptions of agency, as constrained and enabled by structural parameters, in-context and across sport experiences that compounded to the athlete's youth career (Home and Jary, 2004; Rose, 2006). The implications of the study center on exploring the potential a constructivist-based theoretical framework holds in expanding how youth sport participation patterns are examined and conceptualized. The following research questions guided study design and data analysis:

- What structural factors supported continuation in a sport environment?
- What personal (micro-level) factors supported continuation in a sport environment?
- How did structural and personal factors compound across time and contexts to affect sustained participation in youth sport?

## Situating Theory in Youth Sport Participation Trends

The predominance of research on supporting youth sport participation has centered on youths' motivation to participate in sport and the perceived benefits of participation. Among the

primary motives to participate that youth identify are: (a) to have fun, (b) to be with friends, (c) to get exercise, and (d) for the excitement or challenge of competition (Fraser-Thomas et al., 2005; Balish et al., 2014; Wendling et al., 2018). Youth's motives for sport participation were derived from analyses primarily grounded in theory that is situated in a post-positive paradigm, such as Ryan and Deci's (2000) Self Determination Theory (SDT) of motivation and personality, in which micro-level processes are quantifiable determinants of motivation (Balaguer et al., 2017; Gould, 2019).

Through the lens of SDT, motivation is predicated on the level to which the three basal human needs of autonomy, competence, and relatedness are met in a given context, consequentially affecting the degree to which behavior is self-determined (Ryan and Deci, 2000, 2002). Intrinsic motivation and basic need fulfillment—the foundational tenets of SDT—are widely supported as determinants of youth's motivation to participate in sport (Balaguer et al., 2017). Though work framed in motivational theory has made a significant and well-supported theoretical contribution to examining patterns of participation in sport, analyses grounded in a post-positivist lens might be limited in providing a holistic framework for examining youths' compounding experiences within and across environments as co-constructed (Home and Jary, 2004; Bateman et al., 2020; Reverberi et al., 2020); SDT identifies social contexts as influences, but it does not account for the effects of perceived agency or positioning in-context, or the amalgamation of experiences an athlete gains across multiple environments as they age through the youth sport system (Home and Jary, 2004; Balaguer et al., 2017). Motivational lenses are critical to examining sustained participation among youth, but tend to operate in a single context, delimiting analyses around motivation to those context-specific factors (Petitpas et al., 2005; Balish et al., 2014; Crane and Temple, 2015).

## Structuration Theory

Giddens' (1984) Structuration Theory (ST) is a macro social theory grounded in a constructivist lens that provides for the degree of influence the interaction between an individual and their environment(s) has across time and space. ST is often associated with organizational research grounded in institutional theory (Scott, 2001; Veliquette, 2013); very little research on sport participation and sport environments has been conducted through the lens of ST despite the presence of sport research framed in constructivist paradigm, which is common in investigations designed around exploring or interpreting the meaning ascribed to sport experiences (Beni et al., 2017). ST has been employed as the theoretical lens in research conducted by Cooky (2009), who explored girls' constructions of interest in sport, by Ogden and Rose (2005), who explored African American youth's orientation toward baseball participation, and Dixon (2011), who examined the social construction of football fandom. Though each of these sport-related research papers have garnered attention, reflected in their citation indices, an ST lens does not otherwise appear in the body of knowledge on participation patterns or lived sport experiences.

An application of ST to a sport context provides further opportunities for insight into understanding the individual's position within an environment, how norms and rules impact the individual, and the influence of prior experiences across age levels and contexts, which Cooky (2009) and Ogden and Rose (2005) found to be key determinants of participation patterns in sport. The foundational constructs of ST are agency and structure, and the recursive relationship between them, in which micro (agent) and meso (structure) level activities enable and reproduce the other (Giddens, 1984; Home and Jary, 2004).

### Agency

Agency, opposed paradigmatically to motivation, encompasses the individual's opportunity to make decisions, extending boundaries of motivation to include the capacity to act, which is affected by the organization of power in the context (Giddens, 1984). The term agency implies the "power of effect" (Giddens, 1984, p. 41), and so is not determined by the intent or outcome of an act, but that the individual is the perpetrator of the act. Thus, the construct is grounded in the capacity of the individual to have chosen a different act (or none at all) at any time. According to Giddens (1984):

To be able to act otherwise means being able to intervene in the world, or to refrain from intervention, with the effect of influencing a specific process. An agent employs a range of causal powers, including influencing others. Action depends on the capability of the individual to make a difference to a pre-existing state of affairs or course of events. An agent loses the capacity to do so if he/she can't exercise power. (p. 46)

Agency, as a construct, has reach beyond the individual's intended outcome (relative to the self), extending to an impact on the environment in which the act is chosen. This is particularly salient in the youth sport environment, as the athlete's choice in behavior is not fixed or conclusive—the athlete's experience extends across time; athletes learn adaptive behaviors and interpersonal skills across varying contexts (e.g., sports, teams, relationships; Home and Jary, 2004; Cooky, 2009; Reverberi et al., 2020).

Agency does not occur in a fixed time and space, but is a function of "reflexive monitoring" (Giddens, 1984, p. 43). Decision-making is not only based on the agent's evaluation of their own behaviors, but is also based on an evaluation of the behaviors of other actors in the environment, and the subsequent consequences (Giddens, 1984); decisions are grounded in compounded observations of consequences within and across environments. Giddens (1984) distinguishes between intended and unintended consequences of an individual's actions across time and space, where intended consequences result in a perceived causal impact on the environment, in contrast to SDT's autonomous locus of causality (Giddens, 1984; Ryan and Deci, 2000; Home and Jary, 2004; Rose, 2006).

### Structure

Structure is the second construct central to ST. Structure is defined as the contextual organized rules and resources that enable individual agent's actions (Giddens, 1984). In any structure, the rules and the socialized norms for behavior provide

the framework in which agency is constituted. Rules are guided by structural common practice, or routines, by which actors are enabled to make decisions, as well as demonstrate an understanding of the normative behaviors within the structure, reconstituting the routine (Veliquette, 2013; Oppong, 2014). Where rules dictate the range of possible decisions or behaviors, resources are the means through which an agent performs an act (Giddens, 1984).

The recursive nature of the relationship between agency and structure is such that positioned agents influence the structure, but it is the structure that constitutes the agent's range of possible decisions and behaviors (Giddens, 1984). As agents act in a given structure, they move the existing parameters, recreating or reproducing the structure over time. This "Duality of Structure" (Giddens, 1984, p. 47) is the foundational tenet of ST, and represents the critical contribution ST can make to an examination of sport environments through a constructivist lens.

According to Giddens (1984), resources within a structure are either allocative or authoritative. Allocative resources are those that are tangible—control of material goods or access to employ material goods, and thus are particularly salient for low SES individuals or families (Cooky, 2009; Veliquette, 2013). Examples of allocative resources in a sport context are the opportunity and access to participate (e.g., finances, location, and offerings), or the perceived competence of the agent within the team or competitive structure. Allocative resources are any holding that enables the agent to influence the current practice within the structure. Authoritative resources are less tangible, such as power or platform, and reflect the capacity of the actor to employ allocative resources to transform the structure (Giddens, 1984; Veliquette, 2013; Oppong, 2014). The recursive nature of agency and structure is predicated on authoritative resources, as it is the capacity to influence the structure that results in the reconstitution of it (Giddens, 1984). However, if the agent does not have the allocative resources required to support authoritative capacity, influence is not possible, which is referred to by Giddens as "positioning" (Giddens, 1984, p. 109).

The positioning of an actor is determined by the actor's access to and employment of resources as constrained by structural parameters (Giddens, 1984; Cooky, 2009). Individuals within a structure will be uniquely positioned based on their contrasting levels of allocative and authoritative resources. It is this balance (or imbalance) of distribution of resources that both enables and constrains the agent's potential for influence on the structure (Giddens, 1984; Rose, 2006). Thus, structures are comprised of the individuals within them, and are reproduced by the interplay between agents and the resources they hold.

## METHODS

By the nature of ST as a macro social theory, the examination of sustained youth sport participation through this lens is situated in a constructivist paradigm that supports positioning the study within a greater societal context (Cooky, 2009; Kamal, 2019). In a constructivist paradigm, an individual's accounts of lived experiences, and the researcher's interpretation of

those accounts, are epistemologically situated as socially co-constructed (Kamal, 2019). Constructivism is foundationally commensurate with Giddens (1984) ST, as the theory is predicated on the interplay between structure and the agent's interpretation of consequences and positioning within the structure (Vaismoradi et al., 2013; Veliquette, 2013; Kamal, 2019). Additionally, the paradigmatic contrast embedded in the design of this study positions the researcher epistemologically to interpret and analyze participants' accounts of their experiences across their youth sport career (Kamal, 2019).

A deductive thematic analysis situated within a constructivist paradigm was the qualitative method employed to collect, analyze, and frame the discussion and reporting of the data. A thematic analysis methodology is on the simplistic end of the interpretive continuum of qualitative research methods, where discussion of the data is composed of descriptions of participant accounts; in contrast, and opposite an interpretive phenomenology, in which author interpretations comprise the data discussion (Vaismoradi et al., 2013). Thematic analysis supports developing nuance in a particular dimension of a story or a specified group of themes (Braun and Clarke, 2006; Vaismoradi et al., 2013); in a thematic analysis, patterns are identified and extracted from narratives of life stories and experiences collected around a specific set of phenomena (Vaismoradi et al., 2013). Data analysis in this methodology is conducted through segmenting and describing patterns in the data (Vaismoradi et al., 2013). Patterns in the data that substantiated the themes in this study were derived from inclusive coding of data segments, which, per Braun and Clarke (2006) supports the rotation of coded segments across different themes to develop richer context around the data.

## Methodological Rigor

Issues of credibility, dependability, and confirmability were addressed through a comprehensive and transparent audit trail, the constant comparative method in data collection and analysis, triangulation across theoretical lenses, and examination of negative cases (Zhang and Wildemuth, 2009; Creswell, 2012). Through the process of coding the data, the support for deduced themes was recorded and developed in the audit trail (Zhang and Wildemuth, 2009; Creswell, 2012). The constant comparative method was used to systematically compare existing codes, emergent sub-themes, and to categorize units of text that composed patterns in the data that substantiated the themes (Zhang and Wildemuth, 2009).

Two methods of triangulation supported data analysis: (a) theme saturation across multiple sources (interviewees) and (b) across theoretical frameworks from which the themes were deduced (Zhang and Wildemuth, 2009; Vaismoradi et al., 2013). Trustworthiness was supported through two peer-debrief sessions over the coded data and appropriateness of themes, and through an examination of negative cases (Creswell, 2012; Vaismoradi et al., 2013). The examination of negative cases was critical to data analysis, as the comparisons that participants drew between *those environments that supported participation* and *those environments that did not* were central to informing the discussion of results and potential implications of the study.

## Design

The authors were granted approval by their institutional review board to interview the participants. The data were collected through semi-structured interviews that were conducted on-site at IMG Academy. The interview guide was generated through a review of research on youth sport participation patterns, theory employed in analyses around motivation and supportive frameworks, and the constructs of ST that are salient to the research questions. Interviews were conducted with individual players in a private setting over the course of 3 weeks, after 2 weeks of the interviewer's immersion in the environment.

The interview guide consisted of three primary sections, organized by the age at which participation occurred: elementary school, middle school, and high school. Participants were prompted through their account of experiences at each age level, chronologically examining sports played, teams, social influences, coaches, and parental involvement. For instance, participants were asked "What did you like most about the sport?" and "Tell me about your team." Participants were also asked for their interpretations of their role(s) on the team (e.g., on-field and off-field), and for their recalled perceptions of their relationships with coaches. During each interview, if the participant identified a particularly salient memory, probing follow-up questions were posed to the participants to engage them in in-depth conversation to further explore the impact of the event (Creswell, 2012). The interviews ranged from 44 to 73 min and could be characterized as a conversation with the participants about their interpretation of the most poignant memories from their youth careers, while layering in structural components, such as rules and norms. A total of 1,254 min of transcribed interview data comprised the data set.

## Participants

Purposive sampling identified those who could inform the study with their experiences in youth sport (Zhang and Wildemuth, 2009; Vaismoradi et al., 2013). The participants ( $N = 20$ ) were collegiate soccer players from universities across the US, representing NAIA ( $n = 1$ ), NCAA Division I ( $n = 17$ ), and NCAA Division II ( $n = 2$ ) men's programs, and included three international participants who had experience in non-US youth sport systems ( $n = 3$ ). To reach theme saturation, 20 interviews were conducted with men ages 18 ( $n = 1$ ), 19 ( $n = 4$ ), 20 ( $n = 9$ ), 21 ( $n = 5$ ), and 22 ( $n = 1$ ). The participant pool was comprised of those who identified as Hispanic/white ( $n = 2$ ), Hispanic/Black ( $n = 1$ ), Hispanic with no racialized identification ( $n = 2$ ), Black ( $n = 1$ ), white ( $n = 14$ ). The participants in the sample represented success stories that were anchored by access and opportunity, where *success* was defined as having sustained participation in organized competitive sport beyond the youth level.

## Procedure

The interviews were conducted by the first author, whose experiences in soccer established commonality in the language of the sport and supported the interpretation of the athletes' accounts of the experiences and the development of the codebook (Attride-Stirling, 2001). For example, when a player recalled



being moved from right winger to right back when he progressed from his club team to the US Soccer Development Academy, there was a mutual understanding of the position and competitive level of the moves; knowledge of the game enabled the first author to translate and interpret the account beyond the manifest meaning of the moves, engendering an exploration of the athlete's perception of the moves and the implications the moves had on his youth experience. To maintain confidentiality in reporting, details in datum that might be identifiable were omitted entirely or obscured in cases where the nuance in the datum represented a salient expression (Vaismoradi et al., 2013). Each player was assigned a pseudonym in reporting.

Prior to data analysis, *post-hoc* notes on the interviews were detailed in the audit trail. The interview notes evidenced initial interpretations of each interview and amendments to the interview guide. The audit trail also contained notes on previous research, demonstrating the origination of the established themes, and the appropriateness of the codes based on initial interpretations of anecdotes provided in the interviews. The record of how the codes were generated and of the critical analysis of the interviews prior to data analysis addressed issues of credibility in the study (Zhang and Wildemuth, 2009).

A deductive thematic analysis was conducted on the interview data, which were transcribed by a third party. The first author, who had extensive experience in the sport, applied the themes to the data and maintained the codebook, as constrained by the *a priori* themes, that emerged from data analysis. The themes were identified deductively, delimiting data analysis, due to the saturation of research framed in SDT and complementary theoretical frames situated in a post-positivist motivation-oriented lens, such as Achievement Goal Theory or Expectancy Value Theory, which have shaped the body of knowledge on youth sport participation (Balaguer et al., 2017); little research has applied the agent/structure-level operations of ST to sustaining sport participation (excluding the previously identified authors), necessitating a starting point for construct development and initial measures of analysis framed in ST and a constructivist lens (Braun and Clarke, 2006; Vaismoradi et al., 2013). The themes identified from the literature on sport participation and attrition patterns were: (a) fun and enjoyment, (b) individual impact on the environment, (c) the environmental structure, (d) peer and coach relationships, and (e) parent involvement.

Coding the data was an iterative process that initiated during interview as researcher notes on initial interpretations of critical components of the story (Attride-Stirling, 2001), such as *politics*, a code that emerged under the *impact on environment* theme. The codebook was kept by hand in an audit trail in which codes were documented, revised (constant comparative), and organized through the progression of the interviews and subsequently through data analysis (Zhang and Wildemuth, 2009; Creswell, 2012). Analytic software was not used to code the data. The data were analyzed through labeling text segments in word doc transcriptions and the segments were pasted into excel spreadsheets tabbed by code and organized by theme/subtheme.

The draft of the codebook generated from the interviews provided an initial coding frame through which the transcribed data were initially analyzed (Attride-Stirling, 2001). Through

iterations of data analysis, the codebook was refined and reorganized to incorporate additional codes or emerging subthemes (Attride-Stirling, 2001).

## RESULTS AND DISCUSSION

Data analysis supported the themes identified (deductively) through a review of the extant literature on youth sport participation (as framed in motivational theory) and a review of ST, which does not have a presence in the literature on youth sport participation (Braun and Clarke, 2006). The themes (a) fun and enjoyment, (b) individual impact on the environment, (c) the environmental structure, (d) peer and coach relationships, and (e) parent involvement were each substantiated in categorizing the common factors that evidenced to affect continued sport participation. However, based on the data from the participants, the thematic structure was amended to promote the themes *individual impact on the environment* and *environmental structure* as the two dimensions of the data that were most associated with the design of the study (Attride-Stirling, 2001; Braun and Clarke, 2006).

The themes *peer and coach relationships* and *parental involvement* are not reported independently; the data and codes associated with *peer and coach relationships* were able to be categorized under the two critical themes and the data and codes associated with *parental involvement* did not represent a salient dimension in the data, beyond access, which is an assumption of study design. The data and codes associated with the deduced theme *fun and enjoyment* are developed in another manuscript because a distinction in meaning between the concepts emerged from the data, and thus the authors determined that the micro-level process warranted a rich description.

Through a constructivist lens, and in accordance with ST, the theme *impact on the environment* (i.e., bottom-up agency) evidenced to be inter-related to the theme *environmental structure* (i.e., top-down structure; Giddens, 1984); the two critical themes are not reported here as exclusive. Though in this study it is assumed that agency and structure are inherently inter-related as constructs, for the purpose of exploring stratifying the ST constructs, participants' reports of individual impact on the team or coach were coded under the *individual impact on the environment* theme, and their interpretation of the rules, norms, and expectations imposed were coded under the *environmental structure* theme.

### Theme: Individual Impact on the Environment

The participants consistently characterized *impact* within a context as a function of allocative and authoritative resources, which configured to determinants of sustained participation across contexts (Rose, 2006; Veliquette, 2013). The participants' perception of impact on the environment was primarily associated with two antecedents: competence, which demonstrated as the most salient allocative resource, and the opportunity to demonstrate competence, which directly aligned with authoritative resources as a mechanism (Kabeer, 1999;



Veliquette, 2013). The *individual impact on the environment* theme was partitioned into two subthemes: *impact on play* and *impact on structure* (see **Table 1**).

Impact on Play

The impact that participants perceived in what they characterized as positive youth environments was notably different from the level of impact they perceived in negative environments. Positive youth environments evidenced to be those in which the participants perceived competence in conjunction with the opportunity to leverage their ability in their performances. At the younger age levels, the participants did not continue in sport environments in which they did not possess competence, or lacked allocative resources. However, in soccer, where perceptions of ability were stable, the primary distinction between negative and positive environments was the degree to which the athlete perceived authoritative resources (Kabeer, 1999).

Resources

The participants identified that they perceived an impact on their team, or structure, across sports and developmental stages. Although perceptions of *impact* were coupled with perceptions of competence, the distinguishing factor between the two constructs was the player’s opportunity to demonstrate competence. In positive youth environments, the manifest perception of competence was evidenced in the participants’ belief that they were “a good player.” The latent presumption in their accounts of impact was that they had the opportunity to demonstrate their skill. Thus, the participants invariably perceived that they

possessed both allocative and authoritative resources in positive environments (Kabeer, 1999; Veliquette, 2013). Ryan described perceiving both types of resources through his account of his role as a skilled player and leader:

“I was kind of like a point guard and somewhat the leader of the team. I was kind of the best player, so my friends just kind of gave the ball to me. I was always the one organizing things, I was like that in every sport that I played.”

Freedom

Positive youth environments supported the players in their expression of skill and ability, or provided them with the authoritative resources to demonstrate allocative resources (Kabeer, 1999; Amorose and Anderson-Butcher, 2015); a secondary component of impact was the perception that the player had the freedom to play unrestricted. The term *freedom* was frequently employed when participants spoke to the contextual set of rules or practices imposed by the coach. Within the coach’s framework, the participants valued the opportunity to make their own decisions.

A sense of freedom to play unrestricted was a function of perceptions of competence, as the participants interpreted *freedom* as an opportunity to demonstrate their skill. Oscar differentiated the sense of freedom he felt between two different types of imposed structure under the command of two different coaches:

“I never really did that with [Coach 1] because his style was more of a strict back 4, if you were in the back you stayed back, not

TABLE 1 | Exemplar data segments characterizing the patterns in the Individual Impact on Environment theme.

Theme: Individual Impact on Environment

Impact on Play	Jay: “I felt that I was better than the kids and I felt that I was here, at the big-time club and I can actually play. I was good at it and that is what made me work hard and made me feel in my mind that I was better than some of the kids who were playing... So, being good, it made me...I liked it.” Oliver: “In basketball I felt like I wasn’t as big a part of the game, there wasn’t as much meaning, just running back and forth and throwing the ball. With soccer, I could get the ball, I could score, I could pass, I could do all this stuff. I enjoyed it more.” Ryan: “In football I wasn’t like a quarterback, so I wasn’t leading the team or touching it all the time. I felt like I didn’t have as much of an impact, so I just didn’t like it.” Willis: “There would be games where we wouldn’t have been in the game if I wasn’t in goal. You can tell when everything is really easy for you, when the shots are easy, play is really easy. It was really easy for me. The shots were not challenging, the training was not challenging, the games were not challenging. I could do what I want.”
Impact on Structure	Domingo: “We just understood one another and if I would disagree with him, we would argue. It wasn’t like a brotherly relationship because he was older than me but we understood there was respect there so I was never going to state something that was out of line to him but I would voice my opinion and we just understood each other. In my mind I could tell him what I think. He understands that I am a good player, I can do both things and I won’t go against what he says. I just might not agree with it.” Edwin: “One of the reasons I left was the head coach was just a jerk. He would promise playtime to people and then bench them. He would tell them they were doing well and then not play them. He played his favorites game hard. Those players who stuck around from the [former team] were put on a pedestal and it was hard to knock them off.” Willis: “I felt like we were isolated because we weren’t in the group. But I knew I could play with those kids. So that sucked that I didn’t. I felt like I wasn’t getting the opportunity I deserved. The coaches would focus on the best team, the A team.” Oscar: “So, it was a way to make me step up into a leadership role and take on the responsibility. It was, all right, I am an example, so now I have to play well, I have to push myself harder so that everyone else knows that if I am trying harder, then they should be trying harder too. So, I think I was definitely an impact player on that team. I think that by the time I was a junior and a senior I was one of 2 or 3 guys on the team who the coaches really looked to as the leaders on the team.”

so much freedom to go up. But [Coach 2] was a lot better about letting his outside backs to go up and getting involved in the play and letting them be creative when they needed to be. I think that helped a lot. I remember that when I got recruited to play soccer in college, one of the main reasons was they saw me score a goal from the left back position and that would not have happened if I stayed with [Coach 1], obviously. Giving me that freedom and support to have the confidence to go up and be creative and do what my Dad called ‘a little bit of magic on the ball’ was really important.”

A paradigmatic delineation between agency and motivation was most effectively elucidated by the participants’ accounts of negative experiences. Though the freedom to play was indistinguishable from perceptions of autonomy in accounts of positive environments, descriptions of negative environments often reflected that, even if the participant was the source of their behavior, where the behavior was not allowed, or was not supported by the environmental structure, they did not perceive freedom. As Oliver explained, autonomy may be perceived in a structure, but without authoritative resource holdings, control of the experience deterred sustained participation in the organized structure (Kabeer, 1999; Amorose and Anderson-Butcher, 2015):

“[Hockey] was more like teaching us certain ways to skate, how to pass different, how to shoot instead of tactical stuff. I just remember that once I got there, I liked playing pick-up and playing in my driveway more. I didn’t feel the freedom of it anymore. I felt restricted. It was too organized for me.”

The contrast the participants drew between perceiving competence and the opportunity to demonstrate that competence was linked directly to the rules in-context, supporting agency as a multi-dimensional construct that might more inclusively explain effects of the cultural shift toward structured play among youth and the associated impacts on participation trends (Aspen Institute, 2019).

### Impact on Structure

In environments in which the players perceived impact on the structure, their interpersonal relationship with the coach was frequently reported to support a dyadic exchange (Rose, 2006; Amorose and Anderson-Butcher, 2015; Reverberi et al., 2020). The relationships that supported participant impact on the environment were frequently characterized by a mutual respect between the player and coach, and a perceived value that the coach placed on the participant’s input. The participants reported that they felt empowered to voice an opinion and sometimes even operated as an interpreter for the coach in his (all male coaches were reported) communication with the team. As James described, the participants’ relationships between teammates and coach demonstrated as inter-related in-context based on the positioning of the athlete (the relationship between peer dynamics and agency in-context was not clearly delineated through interview data):

“He had a picture in his mind of what he wanted, and my job was to take what picture he wanted and put words to it. Make it easy for everyone else to understand. He would describe and I

would always be in that central role. And I would be like, ‘OK, you step, and I will be right behind you and you go to the ball’ and all that stuff.”

Where agency was supported by the coach in what participants described as positive environments, many of the negative environments that were characterized by poor relationships with the coach engaged the idea of the coach “playing favorites.” When the participant perceived that he was not valued by the coach, perceptions of agency and impact were reduced, consequently limiting the belief that his actions could produce outcomes (Cooky, 2009; Oppong, 2014). Darren described that he had considered quitting soccer altogether because he felt that the coach did not value him, despite feeling that he possessed the ability to perform:

“I was getting promised stuff and I was showing the results but [he] didn’t believe in me. I wasn’t one of his favorites. I knew I was good enough to play on the team, he just wouldn’t give me the chance. At that time, I was really thinking about stopping soccer.”

In addition to the strains on the coach-player relationship that participants perceived in negative environments, limitations on opportunity imposed by the environmental structure of an organization also impeded the participants’ perception of authoritative resources (Kabeer, 1999; Sheerin et al., 2020). Often, in characterizations of negative environments, the participants identified that they were not afforded the opportunity to demonstrate their ability by forces that extended beyond the immediate context to include broader positioning of the team or player. Ryan explained how his perceived lack of authoritative resources was shaped by the organization of power in-context, including the coach, but extending to the structuring of the competition:

“That was one of the reasons that I quit, I just found it to be so political. One of the most frustrating things I had to deal with was when I was on the ODP team: I played the game and thought I played really well, but a few other kids did too, but there was one kid who didn’t play, didn’t play at all that game and our coach picked him to go to the regional game because he was resting him for the region pool game that night so he would play well.”

Pervasive throughout the common accounts of negative experiences, the most significant detriment to the participants’ perception of impact was a lack of authoritative resources. Giddens (1984) defines authoritative resources as “types of transformative capacity generating command over persons or actors” (p. 63). Giddens (1984) also qualifies that “allocative resources cannot be developed without the transmutation of authoritative resources” (p. 269). As evidenced in the participants’ accounts of environments in which they perceived both allocative and authoritative resources, the environment was perceived as positive or beneficial. Conversely, though the participants reported that they possessed the necessary allocative resources (competence) across contexts, negative environments were those in which they did not possess the

necessary authoritative resources to develop or demonstrate their abilities (Sheerin et al., 2020).

Theme: Environmental Structure

Participants’ accounts of the coach’s expectations or environmental parameters were coded under the theme *environmental structure* (top-down structure). The participants’ accounts of their youth environments evidenced significant variance across contexts within each individual’s career; each participant reported being exposed to multiple structures, both positive and negative, which were invariably characterized by the coach’s personality or coaching style (see Table 2).

The two dimensions of how environmental structure was imposed, and how that impacted the valence of an environment, were coach demands and coach expectations. Without clarity or consistency in expectations, the players were not able to navigate the imposed structure, which evidenced to detract from continuation; however, the opportunity to move into alternative environments supported continuation.

Coach Demands

The demand for skill execution was consistent across the participants’ assessments of positive environments. However,

the manner in which the demands were communicated by the coach was a determining factor in individual assessments of the environment as positive or negative (Witt and Dangi, 2018; Howie et al., 2020). Intuitively, environments in which the coach communicated demands exclusively through only broad or negative language, without providing positive feedback or information, detracted from player engagement. The participants were accepting of those coaches who communicated demands negatively if positive support and encouragement or information were provided. Damon described a coaching style that he remembered as demanding but encouraging, which supported continuation:

“He was kind of like a weird mix between super nice and caring and always trying to pick up you up and be there if you failed, and at the same time he was really hard on you. When we were pretty young, he would be yelling at you if you made mistakes and at the same time, if you lose a game or don’t make a team he would pick you up and be like, don’t worry about it, you are a good player.”

Several participants characterized negative environments as those in which the coach’s demands were perceived to be unrealistic, or where the coach did not accompany demands with positive

TABLE 2 | Exemplar data segments characterizing the patterns in the Environmental Structure theme.

Theme: Environmental Structure

Coach Demands	<p>Damon: “The other thing was their coaching style was harsh like my old coach, but they didn’t really care as much individually. I wasn’t getting as much attention and I wasn’t used to that and I didn’t know how to deal with not getting the attention I had gotten since I was 11. I could deal with the harsh coaching when I was getting the attention before but now that it was like that, without it, I was getting pissed off.”</p> <p>Oscar: “He wasn’t afraid to get into you. He was always really clear about what he expected from everyone. If you weren’t meeting it, he would tell you and would tell you how to fix it. He would not just say, ‘you’re not doing this, do it better’. He would say, ‘this is what you need to do now I will show you how to do it’. ‘If this happens, you need to do this, you need to be thinking about this’.”</p> <p>Willis: “He knew what to say and how to say it. Sometimes you don’t say something to a player, you allow him to figure it out on his own because you know he can. Whereas other times they have done the same thing several times and you say hey, do this or don’t do that. During games and in practice, he knew when to let us work it out as a team internally and when to voice his opinion. I think he balanced that really well.”</p> <p>Ryan: “Screaming. Whenever he was mad, say we had played a bad half, we would go into the locker room and we would know it was coming. He would come in and knock over the water, punch a locker and scream at us. If it was going good, he would relax but most of the time he was intense. It was never, hey you messed that up, next time you need to do this. It was more like, you seriously messed this up, what are you doing? We have worked on this before, how can you not get it?”</p>
Coach Expectations	<p>Ira: “Easy, they were really clear on what they wanted, where some other coaches were more emotional rather than clearly laying out what they want. I clearly knew the system, what he was looking for, everyone knew their roles, style of play. All really level-headed, nothing ever got to him really, ever.”</p> <p>Brian: “The new training was good, it got much more intense. This new coach, who I am still really close to today, he demanded a lot more, which was good. It wasn’t too big of a jump, but you could tell that the demands he made of some kids was a lot, some kids couldn’t handle it and some kids could. He was the guy who really pushed me, he was the first person who I met in soccer who was going to really be hard on me, wouldn’t let things slip. If he wanted me to do something different, he would let me know, real stern. There were a few times in practice where I would cry.”</p> <p>Damon: “If it was a big game, he would be positive, not on your back. But if it was a lesser team and we were messing up, he would get really pissed off, shouting and stuff. We played a bunch of big games, State cups and national games and those games it was like nothing negative. Because I think he didn’t want us to crack under pressure. But when it came to a bad team we were playing and we started messing around he would get really pissed off.”</p> <p>Ryan: “I was probably the closest one to him because again I was kind of like the leader on that team. If he ever needed anything, he would come to me and say make sure this gets changed on the team, or if someone needed to change their attitude, he would come to me and tell me to talk to this kid and help him out.”</p>

feedback or actual information. Though elevated demands were commonly assessed as contributing to development, the participants' ability to interpret and endure imposed demands evidenced as variable across individuals. Environments in which the participants felt that they were unprepared to mitigate the imposed demands, or were not provided sufficient feedback to do so, evidenced to detract from their sense of agency. Willis described a negative environment that was characterized as such because he felt that the demands were unrealistic:

"They were all very intense, it didn't matter that we were in 6th grade, it didn't matter that I was 12 or 13 and had to go up against an 8th grader. That's how they did it, you are young, you have got to get bigger so you are going to go up against the biggest kids. That didn't work for me."

As evidenced by the participants' reports, at some point in their youth career, they were each subjected to an environment in which the coach was "a yeller," or in which elevated demands were placed on them. However, these characteristics were not frequently associated with negative environments. Conversely, yelling and elevated demands were often associated with positive environments, if the demands were accompanied by positive support and care or simply information that enabled the participant to meet the demands.

### **Coach Expectations**

Though participants reported that coach behaviors that would commonly be accepted as negative (i.e., yelling or placing excessive demands on the players) were not associated with negative environments, the coach's expectations were consistently reported as a determinant of the valence of the environment. The significance of the coach's expectations is closely aligned with player's perception of impact on the environment (developed earlier), as the expectations are a manifestation of the environmental structure, and the player's agency within the structure is delimited by the imposed parameters (Home and Jary, 2004; Cooky, 2009). Consequently, the participants identified that clear and predictable expectations, and role definition, were elements common to positive environments, which supported their perceived impact on the structure.

Oscar explained how a coach who constructed a positive environment provided role clarity for him, which was central to his ability to navigate the structure:

"He was always really clear about what he expected from everyone. If you weren't meeting it, he would tell you and would tell you how to fix it. He would not just say, 'you're not doing this, do it better'. He would say, 'this is what you need to do now I will show you how to do it'. 'If this happens, you need to do this, you need to be thinking about this'."

The athletes' descriptions of environments that supported participation were focused on their learning to meet expectations through the provision of specific and informational feedback, which would operationalize (in-context) an allocative resource; where the environment was positive without demands or information, it was not sustainable, but in contexts in which

excessive demands were perceived in conjunction with specific information to meet those demands, participants reported that they engaged with the team and sport more completely.

In accordance with ST, the participants identified that positive environments were those in which the expectations were clear and predictable, and the expectations included the information necessary to meet demands. However, the participants' appreciation of clarity in expectations was more effectively demonstrated through their accounts of negative environments, in which participants' described coach expectations as unclear or inconsistent. Also in accordance with ST, participants characterized negative environments as those in which their inability to define or predict expectations affected their ability to make constructive or routinized decisions (Giddens, 1984; Rose, 2006). Ira described an example that demonstrated why he felt unprepared to interpret the coach's expectations even in a familiar context/relationship:

"Another would get praised for something and you wouldn't. There was a different expectation. I remember there would be times where I would whip in a great cross, and nothing would be said of it. And then, another guy he liked would whip in a great cross, and he would get excited, he would be very charismatic about it. I don't know if it was just because he knew me forever, or if that was just what was expected. There would be an expectation to put the ball in the box and I would do it 5 times out of 5, then the 6th time mess up. He would get on me. Another guy got it 1 out of 6 and he gets praised."

The participants' reports of negative environmental structures mirrored their reports of limitations in their impact on the environment. In those environments in which the players perceived a significant impact on the environment, their perceptions of competence, or allocative resources, were coupled with their ability to demonstrate competence, or authoritative resources (Giddens, 1984). Due to the recursive nature of the relationship between agency and structure, when the parameters in the structure were constantly moving, the agent was unable to discern the appropriate decision or course of action, which undermined their perception of the resources they possessed (Giddens, 1984; Kabeer, 1999). Consequently, unpredictability or inconsistency in the coach's expectations was a determining factor in the participants' assessment of negative environmental structures; the players expressed that they needed to know the expectations in order to meet them.

## **CONCLUSIONS**

The nature of sustained participation, or keeping kids in sport, is such that the motivation to participate is a dynamic process that evolves as the athlete ages and gains experiences (Home and Jary, 2004; Amorose and Anderson-Butcher, 2015). Where the predominance of extant literature on youth sport participation and attrition patterns is situated in a post-positivist paradigmatic lens, often operating in a snapshot (Balaguer et al., 2017), the purpose of the study was to explore the potential a constructivist-based theoretical



framework holds in identifying novel conceptualizations of those factors that supported sustained participation; in other words, in what ways were the success stories co-constructed through the players' progression in soccer in and across contexts? Through this examination of sustained participation, which centered the agency/structure relationship in-context and across the youth sport career, participants described the central elements that might be explored in order to extend the literature on supporting continued youth sport participation. It is not suggested here that ST be considered as an explanation for motivation in sport participation, but that ST can provide a lens through which sustained participation across time and space can be evaluated holistically through a constructivist lens.

The data collected to address the research questions that guided this study, around the compounding of personal and structural factors, demonstrated that a critical function of sustained participation reflected the fundamental tenet of ST: that an agent positioned with allocative and authoritative resources can affect the structure (Giddens, 1984). In this study, the participant's perception of authoritative resource holdings was the most salient element of his experiences across time, where authoritative resources were described in terms of the participant's reported impact on play and their reported impact on the group, or the structure.

Where the micro-level element of positive experiences was the perceived holding of authoritative resources, the paramount structural elements that evidenced to support continuation were coach demands and coach expectations, the subthemes of the *Environmental Structure* theme. The subthemes are differentiated as *coach demands* being the delivery of the coaching, where *coach expectations* reflected the formal or informal and normative rules in-context, as imposed by the coach. The opportunity to move environments (i.e., away from those environments that were characterized as negative; into more elite levels of competition), also evidenced as a structural component of sustained participation.

## Implications

The primary contribution the ST lens provided for reframing participation data evidenced to be the concept of the athlete's positioning within a structure, predicated on allocative and authoritative resource holdings (Giddens, 1984). Though allocative resources, such as access and competence, are ubiquitous in extant literature on youth sport participation, authoritative resources (the opportunity to employ allocative resources) within and across environments is a construct that has received less attention. The holding of authoritative resources evidenced to be a critical determinant in the participants' assessments of an environment as positive or negative, where positive environments supported sustained participation and negative environments detracted from the participant's intent to continue. Recursively, the structure of the environment (e.g., rules, norms, and the coach's expectations) dictated the participants' perceptions of holding authoritative

resources; environments in which the expectations were clear and consistent, indifferent to the valence of the coach's communication, were identified as positive environments that supported continuation.

A second contribution an ST lens provides in examining sustained participation is the allowance for prior experiences to mitigate negative environments that threatened to demotivate the participants. Though the participants perceived a lack of authoritative resources in singular environments, the perception was not consistent across environments. Respectively, the perception of holding allocative resources was consistent across environments, including those in which the participant did not perceive holding authoritative resources. The participants frequently reported that though they were not granted the opportunity to demonstrate their ability in negative environments, they maintained their perceptions of allocative resources derived from past experiences.

## Limitations and Recommendations for Future Research

The sample of participants in this study presents a limit to the generalizability or transferability of the findings, as each participant represents a success story of those with societal position to access resources required to sustain participation, such as moving to an alternative environment (Schmid et al., 2020). Opportunity and access to participate in sport are limited for many youth (Aspen Institute, 2019), but are assumed for the participants of this study.

Commensurate with the assumption about the study sample, a second limitation of the study is that it operates in the micro-level processes of the relationship between agency and structure as positioned in a constructivist lens, and framed in a macro-level social theory, without positioning the contexts within the greater youth sport system. Though a macro-level analysis of the duality of structure is beyond the scope of this study, as this study examines only micro-level agency as constrained by structural parameters, the position of a structure within a system, and systems as they constitute structuration, should be identified in order to situate the functions of the agent and the structure within ST. While the co-construction of local contexts cannot be decoupled from their position in greater society (Giddens, 1984), the conclusions and implications of this study are constrained by study design that does not position the youth sport contexts examined into greater social systems. Future research on the impact of sport structures on educational systems or social systems is necessary to comprehensively examine a macro-level association with sport participation through the lens of ST.

The participants' perception of holding authoritative resources emerged as a critical determinant of motivation to sustain participation in a specific context, and was the primary factor that distinguished a negative environment from a positive one. Though ST has rarely been employed in the analysis of sport environments, the micro-level operations of ST (i.e., allocative and authoritative resources) as the determinants of an

agent's position within the structure evidenced to be a tenable framework to characterize negative and positive environments. Thus, a recommendation for future research is to validate the micro-level concepts of ST as factors that support sport continuation through quantitative or structural methodologies.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Florida IRB. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

MF designed and conducted the study. MS provided advising oversight and writing support. All authors contributed to the article and approved the submitted version.

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# Higher Physical Activity Levels May Help Buffer the Negative Psychological Consequences of Coronavirus Disease 2019 Pandemic

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This study explored the associations between physical activity (PA) anxiety levels, and the perception of satisfaction of basic psychological needs (BPN), during Coronavirus Disease 2019 (COVID-19) lockdown. Thus, 1,404 participants (977 women, 426 men, and one respondent preferred not to answer) ranging from 18 to 89 years old ( $36.4 \pm 11.7$  year-old) completed a questionnaire in the period between 1st and 15th April 2021. The survey included sociodemographic data and the following validated instruments: the International Physical Activity Questionnaire (IPAQ), the Basic Need General Satisfaction Scale and the State-Trait Anxiety Inventory. The Kruskal-Wallis test was performed to examine variation in anxiety levels and BPN satisfaction according to PA category (low, moderate, and high). Spearman's Rho correlations coefficients were used to determine the association between anxiety levels and psychological needs. Individuals presenting a higher level of PA revealed lower levels of anxiety-state ( $H = 20.14$ ;  $p < 0.01$ ). Differences between elements from different levels of PA were found for the autonomy ( $H = 23.52$ ;  $p < 0.001$ ), competence ( $H = 18.89$ ;  $p < 0.001$ ), and relatedness ( $H = 24.42$ ;  $p < 0.001$ ) psychological needs, suggesting that those who feel their BPN as more satisfied have higher levels of PA. The study found statistically significant correlations between anxiety-state and the satisfaction of the needs for autonomy ( $p = 0.01$ ;  $r = -0.46$ ), competence ( $p = 0.01$ ;  $r = -0.40$ ), and relatedness ( $p = 0.01$ ;  $r = -0.21$ ). These findings support the importance that PA has in the anxiety levels during social isolation, emphasizing the importance of multidisciplinary teams in an individual-based approach.

**Keywords:** coronavirus (2019-nCoV), motivation, public health, physical activity, exercise, anxiety

## INTRODUCTION

On the 30th January 2020, the WHO (World Health Organization, 2020a) declared the new Coronavirus Disease 2019 (COVID-19) as public health emergency of international concern and later as a pandemic, as the SARS-CoV-2 virus spread worldwide among humans at an exponential rate. Several countries adopted procedures to prevent the spread of the virus



such as the restriction of the people's free movement and circulation (World Health Organization, 2020b). Among these procedures, quarantine (i.e., the control of activities or separation of non-sick people to monitor their symptoms and detect earlier cases) and social isolation (i.e., the separation of infected people from the remaining population to prevent the spread of the infection) were applied as part of wider actions (World Health Organization, 2020c).

The state of emergency was declared in Portugal on March 18th by the President (Decree of the President of the Republic no. 14-A/2020). Thereafter, the Portuguese Government dictated a set of mandatory rules promoting social isolation. For example, gyms, health clubs, and sports centers were closed and all forms of collective exercise were also prohibited. Nevertheless, it was possible, during this time (during the first lockdown), to make short trips with the purpose to practice physical activity (PA).

These social isolation measures, as well as quarantine measures, may have a positive effect in protecting peoples' physical health. However, while preventing and mitigating the virus transmission, the application of these restraint initiatives can have a long-lasting and wide-ranging negative psychosocial impact. Indeed, they may induce the separation of significant relatives, and the perception of isolation, the loss of freedom and the demanding restructure of a new lifestyle (Hawryluck et al., 2004; Jeong et al., 2016; Antunes et al., 2020; Brooks et al., 2020).

Literature acknowledged several psychological effects of social isolation such as high levels of anxiety (Antunes et al., 2020), stress, or fear that can persist beyond that period (Jeong et al., 2016; Brooks et al., 2020). Moreover, the implementation of these actions may have a greater physical and mental effect on peoples' who are used to practice regular physical activities (Hammami et al., 2020), regardless it is home-based or outdoor-based activities. Thus, it is crucial to explore the psychological effects of social isolation particularly considering that positive social interactions may be considered as basic human needs causing social cravings similar to food cravings (Tomova et al., 2020). The theory of basic psychological needs (BPN) argues that a subject's motivation is directly related to factors of social involvement because the influence of these factors is mediated by the satisfaction of all three BPNs (Deci and Ryan, 2008). The three BPN, comprehend autonomy (i.e., the subject's ability to regulate his or her own actions), competence (i.e., the subject's efficiency in interaction with the environment), and relatedness (i.e., the subject's ability to search for and develop connections and interpersonal relationships; Deci and Ryan, 2000).

Considering the possible negative consequences of this period, particularly by increasing the levels of stress and anxiety, the WHO emitted a set of deliberations (World Health Organization, 2020d). These aim to minimize the negative effects, highlighting the need to maintain family routines and to seek a healthy lifestyle through regular PA, healthy eating, and regular sleep routines. The practice of PA may have a fundamental role, as changes in daily routines may lead to an increase in sedentary behaviors and anxiety levels (Chen et al., 2020). Frequent PA not only has unquestionable benefits for physical health

(Bentlage et al., 2020), but it is also associated with a decrease in anxiety levels (Stubbs et al., 2017; Gammon and Hunt, 2018). Although this pandemic and its consequence are still recent, the available studies already demonstrated a trend for the impact of social isolation on people's physical and mental health (Lesser and Nienhuis, 2020; Roma et al., 2020; Hawes et al., 2021). Still, the consequences on BPN are not fully known.

The aim of this study was to examine if subjects with different levels of PA [determined by resorting to the International Physical Activity Questionnaire (IPAQ) physical activity categories], reported different anxiety levels and different perceptions of satisfaction of BPN, during the isolation period due to COVID-19. Thus, the association between PA, anxiety, and psychological needs were explored, using self-reported measures in a non-representative sample of Portuguese volunteers during the first COVID-19 lockdown. It was hypothesized that individuals who reported higher levels of physical activity would report lower levels of anxiety and higher perceptions of satisfaction of three BPN. It also expected that physical activity was associated with BPN and anxiety. It was also hypothesized that gender moderated the relationship between anxiety state and anxiety trait.

## MATERIALS AND METHODS

### Study Design and Procedures

This is a cross-sectional design conducted in the period between April 1st and 15th, 2020, during which a state of emergency was decreed in Portugal. Social media (Facebook and Instagram) and regional newspapers (both in digital format and in paper) were primary vehicles to advertise and recruit volunteers to take part in this study. Participants completed a questionnaire through google forms, which included four domains: sociodemographic data, PA levels, anxiety, and BPN satisfaction. There was no compensation or reimbursement involved for study participants.

Procedures followed standards for research in sports medicine and were performed according to the Declaration of Helsinki. Participants were fully informed about the nature of the study and the procedures involving data recording. Participants were voluntary, could withdraw from the study at any time and provided informed consent before the questionnaire's completion. Anonymity was guaranteed.

### Participants

Subjects were recruited by convenience sample method and were only eligible if they were aged over 18 years old and had Portuguese nationality. A total of 1,404 respondents participated ( $36.4 \pm 11.7$  years of age), ranging from 18 to 89 years old. The sample comprised 977 women (69.6%) aged  $35.7 \pm 11.6$  years, 426 men (30.3%) aged  $38.1 \pm 11.6$  years, and one respondent preferred not to answer (35.0 years old; 0.1%). This survey, involving community adults, intended to embrace several domains of an individual's behavior and feelings toward the confinement period of COVID-19. The survey sociodemographic questions were developed and reviewed by

four experts in the areas of Exercise, Sports, and Psychology. The remain domains assessment comprised validated instruments.

## Variables

### Sociodemographic Characterization

Participants were required to self-report age, gender, marital status, living status during the COVID-19 and academic level.

### Anxiety

The Portuguese version (Silva, 2003) of the State-Trait Anxiety Inventory (STAI-state, STAI-trait; Spielberger et al., 1983) was used. This questionnaire is composed of two blocks (Form 1 and Form 2) of 20 statements, evaluated in a four-point Likert scale. Form 1 – STAI-State, evaluates transient or temporary anxiety, i.e., the anxiety the person is feeling at the present moment. The form 2 – STAI-Trait assesses dispositional or general anxiety. The score is generated by the sum of the 20 items for each scale. Higher levels correspond to higher anxiety levels. Internal consistency in this study proved to be good (state  $\alpha = 0.93$ ; trait  $\alpha = 0.93$ ).

### Basic Psychological Needs

The Portuguese validated version of the Basic Need General Satisfaction Scale (BNSG-S; Gagné, 2003) was used (Sousa et al., 2012). This questionnaire comprises 21 items, to which the subjects respond using a seven-point “Likert” scale ranging from one (“totally disagree”) to seven (“totally agree”). The items are grouped into three factors (autonomy, competence, and relatedness). Internal consistency for the subscales, in this study, ranged from acceptable to good (autonomy  $\alpha = 0.65$ ; competence  $\alpha = 0.78$ ; and relatedness  $\alpha = 0.66$ ).

### Physical Activity

The Portuguese validated version of The International Physical Activity Questionnaire (IPAQ-short form) was used to assess PA (Craig et al., 2003). This questionnaire is formed of four questions related to specific types of PA, e.g., walking and moderate and vigorous activities, in terms of the frequency and duration of each specific type of activity, and the time spent seated per day in a week. The data obtained by the IPAQ is converted into MET-min/week (metabolic equivalent) through the calculation of the marked minutes per week in each category of activities by their specific metabolic equivalent (Walking = 3.3 METs; Moderate PA = 4.0 METs; Vigorous PA = 8.0 METs). The physical activity level of each individual is ranked according to the IPAQ's recommendations, which present the following physical activity categories:

Category 1 (Low) – The lowest physical activity level, which corresponds to individuals who do not fulfill the criteria for categories 2 and 3, who are considered to be inactive; Category 2 (Moderate) – Individuals who meet one of the following criteria: (a) 3 or more days of vigorous physical activity for at least 20 min a day; (b) 5 or more days of any combination of walking, or moderate or vigorous physical activity, which reaches a total minimum of physical activity of at least 600 MET-min/week; Category 3 (High) – Individuals who meet

one of the following criteria: (a) vigorous activity for at least 5 days, reaching a total minimum of physical activity of 1,500 MET-min/week; (b) 7 or more days of any combination of walking, or moderate or vigorous activities, which reach a total minimum of physical activity of at least 3,000 MET-min/week.

## Data Analysis

Counts (and proportions), means, SD 95% CI (95% CI), and medians (interquartile range, IQR) were computed to describe both categorical and continuous variables for the total sample. Normality was checked using the Shapiro-Wilk test and by visual inspection of normality plots. The assumptions of normal distribution were violated for all variables.

Participants were grouped according to PA level (low, moderate, and high). The Kruskal-Wallis test was used to compare groups for anxiety levels and the perception of satisfaction of BPN. When the results for the dependent variables were significant, appropriated procedures for multiple comparisons between groups were executed.

The reported estimate of effect size measures following the recommendations for non-parametric tests (Tomczak and Tomczak, 2014). Those estimates assumed values ranging from 0 to 1; multiplied by 100 indicates the percentage of variance in the dependent variable explained by the independent variable. According to Hopkins et al. (2009) the magnitude of the correlation coefficient was considered as trivial ( $r < 0.1$ ), small ( $0.1 < r < 0.3$ ), moderate ( $0.3 < r < 0.5$ ), large ( $0.5 < r < 0.7$ ), very large ( $0.7 < r < 0.9$ ), and nearly perfect ( $r > 0.9$ ). Significance was set at 5%.

Spearman's Rho correlations coefficients were used to determine the association between the selected variables. Data analysis was performed using the IBM Statistical Package for Social Science software for Windows (v.26.0, IBM Corp.; Armonk, NY, United States).

The moderation was performed using Model 1 of PROCESS (Hayes, 2013), an SPSS macro for path analysis-based moderation. PA was used as the independent variable and anxiety-state as the dependent variable. Gender was the moderator. A bootstrapping procedure was used (with 10,000 resamples). Significance was set at the 0.05 level.

## RESULTS

The sample characteristics are presented in **Table 1**. Nearly half the participants (49.6%) were classified as moderate in the IPAQ categories. Mean values for anxiety-state ( $45.1 \pm 11.2$ ), anxiety-trait ( $37.9 \pm 10.3$ ) and the BPN factors were reported for the total sample.

Variation associated with PA level showed significant differences among groups in both anxiety-state and anxiety-trait, and in all BPN (**Table 2**). The results seem to point to two interesting trends from the low PA level category to the high PA level category: a decreasing trend in anxiety-state and anxiety-trait; an increasing trend in autonomy, competence, and relatedness.

Results for the association between anxiety levels and BPN are summarized in **Table 3**. Significant negative associations

**TABLE 1** | Summary of descriptive statistics ( $n = 1,404$ ).

	<i>n</i> (%)	Mean		Median (IQR)
		mean $\pm$ SD	(CI 95%)	
Age (years)		36.4 $\pm$ 11.7	(35.8–37.0)	37.0 (18.0)
Marital status				
Single	620 (44.2)			
Married	642 (45.7)			
Separated	16 (1.1)			
Divorced	108 (7.7)			
Widower	9 (0.6)			
Other	9 (0.6)			
Living status – COVID 19				
In social isolation at home, not working and alone	40 (2.8)			
In social isolation at home, not working, with other people	472 (33.6)			
Working out in full-time	136 (9.7)			
Working out in part-time	104 (7.4)			
Teleworking at home, alone	72 (5.1)			
Teleworking at home, with other people	575 (41)			
Home quarantine	5 (0.4)			
Academic level				
Elementary	50 (3.6)			
Secondary	263 (18.7)			
Professional	107 (7.6)			
Superior	984 (70.1)			
IPAQ categories				
Low	447 (31.8)			
Moderate	697 (49.6)			
High	260 (18.5)			
Total energy expenditure (METs)		1843 $\pm$ 2,155	(1730–1956)	1,206 (1942)
Anxiety-state		45.1 $\pm$ 11.2	(44.5–45.7)	44.0 (15.0)
Anxiety-trait		37.9 $\pm$ 10.3	(37.4–38.4)	36.0 (13.0)
Autonomy		4.43 $\pm$ 0.67	(4.40–4.47)	4.43 (0.86)
Competence		5.01 $\pm$ 0.88	(4.97–5.06)	5.00 (1.13)
Relatedness		4.95 $\pm$ 0.58	(4.92–4.98)	5.00 (0.88)

SD, standard deviation; CI 95%, confidence interval 95%; IQR, interquartile range.

**TABLE 2** | Comparison between the International Physical Activity Questionnaire (IPAQ) categories, anxiety levels and basic psychological needs (BPN;  $n = 1,404$ ).

	IPAQ category 1		IPAQ category 2		IPAQ category 3		Kruskal-Wallis test value	Post hoc
	Low		Moderate		High			
	(n = 447)		(n = 697)		(n = 260)			
	mean ± SD	median	mean ± SD	median	mean ± SD	median		
Anxiety-state	46.94 ± 11.51	46.00	44.79 ± 11.04	44.00	42.68 ± 10.40	42.00	20.14**	2 > 3 1 > 3 1 > 2 1 > 2
Anxiety-trait	39.70 ± 10.71	39.00	37.42 ± 9.88	36.00	36.01 ± 9.98	34.00	23.11**	1 > 3 2 > 3 2 > 1
Autonomy	4.30 ± 0.70	4.28	4.46 ± 0.65	4.42	4.56 ± 0.63	4.57	23.52**	3 > 1 2 > 3
Competence	4.86 ± 0.87	4.83	5.05 ± 0.84	5.00	5.16 ± 0.91	5.16	19.89**	2 > 1 3 > 1
Relatedness	4.79 ± 0.57	4.87	4.99 ± 0.57	5.00	5.03 ± 0.57	5.00	24.42**	3 > 1 2 > 1

\*\* $p < 0.001$ .

**TABLE 3** | Spearman's  $\rho$  correlations between anxiety levels and self-reported BPN ( $n = 1,404$ ).

	Anxiety-state	Anxiety-trait	Autonomy	Competence	Relatedness
Anxiety-trait	0.670**	-	-	-	-
Autonomy	-0.468**	-0.494**	-	-	-
Competence	-0.401**	-0.613**	0.512**	-	-
Relatedness	-0.214**	-0.323**	0.349**	0.462**	-
Total energy expenditure	-0.148**	-0.140**	0.135**	0.119**	0.119**

\*\* $p < 0.001$ .

were noted between both anxiety levels and three basic psychological needs: autonomy, competence, and relatedness.

## Moderation Analyses

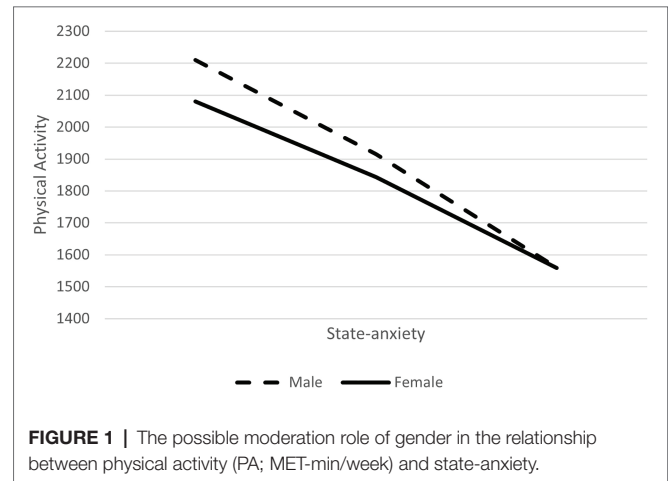
To test the moderating effect of gender on the associations between PA and state-anxiety path analysis-based moderation was performed. Next, using ModGraph (Jose, 2013) this significant interaction was plotted (see **Figure 1**). Results showed that higher levels of PA were related to lower levels of state-anxiety, but this association occurred in both males and females.

## DISCUSSION

This study explored the associations between PA, assessed by the IPAQ questionnaire, anxiety levels, and perception of satisfaction of basic psychological needs, during COVID-19 lockdown. Our main findings suggest that people with higher levels of PA present higher values of satisfaction of autonomy, competence, and relatedness, and lower levels of anxiety, both when we analyze PA category-related variation, and when testing the moderating effect of gender on the associations between PA and state-anxiety.

Regarding the anxiety-state, we verified significant differences between the three levels of PA ( $H = 20.14$ ;  $p = < 0.01$ ;  $\eta^2_H = 0.013$ ). Individuals presenting a higher level of PA showed lower levels of anxiety, which meets the conclusions of several studies that stated that PA is crucial to reduce anxiety levels (Stubbs et al., 2017; Lesser and Nienhuis, 2020; Meyer et al., 2020; Pons et al., 2020). This is particularly important considering the current pandemic and all the changes associated with it, along with the impact that this period has by being a source of anxiety (Chen et al., 2020; Lai et al., 2020). Some studies showed that one of the direct consequences of COVID-19 is the rise in anxiety levels, which as been found in Portugal (Frontini et al., 2021), and in other countries such as China (Hou et al., 2020; Pieh et al., 2020; Wang et al., 2020), Austria (Xiang et al., 2020) or Republic of Ireland (Hyland et al., 2020).

Concerning the BPN, with higher levels of PA were those who felt their BPN as more satisfied; significant differences were observed for autonomy ( $H = 23.52$ ;  $p = < 0.001$ ), competence ( $H = 18.89$ ;  $p = < 0.001$ ), and relatedness ( $H = 24.42$ ;  $p = < 0.001$ ). These results are in line with previous investigations, stating that the higher the satisfaction's perception of their basic psychological needs the more self-determined (more autonomous) is the behavior (Deci and Ryan, 2000) which in turn can contribute to higher levels of PA (Almagro et al., 2011;

**FIGURE 1** | The possible moderation role of gender in the relationship between physical activity (PA; MET-min/week) and state-anxiety.

Sicilia et al., 2014). In fact, previous research showed a positive relationship between meeting these three BPN and greater intrinsic motivation (Franco et al., 2017), which is recognized to be fundamental for greater PA practice (Ryan and Deci, 2000). According to the theoretical model and considering an isolation period such as the one we are living in, the satisfaction of BPN can be influenced by the alteration of behaviors due to changes in relationships or interaction context (La Guardia and Patrick, 2008). The same applies to a regular practice of PA and exercise (Fraguela-vale et al., 2020).

By promoting the satisfaction of BPN, the person may feel more self-determined and self-sufficient for the practice of PA, promoting higher levels of their practice which, in turn, will have not only positive repercussions in their physical health but also a positive impact on their mental health, namely in anxiety levels. Thus, with these psychological resources available, the individual may feel more confident to engage in PA in social isolation periods.

In this study, people with higher levels of satisfaction of BPN were engaged in higher levels of PA, which has several implications. Regarding relatedness, exercise physiologists dealing with people in social isolation (e.g., due to a disease, a pandemic or even due to a new COVID-19 wave) may integrate relatedness in addition to PA. Nowadays, with the massive use of social networks and technological devices such as the smartphone, computer, or tablets, this contact can be established even if the person is in social isolation. In fact, online training is considered number one in fitness trends for 2021 (Thompson, 2021). To promote autonomy, exercise physiologists must consider the importance of particular exercises for the physical and



mental health of the practitioner, meeting their personal goals and interests (Ntoumains and Mallett, 2014). The individual should be encouraged to participate in the decision-making construction of the exercise-plan and the exercise physiologist should understand the individual's perspective before offering suggestions. A critical procedure that has been recognized as important for engagement and for the establishment of autonomy in sports and exercise psychology (Mageau and Vallerand, 2003). Since people are in social isolation the exercise physiologist may bear in mind that the individual must use personal material that can be found at home which, in turn, will meet the satisfaction of the need for autonomy. This autonomous work can later be continued at a gym after the end of confinement. Considering the need for competence, it may be important to prescribe training programs promoting individuals' skills, providing clear indications on success criteria, empowering the person to assess his/her progression.

It is imperative that exercise physiologists are able to provide the satisfaction of BPN, in this context of social confinement. That will lead to internalizing behaviors, to more self-determined levels, in order to create conditions for the subjects to maintain this type of regulation of motivation that is usually associated with greater maintenance of behavior, commitment, persistence, and fun in the activity performed (Deci and Ryan, 2000).

The media and the Public Health Portugal have been advocating PA as crucial to individuals physical and mental health. It is thus important that future studies on COVID-19 or on social isolation and/or quarantine should try to understand if there were visible changes in PA practice and possible consequence on anxiety levels and/or mental health in general. It will be interesting to understand if someone starts practicing physical activities during the isolation period and if this habit is kept afterward. Looking for related differences could also be interesting. Future studies should consider the potential effect that PA could have on anxiety, which might be enhanced by an environment that promotes the satisfaction of BPN.

Regarding the analysis correlations, there were statistically significant correlations between state-anxiety and the satisfaction of the needs for autonomy ( $p = 0.01$ ;  $r = -0.46$ ), competence ( $p = 0.01$ ;  $r = -0.40$ ), and relatedness ( $p = 0.01$ ;  $r = -0.21$ ), which in line with literature that refers that BPN negatively predicts anxiety (Brunet and Sabiston, 2009; Quested et al., 2011). Further research is needed to better understand the relationship between these variables. In fact, it is possible that the correlation between these variables is low because the relationship between them is not direct (Hayes, 2013). Rather, other variables may, for instance, mediate the relationship between needs for autonomy, competence, and relatedness and anxiety. Further studies, namely path analysis, are needed. To further deepen this relationship, we tested the possible moderating role of gender in this relationship and, through a moderation analysis, we probed our knowledge regarding the relationship between PA and state anxiety. Our results showed that the relationship between the two variables does exist, but it is independent of gender.

Some limitations should be noted: the cross-sectional design of the study, which does not allow causal inferences to be made and the convenience sample enrolled with the recruitment being online and which does not allow the generalization of results. Thus, results should be interpreted with caution. However, the present study presents several strengths. When studying individual concepts such as anxiety or satisfaction with psychological needs, self-reports are vital and the ideal strategy. Moreover, the sample size is notable, especially considering it was difficult to conduct any objective measurements during the COVID-19 pandemic.

## CONCLUSION

These findings may help develop ways to support people psychologically and socially during this outbreak, in case of future pandemics and/or future waves or purely in case of social isolation and/or quarantine. Understanding how to help fight the psychological consequences of social isolation and quarantine is important to advise policymakers and healthcare practitioners. It would be vital to enhance the practice of PA in contexts of social isolation and/or pandemic crises, in association with a climate that promotes the satisfaction of the BPN, which could buffer and reduce anxiety levels.

Our findings support previous studies regarding the importance that PA may have in the anxiety level. Thus, in the case of future intervention programs aiming to help individuals dealing with social isolation, PA may be an important component, along with a motivational and psychological work regarding the satisfaction of BPN. In fact, our results underline the importance that the promotion of BPN may have in reducing anxiety.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

RA was the leader of the research group that conducted the study. RF, RA, RR-G, NA, RS, RM, and PM contributed to the conception and design of the study. RF, RA, and RR-G organized the database. RF and RA performed the statistical

analysis and wrote the first draft of the manuscript. NA, RS, RM, PM, and RR-G reviewed and edited the first draft. All authors contributed to the article and approved the submitted version.

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# Children's Physical Self-Concept, Motivation, and Physical Performance: Does Physical Self-Concept or Motivation Play a Mediating Role?

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The present study aimed to examine the relations between physical self-concept, intrinsic and extrinsic motivation as well as physical performance of 1,082 children aged 7–8 years. The central objective of this study was to contrast a mediation model assuming physical self-concept as a mediator of the relations between both types of motivation and physical performance to a mediation model assuming both types of motivation as mediators of the relations between physical self-concept and physical performance. Physical self-concept and both types of motivation were measured by using self-reported questionnaires, while physical performance was measured with 10 motor skill tests. All tests were carried out during regular school hours (8–12 A.M.) by qualified test personnel. Beyond correlation analyses, structural equation modeling (SEM) was performed to find evidence for the predictive relations between the variables under study. Results showed that physical self-concept was significantly positively related to both types of motivation and physical performance (all  $p < 0.001$ ). In contrast, results of SEM revealed that only physical self-concept ( $p < 0.001$ ) and intrinsic motivation ( $p < 0.05$ ) were significantly positively linked to physical performance. Furthermore, physical self-concept proved to significantly mediate the relations of both types of motivation to physical performance ( $p < 0.001$ ), while only intrinsic motivation, but not extrinsic motivation, proved to significantly mediate the relation between physical self-concept and physical performance ( $p < 0.05$ ). These results suggest that school-based or extracurricular interventions targeted at improving younger children's physical performance only by means of an increased level of physical activity or by external factors without supporting children's physical self-concept and intrinsic motivation may have less or no effects on their physical performance.

**Keywords:** physical self-concept, intrinsic motivation, extrinsic motivation, physical performance, relations



## INTRODUCTION

Physical activity has profound positive effects on health and well-being of young children (Eime et al., 2013; Richter et al., 2016; Brown et al., 2017; Rodriguez-Ayllon et al., 2019). However, of great concern are the increasing decline of children's participation in physical activities (Eime et al., 2016) and the high prevalence of obesity in childhood (Bodzsar and Zsakai, 2014). Over 340 million children and adolescents aged 5–19 were obese or overweight in 2016 (World Health Organization, 2016). Research on the underlying motivational processes that account for varying levels of younger children's physical activity is thus of considerable importance for health enhancement and the promotion of children's physical performance, especially in early childhood when children's physical abilities increasingly develop (Lakes et al., 2020; Schmutz et al., 2020). For this reason, the present study aimed to examine the possible determinants of younger children's physical performance at the early start of their development. More precisely, this study strived to explore the relations between physical self-concept, intrinsic and extrinsic motivation as well as physical performance of children aged 7–8 years. The central objective of this study was to contrast two mediation models to each other within the structural equation modeling (SEM) framework to provide deeper insight into the interplay of physical self-concept, motivation, and physical performance: The first mediation model assumes that physical self-concept is a mediator for the relations between both types of motivation and physical performance, that is children need to be motivated in physical activities to develop a more positive self-concept that, in turn, improves physical performance. In contrast, the second mediation model posits that both types of motivation are mediators of the relations between physical self-concept and physical performance, that is children need to perceive themselves as competent in physical activities (i.e., show a positive physical self-concept) to increase or maintain their motivation, leading to better physical performance. Both mediation models thus differ in terms of their predictive power on adherence to regular physical exercise in the pediatric population: While the first model proposes that a high level of motivation is essential to develop a positive physical self-concept and to perform well in physical activities, the second mediation model suggests that it is rather a high physical self-concept that is needed to increase motivation and to improve physical performance. However, to the best of our knowledge, no research has tested both models in one empirical study simultaneously. As a consequence, it is still unclear in the literature whether the first model assuming physical self-concept as a mediator would be more rigorous than the mediation model assuming both types of motivation as mediators. To find answers to this research question, both mediation models were tested simultaneously in this study. **Figure 1** depicts both mediation models under investigation.

### Physical Self-Concept and Motivation

Physical self-concept and motivation are two important factors that influence children's physical performance. Physical self-concept represents a specific domain within the hierarchical self-concept model developed by Shavelson et al. (1976) and

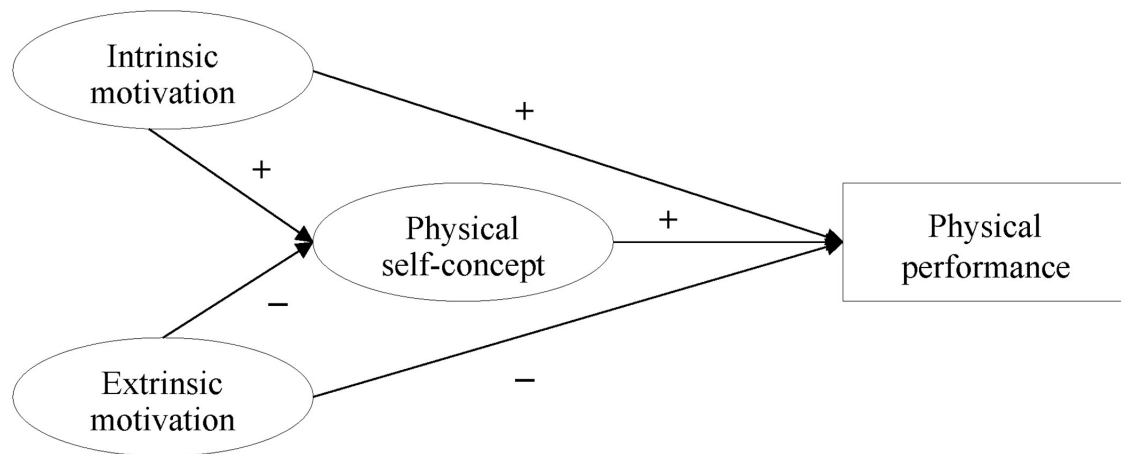
describes how individuals perceive their abilities in physical domains (Marsh and Redmayne, 1994; Marsh, 2007). Due to its great impact on various educational outcomes, physical self-concept has caught considerable interest in research of sport sciences and psychology (Mendo-Lázaro et al., 2017; Fernández-Bustos et al., 2019; Onetti-Onetti et al., 2019). For instance, many studies have provided evidence for a reciprocal effects model between physical self-concept and physical achievement, that is prior physical self-concept/achievement predicts subsequent physical achievement/self-concept that, in turn, predicts subsequent physical self-concept/achievement (i.e., Marsh et al., 2006a,b, 2007a; Trautwein et al., 2008; Garn et al., 2019). Beyond a positive self-concept, motivation has also been found as a strong predictor of physical achievement [see Ntoumanis and Standage (2009), Cerasoli et al. (2014) for a meta-analysis]. Motivation describes the internal and/or external forces that produce the initiation, direction, intensity, and persistence of a behavior (cf., Vallerand, 2007, p. 59). In the present study, we focused on the dichotomy of motivation, that is intrinsic and extrinsic motivation. Intrinsic motivation is characterized by a completely internal regulation of a behavior, referring to all behaviors that are performed for the inherent pleasure emanating from an activity (Deci and Ryan, 2002). In contrast, extrinsic motivation is defined as the external control of a behavior, referring to all behaviors that are governed by the consequences of an activity or externally controlled constraints such as rewards or threats (Vasconcellos et al., 2020). Numerous studies have shown that these two types of motivation were differentially related to physical achievement (e.g., Craggs et al., 2011; Standage et al., 2012; Wang et al., 2016). While intrinsic motivation has been found to positively relate to physical achievement (e.g., Standage et al., 2003, 2008; Gillet et al., 2010), extrinsic motivation has been found to negatively relate to physical achievement (e.g., Vallerand, 2007; Boiché et al., 2008; Gillet et al., 2010).

### Relations Between Physical Self-Concept, Motivation, and Physical Performance

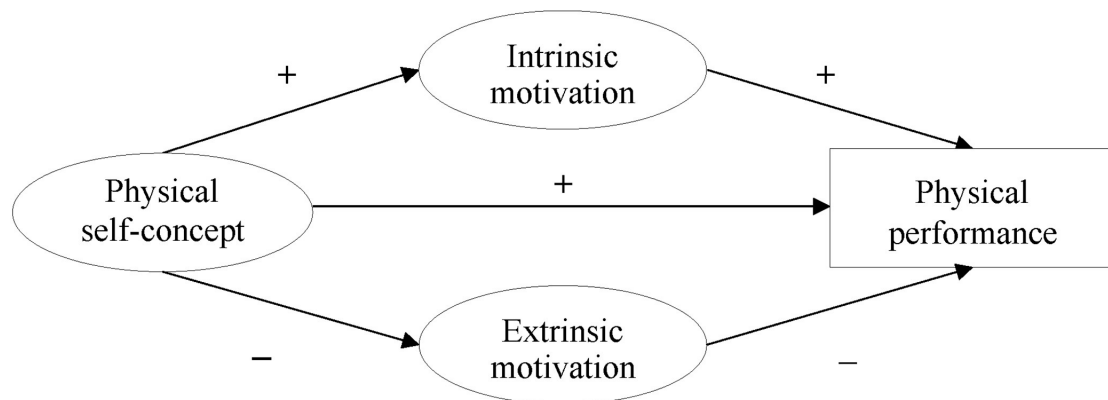
A central theoretical rationale for proposing relations between physical self-concept, motivation, and physical achievement is expectancy–value theory (Eccles and Wigfield, 2020). This theory assumes that expectancies of success reflect individuals' ability beliefs (i.e., self-concepts) that influence many achievement-related outcomes such as achievement. For this reason, we hypothesize that children who feel competent and are more motivated in physical activities perform better in physical activities than children with a more negative physical self-concept and lower motivation. Physical self-concept and motivation should therefore predict physical performance. However, most studies with younger children have investigated the relations between self-concept and achievement in academic domains (e.g., Nicholls, 1979; Stipek and MacIver, 1989; Wigfield, 1994; Marsh et al., 2002; Arens et al., 2016). In contrast, very little research has yet explored the relations between physical self-concept, motivation, and physical achievement of younger children in the physical domain, especially in early childhood. As a consequence, it is still unknown whether physical self-concept or motivation plays a mediating role

## PHYSICAL SELF-CONCEPT, MOTIVATION, AND PERFORMANCE

### A Mediation model of physical self-concept



### B Mediation model of motivation



**FIGURE 1 |** Mediation models under investigation. **(A)** Mediation model of physical self-concept. **(B)** Mediation model of motivation.

in predicting physical performance of younger children at earlier developmental stages. For this reason, the present study sought to assess the possible mediating effects of physical self-concept and the two types of motivation (i.e., intrinsic and extrinsic motivation) on younger children's physical performance in early childhood. Some evidence for the mediating role of physical self-concept (e.g., Ntoumanis, 2001; Standage et al., 2003; Thøgersen-Ntoumani and Ntoumanis, 2006; Sproule et al., 2007; Cumming et al., 2011) or the mediating role of motivation have already been found in previous studies (e.g., Marsh et al., 2005; McDonough and Crocker, 2007; Guay et al., 2008). However, those studies have not tested the mediating role of physical self-concept or motivation in younger samples of children at the early start of their development.

### Gender and Physical Differences

In early childhood, children typically show a very positive physical self-concept and high motivation in physical activities, which increasingly decline during adolescence (Marsh et al., 1998; Harter, 2012). Although gender differences may be less prevalent in younger children before adolescence, boys usually show a more positive physical self-concept and higher motivation as well as better physical performance than girls (e.g., Eccles and Harold, 1991; Jacobs et al., 2002; Morano et al., 2011). In addition, several studies have revealed that children's body mass index (BMI), calculated as weight (kg) divided by height (m) squared, was closely intertwined with differences in physical self-concept (Paeratakul et al., 2002; Marsh et al., 2007b; Morano et al., 2011), motivation, and physical achievement (Trost et al., 2001; Morano et al., 2011; Zsakai et al., 2017):

overweight or obese children typically demonstrate a lower physical self-concept, lower motivation, and poorer performance in physical activities than their normal-weight peers. However, it is still unclear in the literature whether children's BMI also changes the relations between physical self-concept, motivation, and physical performance (i.e., does being obese reinforce or decrease the relations?). For this reason, it is important to control for children's sex and BMI when exploring the relations between children's physical self-concept, motivation, and physical performance.

## OBJECTIVES AND HYPOTHESES

Drawing on a very neglected sample of children aged 7–8 years, the present study aimed to examine the relations between physical self-concept, intrinsic and extrinsic motivation as well as physical performance. One of the central objectives of this study was, in particular, that two mediation models were contrasted to each other: a mediation model assuming physical self-concept as a mediator of the relations between both types of motivation and physical performance to a mediation model assuming both types of motivation as mediators of the relations between physical self-concept and physical performance. Despite the rather exploratory nature of this study, the theoretical and empirical framework allowed us to suggest the following three hypotheses.

Hypothesis 1: Physical self-concept is positively related to intrinsic motivation and physical performance but negatively related to extrinsic motivation.

Hypothesis 2: Both physical self-concept and motivation will predict physical performance, that is a more positive physical self-concept and higher levels of intrinsic motivation will positively predict physical performance, while higher levels of extrinsic motivation will negatively predict physical performance.

Hypothesis 3: There is support for both a mediation model of physical self-concept and a mediation model of motivation.

## METHOD

### Participants

The data set used in this study is part of the larger Fulda Movement Check project that was first introduced as a campaign in Fulda for sustainable movement and health, sport, and talent promotion in 2010. Since then, this project has been pursued as a regular annual and comprehensive sports motor assessment (screening) in the second grade of elementary schools in Fulda. With a number of  $N > 13,500$  children so far, the Fulda Movement Check project provides meaningful data sets and findings on the performance of younger children aged 7–8 years in Fulda (Hohmann et al., 2016). The sample of this study was drawn from this project and consisted of 1,082 children aged 7–8 years from 64 schools in Fulda. Of these,  $n = 526$  children were boys (48.6 %), and  $n = 556$  children were girls (51.4 %). Most of the participating children (68.1 %) were 7 years old ( $M = 7.32$ ;  $SD = 0.47$ ).

## Procedure

The Fulda Movement Check was performed in different sports halls in Fulda during 4 weeks with different school classes. All participants were assessed under similar conditions. The tests were carried out during regular school hours (8–12 A.M.) by qualified test personnel. For the present study, the children were divided into two groups because the entire hall was needed for the 6-min endurance run tested in this project. While one group performed the endurance run, the other group filled out the questionnaires of physical self-concept and both types of motivation. All items were read aloud by a trained student assistant to make sure that all children were able to adequately respond to the items of the questionnaires. Before the responding to the measures began, it was clearly emphasized to the children that there were no right or wrong responses and that they could withdraw from the study at any time without any negative consequences. The responding of the questionnaire took approximately 10–15 min. Participation was voluntary and anonymous. Before entering the test campaign, all children's parents provided written informed consent for the recording and scientific use of the data collected in this study. The district head administration office of Fulda supervised this project in cooperation with the University of Bayreuth, the state education authority of Fulda, the sports department of Fulda, the sports area of Fulda, the participating schools, and the sport clubs of Fulda.

## Measures

### Physical Self-Concept

To measure children's physical self-concept, three slightly modified items of the Self-Description-Questionnaire I (Marsh, 1990) were used. All three items were positively worded and formulated as questions that were deemed more appropriate for younger children than statements (Marsh et al., 2002). The three items were: "Are you good in sports?," "Are you a good athlete?," and "Are you athletic?" All three items were followed by a four-point rating scale ranging from 1 = no to 2 = rather no to 3 = rather yes, and to 4 = yes. The reliability of this scale was good ( $\alpha = 0.80$ ). The selection of these three items was based on previous research using these three items with preschool children (e.g., Marsh et al., 1991, 2002; Arens et al., 2016), in which these items showed the highest factor loadings in confirmatory factor analysis (CFA) and the highest reliability estimates.

### Motivation

Both types of motivation were measured with three slightly modified items from the Academic Self-Regulation Questionnaire (SRQ-A; Ryan and Connell, 1989). These three items have been found as most reliable and valid in previous research as indicated by superior factor loadings and high reliability estimates (Freund and Lohbeck, 2020; Lohbeck et al., 2021<sup>1</sup>). Because the SRQ-A focuses on motivation toward school in general, all items were referred to the physical domain. Like the self-concept scale, all items were formulated as questions,

<sup>1</sup>Lohbeck, A., Istvan, T.-K., and Morin, A. (2021). Latent motivation profiles of elementary school children across math and German domains: A self-determination theory approach.

beginning with the stem: “Why do you do sports? Do you do sports because...,” followed by the reasons described in the three items of intrinsic motivation (i.e., “...you like sports?,” “...you are interested in sports?,” and “... you enjoy sports?”) and the three items of extrinsic motivation (i.e., “...you want to be good in competitions?,” “...you want to perform better than other children in competitions?,” and “...you want to have a good result in competitions?”). The reliability of both scales was satisfactory (i.e.,  $\alpha = 0.81$  for intrinsic motivation and  $\alpha = 0.74$  for extrinsic motivation).

## Physical Performance

All children participated in the Fulda Movement Check that is based on the German Motor Skills Test 6-18 (in German: Deutscher Motoriktest 6-18; Utesch et al., 2018). For the present study, the following 10 tests were considered as indicators of children's physical performance:

**20-m sprint (speed):** To measure children's speed, all children performed a 20-m linear running sprint. The starting position was 0.3 m behind the start line, and children had two possible attempts with a break of at least 2 min between the two running sprints. The reliability of this test was  $r_{tt} = 0.90$  (Boes and Schlenker, 2016).

**Sideward jumping (coordination):** To test children's coordination, children were asked to jump sideward with two legs within two adjacent 50 × 50 cm squares without touching a boundary line. They had five trial jumps before the testing and two possible attempts with a break of at least 2 min. This test took 15 s, in which the number of children's sideward jumps was recorded. The objectivity of this test was  $r_{obj} = 0.99$ , and the reliability was  $r_{tt} = 0.89$  (Boes and Schlenker, 2016).

**Balancing backwards (coordination):** The balancing backwards test was another coordination test in which the children had to balance backwards on three beams (6, 4.5, and 3 cm). For each beam, the number of steps backwards balanced (feet fully raised) until leaving the beam was counted. The maximum number of steps per attempt was limited to eight. For each of the three beams, the children had two possible attempts, resulting in a maximum of 48 steps. The objectivity of this test was  $r_{obj} = 0.99$ , and the reliability was  $r_{tt} = 0.73$  (Utesch et al., 2018).

**Standing torso bend forward (flexibility):** To measure children's flexibility, children were asked to bend forward as far as possible with their fingertips beyond their feet. They had to hold the best position for at least 3 s and had two possible attempts. The distance of the fingers in centimeters to ground level was recorded, whereby a low range above ground level was recorded as a negative distance. The objectivity of this test was  $r_{obj} = 0.99$ , and the reliability was  $r_{tt} = 0.94$  (Boes and Schlenker, 2016).

**Push-ups (strength endurance):** The push-ups test targeted at measuring children's strength endurance. In this test, children were requested to touch their hands with each other when the body was lying down on the floor and the arms were extended after the push-up. A complete repetition was evaluated when

the upper body was laid down on the mat and the hands touched each other. Children had only one attempt, and the number of correctly executed push-ups within 40 s was recorded. The objectivity of this test was  $r_{obj} = 0.98$ , and the reliability was  $r_{tt} = 0.69$  (Boes and Schlenker, 2016).

**Sit-ups (strength endurance):** The sit-up test was also carried out to measure children's strength endurance in 40 s. After a short practice phase, only one test was performed, and the number of correctly executed sit-ups was assessed. The objectivity of this test was  $r_{obj} = 0.92$ , and the reliability was  $r_{tt} = 0.74$  (Klein et al., 2012).

**Standing long jump (speed):** In the standing long jump test, the distance of two-leg standing jumps in centimeters (measured from the heel) was measured. Children had two possible attempts with a break of at least 2 min, but no practice phase was permitted before the testing. The objectivity of this test was  $r_{obj} = 0.99$ , and the reliability was  $r_{tt} = 0.89$  (Boes and Schlenker, 2016).

**6-min endurance run (endurance):** To measure children's endurance, the number of meters in a 6-min endurance run around a volleyball pitch (9 × 18 m) was recorded. The test was conducted in groups of 15 children at the same time.

**Ball throw (strength):** The ball throw test was executed with a ball weight of 80 g and with both feet on the ground behind a line. No step or run-up was allowed. The throwing distance was assessed perpendicular to a measuring tape attached to the floor. Accuracy was 0.1 meter. This test showed a high test-retest reliability of  $r_{tt} = 0.82$  ( $p < 0.001$ ;  $n = 3,193$ ; Hohmann et al., 2018).

**Agility test (coordination and speed):** The agility test consisted of 10 runs of 2 m forth and 2 m back into four different directions according to four different colors presented in random order on a computer screen. Each signal was self-triggered by a buzzer. The split-half reliability of the agility test was  $r_{tt} = 0.78$  ( $p < 0.001$ ;  $n = 131$ ; Hohmann et al., 2018).

## Physical Characteristics

Beyond the 10 motor skill tests, children's body height and body weight were also measured according to standardized test prescriptions (Hawes and Martin, 2001; Stewart et al., 2011): body height was measured to the nearest 0.1 cm (seca height tester), and body weight was measured to the nearest 0.1 kg (calibrated seca alpha 770).

## Statistical Analyses

All correlational and SEM analyses were performed in *Mplus* 8.5 (Muthén and Muthén, 1998–2018) using the robust maximum likelihood estimator and the full information maximum likelihood approach. Missing values were negligible, ranging from 0 to 0.4% on the item level. To evaluate the fit of the models, chi-square test statistics, comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA) with its 90% confidence interval were considered. A good model fit was assumed with CFI/TLI values  $> 0.90$  and RMSEA values  $< 0.06$  (Hu and Bentler, 1999). When testing the two mediation models for this study (see **Figure 1**), the “model indirect” option implemented in *Mplus* was applied.



Children's sex and BMI were included as control variables in all models under investigation. All dichotomous variables were *z*-standardized prior to the analyses. For easier interpretation, all *z*-standardized scores of the 10 tests in the Fulda Movement Check were added up to a total performance score and averaged because the results of these 10 tests were based on different scores (e.g., meters, time, and numbers). For this reason, the results of the 20-m sprint, standing torso bend forward, and agility test were recoded such that higher values indicated higher physical performance. Upon request, the authors can send the specific results of the 10 tests obtained in this study.

## RESULTS

### Descriptive Statistics and Correlations

Descriptive statistics and latent (inter-)correlations of all variables are presented in **Table 1**. As expected, younger children showed a very high physical self-concept and high levels of motivation. Their total performance score ranged from 22.82 to 163.97 ( $M = 116.97$ ,  $SD = 15.65$ ; modus: 102.64; median: 117.79). All item factor score correlations were significantly positive, ranging from 0.21 to 0.38. Both types of motivation were significantly positively correlated with each other.

### Preliminary Analysis

As a prerequisite of all further analyses, CFA was first performed to test the measurement separability of children's physical self-concept and motivation. More specifically, the following two models were estimated: (1) a two-factor model assuming two distinct factors for physical self-concept and both types of motivation and (2) a three-factor model differentiating between three distinct factors for physical self-concept, intrinsic motivation, and extrinsic motivation. Results of the fit of these models are provided in **Table 2**.

The three-factor model showed a superior fit to the data when compared to the two-factor model, indicating that children participating in this study were able to clearly differentiate between their physical abilities and both types of motivation.

### Physical Self-Concept and Motivation as Predictors

Results of SEM testing the relations between physical self-concept, both types of motivation (i.e., intrinsic, extrinsic), and physical performance are depicted in **Figure 2**.

Both physical self-concept and intrinsic motivation were significantly positively related to the total performance score, while extrinsic motivation was slightly negatively but not significantly related to the total performance score. Girls and children with a higher BMI showed a significantly lower total performance score and a lower physical self-concept than boys and children with a lower BMI. Furthermore, girls exhibited significantly higher levels of extrinsic motivation than boys. The fit of this model was good (see **Table 2**), and the amount of explained variance in the children's total performance score was 0.23.

### Physical Self-Concept and Motivation as Mediators

Results of both mediation models exploring the possible mediating effects of physical self-concept and motivation on physical performance are provided in **Table 3**.

In Model 1 assuming physical self-concept as a mediator of the relations between both types of motivation and physical performance, physical self-concept proved to significantly mediate the relations of both types of motivation to physical performance. In contrast, in Model 2 assuming both types of motivation as mediators of the relation between physical self-concept and physical performance, only intrinsic motivation

**TABLE 1 |** Descriptive statistics and latent (inter-)correlations between the variables under investigation.

Variables	Min	Max	<i>M</i> ( <i>SD</i> )	Intrinsic motivation	Extrinsic motivation	Physical performance
Physical self-concept	1	4	3.51 (0.76)	0.38*** (0.05)	0.38*** (0.04)	0.33*** (0.04)
Intrinsic motivation	1	4	3.73 (0.64)	–	0.21*** (0.04)	0.19*** (0.04)
Extrinsic motivation	1	4	3.12 (0.99)		–	0.13*** (0.04)
Physical performance	22.82	163.78	116.97 (15.65)			–

\*\*\* $p < 0.001$ .

**TABLE 2 |** Goodness-of-fit statistics and information criteria of the models under investigation.

Models	$\chi^2$	<i>df</i>	<i>CFI</i>	<i>TLI</i>	<i>RMSEA</i> [90% <i>CI</i> ]
2-factor model	589.132	26	0.695	0.578	0.041 [0.132, 0.152]
3-factor model	36.335	24	0.993	0.990	0.022 [0.000, 0.035]
Predictive model	96.250	43	0.978	0.967	0.034 [0.025, 0.043]
Mediation model of self-concept	73.834	43	0.988	0.981	0.026 [0.015, 0.036]
Mediation model of motivation	96.250	43	0.978	0.967	0.024 [0.025, 0.043]

$\chi^2$ , chi square; *df*, degrees of freedom; *CFI*, comparative fit index; *TLI*, Tucker-Lewis Index; *RMSEA*, root mean square error of approximation; *CI*, confidence interval.

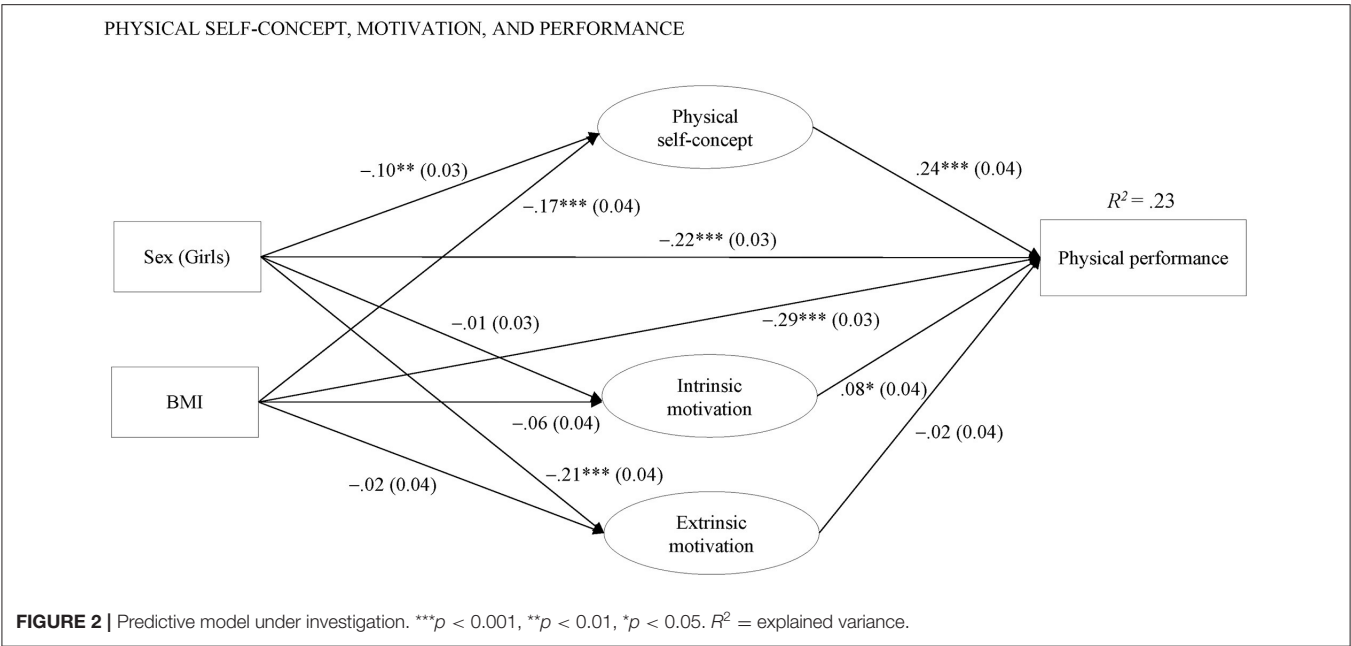


TABLE 3 | Standardized path coefficients (standard errors in brackets) of the mediation models.

Standardized direct effects	Mediation model of physical self-concept				Mediation model of motivation			
	PSC	INTR	EXTR	PP	PSC	INTR	EXTR	PP
Sex (girls)	−0.02 (0.03)	−0.01 (0.03)	−0.21*** (0.04)	−0.22*** (0.03)	−0.19** (0.07)	0.05 (0.06)	−0.35*** (0.07)	−0.45*** (0.06)
BMI	−0.15*** (0.04)	−0.06 (0.04)	−0.02 (0.04)	−0.29*** (0.03)	−0.07*** (0.02)	0.00 (0.02)	0.02 (0.02)	−0.12*** (0.01)
Physical self-concept (PSC)				0.24*** (0.04)		0.39*** (0.05)	0.38*** (0.04)	0.24*** (0.04)
Intrinsic motivation (INTR)	0.33*** (0.05)			0.08* (0.04)				0.08* (0.04)
Extrinsic motivation (EXTR)	0.32*** (0.04)			−0.02 (0.04)				−0.03 (0.04)
Standardized indirect effects								
INTR → PSC →				0.08*** (0.02)				
EXTR → PSC →				0.08*** (0.02)				
PSC → INTR →								0.03* (0.01)
PSC → EXTR →								−0.01 (0.01)
$R^2$				0.23				0.23

PP, physical performance; \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .  $R^2$ , explained variance.

proved to significantly mediate the relation between physical self-concept and physical performance. The direct relations were similar in both mediation models and to those of the SEM model without indirect relations: Both physical self-concept and intrinsic motivation were significantly positively linked to physical performance, while extrinsic motivation was slightly negatively but not significantly linked to physical performance. Girls and children with a higher BMI showed a lower total performance score than boys and children with a lower BMI. However, only the regression path for girls' lower physical self-concept remained substantial in Model 2, including the mediation of both types of motivation. In contrast, the regression paths for the children's BMI remained significant in both mediation models. Furthermore, in both mediation models, physical self-concept was significantly positively related to both types of motivation. The amount of explained variance was .23 in

both mediation models, and the fit of both mediation models was also good (see Table 2).

DISCUSSION

Based on a very neglected sample of 1,082 children aged 7–8 years, the present study sought to examine the relations between physical self-concept, intrinsic and extrinsic motivation as well as physical performance. Beyond the large sample size, the incremental contribution of this study was that two mediation models were tested simultaneously: (a) a mediation model assuming physical self-concept as a mediator of the relations between both types of motivation and physical performance and (b) a mediation model assuming both types of motivation as mediators of the relations between physical self-concept and physical performance.

In support of previous research (e.g., Marsh et al., 2006a,b; Trautwein et al., 2008; Standage et al., 2012; Wang et al., 2016; Garn et al., 2019; Vasconcellos et al., 2020), physical self-concept was significantly positively related to intrinsic motivation and physical performance. However, not fully in line with hypothesis 1 and previous results (e.g., Vallerand, 2007; Boiché et al., 2008; Gillet et al., 2010), physical self-concept was also significantly positively related to extrinsic motivation. In contrast and consistent with Hypothesis 2, results of SEM revealed that physical self-concept and intrinsic motivation were significantly positively linked to physical performance, while extrinsic motivation was slightly but not significantly negatively linked to physical performance. The negative regression path of extrinsic motivation may result from the typically higher levels of intrinsic motivation of younger children, as also evidenced in the descriptive analysis of this study. Furthermore, in accordance with Hypothesis 3, results also provided support for both mediation models: physical self-concept proved to significantly mediate the relations of both types of motivation to physical performance. In contrast, only intrinsic motivation proved to significantly mediate the relation between physical self-concept and physical performance, while extrinsic motivation did not play a significant mediating role in predicting physical performance. A possible reason for these findings is that younger children are typically more motivated in physical activities than older children (e.g., Xiang et al., 2004; Gao et al., 2008), as also indicated by the increasing decline of participation in physical activities during adolescence [see the review by Eime et al. (2016)]. To help younger children develop a healthier lifestyle, which is one of the central objectives of the Fulda Movement Check project, children's physical self-concept and intrinsic motivation should be supported in early childhood, when children's physical self-concept and motivation mainly develop (Harter, 2012). In contrast, interventions aiming at improving children's physical performance only by means of an increased level of physical activity without enhancing children's physical self-concept may have less or no effects on their physical performance. However, results of this study also yielded a slightly negative regression path of extrinsic motivation on physical performance, indicating that extrinsic motivation is rather detrimental for children's physical performance. In addition, girls and children with a higher BMI had a significantly lower physical self-concept and a lower total performance score than boys and children with a lower BMI, as also earlier shown in previous studies (e.g., Deaner et al., 2016; Ferreira et al., 2019; Queiroz et al., 2020). By implication, girls and children with a higher BMI are at risk and should be supported in physical activities by, for instance, specific physical tests related to their individual motor skills to sustainably motivate them to more physical activities and a healthier lifestyle.

## Limitations and Future Directions

Although results of this study provide great insight into the interplay of younger children's physical self-concept, motivation, and physical performance, some limitations must be warranted. The first limitation concerns the cross-sectional data which do not provide solid evidence for causality. Second, only a small number of variables were taken into consideration in

the regression analyses under study. Further studies should therefore measure additional variables to increase the explained variance in children's physical performance and to provide a more comprehensive picture of the underlying processes that account for the varying levels of children's physical performance. In particular, there is a deficit of psychosocial variables, such as the level of physical activity, and family or home environment factors, such as the relationships with parents and peers, which also influence children's physical performance [Barnett et al., 2019; see the meta-analysis by Barnett et al. (2016)]. Third, despite the large sample size, results of this study are only representative for children aged 7–8 years. For this reason, no implications can be drawn for older children, and further studies with more heterogeneous age groups must show how the relations change during childhood and adolescence. Keeping especially in mind that achievement mainly influences self-concept in early childhood and that self-concept is more likely to reciprocally relate to achievement at the end of elementary school (Guay et al., 2003; Chen et al., 2013), longitudinal studies should test the relations at different developmental stages. Furthermore, since the tests of the Fulda Movement Check project took place outside of school in different sports halls, no data of the classes, in which the children were drawn, were available. As a consequence, it was not possible to perform multilevel analyses or to take the hierarchical data (i.e., students in classes) into account, which increases the possibility of inflated standard errors.

## Implications and Conclusion

Despite the limitations mentioned, results of this study are extensible to a very specific segment of the population, favoring the individualization of intervention strategies in the field of physical education and sports, and provide some important implications for sport coaches and physical teachers. A first implication targets the mediation models under investigation. While physical self-concept proved to significantly mediate the relations of both types of motivation to physical performance, only intrinsic motivation proved to significantly mediate the relation between physical self-concept and physical performance. This is a novel finding which has not been stated in previous research so far. An important implication of this finding is that children who are intrinsically motivated in physical activities only perform better in motor skill tests when their physical self-concept is high. Furthermore, the significant mediating effect of intrinsic motivation suggests that children who feel competent in physical activities perform better when they are intrinsically motivated, that is performing physical activities for their inherent pleasure without any external pressure. By implication, sport coaches or physical teachers should avoid extrinsic contingencies such as rewards or good grades. Finally, of great concern is the lower physical self-concept and poorer physical performance of girls and children with a higher BMI. Appropriate interventions are therefore needed to support the physical self-concept and physical skills of girls and children with a higher BMI. For instance, devising appropriate instructions of arousing children's physical self-concept and giving continuous feedback by using individual reference norms are effective strategies to promote

children's physical self-concepts and improve their physical performance (Schmidt et al., 2013).

In conclusion, results of this investigation replicate and expand previous literature by showing that it is predominantly children's physical self-concept and intrinsic motivation that determine their physical performance and play a mediating role in predicting their physical performance. Interventions targeted at improving younger children's physical performance should thus establish conditions to promote children's physical self-concept and intrinsic motivation by means of adapting the level of motor skill tests to children's individual physical abilities, providing positive feedback to their physical performance, and enhancing their individual progress (Deci and Ryan, 2002). This may be of particular importance for girls and children with a higher BMI who showed a much lower physical self-concept and poorer physical performance in this study and many other studies (e.g., Morano et al., 2011; Zsakai et al., 2017; Ferreira et al., 2019; Queiroz et al., 2020).

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

AL developed the measures of self-concept and motivation, cleaned the data, performed the data analysis, and wrote the initial draft of the manuscript. PK recruited the sample, developed the study concept, collected the data, and reviewed the manuscript. MD and AH developed the study concept and reviewed the manuscript. All authors read and approved the submitted manuscript.

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# The Effect of Social Support on Athlete Burnout in Weightlifters: The Mediation Effect of Mental Toughness and Sports Motivation

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**Objectives:** Athlete burnout is a crucial concern affecting the development and athletic performance of young weightlifters. To reduce or relieve the prevalence of athlete burnout, this study examined the relationship across social support, sports motivation, mental toughness, and athlete burnout in weightlifters.

**Methods:** A total of 315 weightlifters aged 17–28 years old (151 males, 164 females;  $M_{age} = 18.89$  years,  $SD = 3.66$ ) from Sichuan, Chongqing, and Shanxi in China participated in this survey. The Perceived Available Support in Sport Questionnaire (PASS-Q), Sports Motivation Questionnaire (SMQ), Sports Mental Toughness Questionnaire (SMTQ), and Athlete Burnout Questionnaire (ABQ) were used in this study. SPSS Statistics 19.0, AMOS 21.0, and PROCESS 3.0 macro were used to analyze the collected data.

**Results:** The results indicated that weightlifters' social support could negatively significantly affect athlete burnout [ $\beta = -0.398$ ; 95% confidence interval (CI):  $-0.3699$ ,  $-0.2184$ ;  $P < 0.05$ ] via mental toughness and sports motivation. The mediation analysis revealed that they had partial mediating effect, including three paths: First, social support had a direct effect on athlete burnout ( $\beta = -0.150$ ; 95% CI:  $-0.1824$ ,  $-0.0397$ ;  $P < 0.05$ ); second, sport mental toughness had a mediating effect on athlete burnout ( $\beta = -0.113$ ; 95% CI:  $-0.1703$ ,  $-0.0631$ ;  $P < 0.05$ ); and finally, sports motivation had a mediating effect on athlete burnout ( $\beta = -0.124$ ; 95% CI:  $-0.1751$ ,  $-0.0793$ ;  $P < 0.05$ ).

**Conclusion:** The findings revealed that social support could inhibit or prevent athlete burnout via mental toughness and sports motivation; thus, to decrease or relieve the prevalence of burnout in weightlifters, it is an important solution to enhance their social support.

**Keywords:** social support, mental toughness, sports motivation, athlete burnout, weightlifter

## INTRODUCTION

Weightlifting needs performers' skilled techniques, strong physical performance, and excellent psychological characteristics to exert their maximum efforts to lift optimal weights (Dvorkin, 2005). Nowadays, the performance gap among the world's top weightlifters has gradually narrowed. Thus, the role of psychological quality, which can be measured by scales on emotion, confidence, willpower, resilience, and so on, is becoming more and more critical. A variety of studies have shown that when competing with opponents with equal ability, the athletes' psychological differences, such as toughness, cognition, or personality, can affect the competition outcomes by more than 50% (Weinberg and Gould, 2003). Therefore, excellent psychological quality has become an essential factor in athletes' evaluation (Chang et al., 2012; Lou et al., 2014). Thus, monitoring the psychological state of athletes has an important practical significance.

Athlete burnout has received widespread attention due to its negative impact on athletes' training and competition (Chen and Zhou, 2007; Goodger et al., 2007). This term was originally proposed by Freudenberg (1974). It is used to describe the exhaustion of psychological resources in long-term and high-stress environments, mostly in high-stress industries such as doctors and nurses. The research on burnout in the field of sports psychology started in the 1980s. Weinberg and Gould (2003) believed that athlete burnout is a response to overtraining (both psychological and physiological stress), which is a type of athlete's difficulty in maintaining regular training and reaching the optimal state of the past performance. To effectively distinguish it from physiological fatigue and fully demonstrate its development process, Zhang et al. (2006) defined it as "mental fatigue," which mainly refers to the comprehensive performance of the decline in psychological function caused by athletes' failure to replenish psychological and physiological resources in the process of continuous consumption when coping with pressure. Hu and Ning (2015) pointed out that professional weightlifting training will cause deep fatigue in the central nervous system, musculoskeletal system, and respiratory system of weightlifters, and it will take a long time to recover. The production of mental fatigue not only damages the athletes' mental health but also may cause their withdrawal from training. As a result, many scholars are committing to find out some effective approaches to relieve athletes' mental burnout.

The occurrence and development of athlete burnout is related to a series of physical, psychological, and sociological factors, among which social support and mental toughness are two very important protective factors (Lou et al., 2014; Ye et al., 2016). However, there are few models that emphasize the interaction between personality and environmental aspects (Goodger et al., 2007). In addition, whether it is the cognitive-affective model proposed by Smith (1986), the commitment model of Raedeke (1997), or the athlete burnout integration model proposed by Gustafsson et al. (2011), the decline of sports motivation all plays an important role in the production of athlete burnout. Gustafsson et al. (2011) believed that the diminishing motivation is an early symptom of athlete burnout. Through literature

review and analysis, it was found out that mental toughness and motivation may play a mediating role between the effect of social support on athlete burnout.

Social support commonly refers to the various forms of support and assistance provided by the individual's social network system, such as care, attention, or respect from other members in the social network, which directly affect the individual's health (Uchino et al., 1996). The stress model believes that any factors related to increased stress levels may cause mental burnout (Zhang et al., 2014). Previous studies have shown that social support can "buffer" stress through spiritual and material comfort, care, respect, and help from family, relatives, and other members of the society (Fisher, 1985; Kaiseler et al., 2009). It is not difficult to speculate that more social support can help athletes reduce fatigue in stressful situations. The research by Zhang and Zhi (2018) also suggested giving athletes more support to regulate the production of mental fatigue.

Mental toughness, also known as psychological resilience, refers to the process of an individual's good adaptation in the face of adversity, trauma, or stress (White et al., 2008). Jones et al. (2002) found out that many studies exploring the causes of successful athletes used mental toughness as an essential component, and their findings pointed out that mental toughness is an inherited or acquired psychological advantage, enabling athletes to better cope with stress in competition, training, and life than their counterparts (Jones et al., 2007). According to the stress model explaining the induction of mental fatigue (Zhang et al., 2014), it is not difficult to speculate that mental toughness can inhibit mental fatigue. The mentally tough athletes can positively evaluate external stimuli in stressful situations, effectively control and regulate their own emotions, and possess more optimistic expectations for goal pursuit (Madigan and Nicholls, 2017). These positive emotions and behavioral tendencies can protect athletes from sports fatigue symptoms. On the other hand, mental toughness is not static. In addition to genetic factors, the influence of the acquired environment is equally important. Previous studies believed that social support results in important attributions to mental resilience (Jones et al., 2002). Connaughton et al. (2010) also suggested that the formation of a good social support network around athletes has important practical significance for improving mental toughness.

Motivation is the psychological motivation or internal driving force that promotes a person's activities, and it has the initiating, directing, and strengthening effect on people's behaviors. Sports motivation is the internal motivation that causes and maintains individuals to engage in sports and to strive to reach their goals (Ma and Zhang, 2003). Sports motivation directly affects the enthusiasm and investment of athletes in training and competition. It then affects their training effect, competition performance, and career development (Zhang, 2015). Previous studies have investigated widely the correlation between sports motivation and mental burnout (Gould et al., 1996; Goodger et al., 2007). For example, Zhang et al. (2010) found that internal motivation and mental burnout were negatively correlated, while the lack of motivation was positively correlated with mental burnout. Besides, Harter's (1987) behavioral motivation



theory and the overall self-worth mediation model believed that in sports, society, and many other fields, the support of coaches, parents, and peers contributes to individual self-worth perception, which can directly and indirectly affect motivation and related behaviors.

Many studies have shown that athletes' mental toughness is closely related to their motivation. Zeng and Liu (2013) found out that the scores of athletes' sports motivation and participation tendency are significantly correlated with mental toughness dimensions. Strümpfer (2003) pointed out that the emergence of mental toughness can promote individual fitness, which leads to a trend opposite to the tendency of burnout, and athletes with higher levels of mental toughness are more motivated and show better persistence in goal pursuit behavior.

In short, social support, mental toughness, and sports motivation can alleviate the generation of athlete burnout, while social support can affect mental toughness; social support and mental toughness can also affect sports motivation. It can be seen that mental toughness and sports motivation may be the mediators of social support on athlete burnout. However, previous studies have mostly used social support as the unimoderator (Zhou and Guo, 2007; Wang, 2013) and paid little attention to its mechanism of athlete burnout. Based on this, the present study proposed the following four hypotheses to examine the impact of weightlifters' social support on athlete burnout and the role of mental toughness and sports motivation, clarify the value of social support, enrich the path of social support affecting athlete burnout, to provide theoretical bases for further explaining the mechanism of social support on athlete burnout, and provide ideas for the prevention and intervention of athlete burnout.

Hypothesis I: The social support of weightlifters can negatively affect athlete burnout.

Hypothesis II: The mental toughness of weightlifters plays a mediating effect between social support and athlete burnout.

Hypothesis III: The sport motivation of weightlifters plays a mediating effect between social support and athlete burnout.

Hypothesis IV: The mental toughness and sport motivation of weightlifters play a serial mediating effect across social support and athlete burnout.

## MATERIALS AND METHODS

### Participants

In this study, a sample of 327 weightlifters from Sichuan, Chongqing, and Shanxi in China was recruited as participants by communicating with their head coaches *via* email or telephone. Each participant filled out the survey questionnaire online according to the instruction of the scale and their coaches during December 12, 2019, to January 21, 2020. After completing the survey, the data preparation was carried out. Twelve copies were found to have incomplete or missing data; 315 copies were valid. The valid rate was 96.3%. The ages of

the participants ranged from 17 to 28 years old ( $M = 18.89$ ;  $SD = 3.66$ ). For more information on the participants, see **Table 1**.

This study was approved by the Ethics Committee of Chengdu Sports University following the Declaration of Helsinki. Each participant provided written informed consent, and the warranty of confidentiality was promised to them.

## Instruments

### Perceived Available Support in Sport Questionnaire

The Perceived Available Support in Sport Questionnaire (PASSQ) developed by Freeman et al. (2011) was used to test the social support of the respondents. The questionnaire has 16 items, including four dimensions: emotional support, e.g., "provide you with comfort and security"; esteem support, e.g., "instill you with the confidence to deal with pressure"; informational support, e.g., "give you constructive criticism"; and tangible support, e.g., "help with travel to training and matches." A five-point Likert-type scale ranging from 1 (never) to 5 (always) was used. The total score of social support is the sum of the scores of 16 items. A higher score represents a higher perceived level of social support.

### Athlete Burnout Questionnaire

The Athlete Burnout Questionnaire (ABQ) developed by Raedeke and Smith (2001) was used to assess the level of

**TABLE 1** | Summary of the sociodemographic information of the respondents.

Category		Frequency	Percent
Gender	Female	151	47.9
	Male	164	52.1
Athletic level*	Master sportsman	45	14.3
	Level 1	70	22.2
	Level 2	200	63.5
Origin	Rural	279	88.6
	Urban	36	11.4
Education level	College	144	45.7
	High school	96	30.5
	Others	75	23.8
Household income (yuan/month)	Less than 2,000	66	21
	2,000–4,000	161	51.1
	4,000–6,000	51	16.2
	6,000–8,000	22	7
	8,000–10,000	9	2.9
	10,000+	6	1.9
Training experience (years)	Less than 2	105	33.3
	2–5	78	24.8
	5+	132	51.9

\*Based on the criteria of the Chinese State General Administration of Sports.

mental burnout of weightlifters in this study. There are 15 items organized into three dimensions in this inventory: physical and emotional exhaustion (PEE), which contains five items, e.g., “I feel extremely tired from the sport participation” and “I feel physically and emotionally worn out by sport”; reduced sense of achievement (RSA), which contains five items, e.g., “I feel successful at sports” and “It seems that no matter what I do, I don’t perform as well as I should!”; and devaluation of sports practice (DSP), which contains five items, e.g., “I am not as worried about being successful as I used to be” and “I am not as interested in sport as I used to be.” The five-point Likert-type scale from 1 (never) to 5 (always) is used. The first and 14th items are reverse-coded items. The total score of the ABQ is the sum of all 15 items. The higher the score, the higher the burnout level of the weightlifters.

### Sports Mental Toughness Questionnaire

The Sports Mental Toughness Questionnaire (SMTQ) compiled by Sheard et al. (2009) and revised by Wang et al. (2014) was used to test the mental toughness of weightlifters. It contains a total of 12 items with three dimensions: confidence, e.g., “I will set challenging goals for myself”; constancy, e.g., “Having an insatiable desire and internalized motives to succeed”; and control, e.g., “I will become anxious because things cannot be predicted or controlled.” A five-point Likert-type scale ranging from 1 (completely inconsistent) to 5 (completely consistent) was used. The total score of the mental toughness was the sum of all 12 items. The higher the score, the stronger the mental toughness.

### Sports Motivation Questionnaire

The Sports Motivation Questionnaire (SMQ) developed by Zhang and Mao (2004) was used to test the respondents’ sports motivation. The questionnaire contains six items, consisting of two dimensions: approach tendency, e.g., “I can get a lot of fun from the sports I am engaged in”; and avoidance tendency, e.g., “If I can choose, I will practice other sports.” A five-point Likert-type scale from 1 (completely disagree) to 5 (completely agree) was used. The higher the score, the stronger the motivation to exercise. The following formula obtained the total score: score of item 1 + score of item 3 + score of item 5 – score of item 2 – score of item 4 – score of item 6 + 18.

## The Reliability and Validity Measures of the Scales

As shown in **Table 2**, the Kaiser–Meyer–Olkin (KMO) value of the PASSQ was 0.79 ( $P > 0.5$ ). The Bartlett sphere test was less than 0.05. These showed that they were suitable for factor analysis. The percentage of cumulative variance explained of PASSQ was 77.99%, i.e., the four dimensions of emotional, esteem, informational, and tangible accounted for 19.10, 23.14, 15.10, and 20.65%, respectively. The internal consistency Cronbach’s  $\alpha$  coefficients were 0.91, 0.92, 0.84, and 0.90, respectively, indicating that the PASSQ has good reliability. The composite reliability (CR) of the four subscales were 0.91, 0.92, 0.84, and 0.90, respectively, and the average variance extraction (AVE) values were 0.72, 0.74, 0.57, and

0.70, respectively, indicating that the convergent validity of the scale is good.

The ABQ’s KMO value was 0.84, and the Bartlett sphere test result was less than 0.05. The percentage of cumulative variance explained of ABQ was 54.83%. Cronbach’s  $\alpha$  coefficients of the three dimensions of emotional and physical exhaustion, reduced sense of achievement, and devaluation of sports practice were 0.79, 0.72, and 0.79, respectively; CR values were 0.79, 0.54, and 0.80, respectively; and AVE values were 0.45, 0.17, and 0.46, respectively.

The SMTQ’s KMO value was 0.76, and the Bartlett sphere test result was less than 0.05. The percentage of cumulative variance explained of MTQ was 62.51%. Cronbach’s  $\alpha$  coefficients of the three dimensions of confidence, constancy, and control were 0.73, 0.74, and 0.77, respectively; CR values were 0.71, 0.86, and 0.78, respectively; and AVE values were 0.37, 0.82, and 0.48, respectively.

The SMQ’s KMO statistical value was 0.69, and the Bartlett sphere test result was less than 0.05. The percentage of cumulative variance explained of SMQ was 70.92%. Cronbach’s  $\alpha$  coefficients of the two dimensions of approach tendency and avoidance tendency were 0.83 and 0.67, respectively; CR values were 0.85 and 0.71, respectively; and AVE values were 0.65 and 0.46, respectively.

## Statistical Analyses

SPSS Statistics 19.0, AMOS 21.0, and PROCESS 3.0 macro program (Hayes, 2018) were used to process and analyze the data. Descriptive statistics such as frequency analysis, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), regression analysis, and mediation analysis were used in this study. The significance level of all variables was set to  $\alpha = 0.05$ .

## RESULTS

### Correlation Analysis of Weightlifters’ Social Support, Sports Motivation, Mental Toughness, and Athlete Burnout

As shown in **Table 3**, the three dimensions of emotional support, esteem support, and informational support in the social support scale were negatively significantly associated with athlete burnout ( $R = -0.23 \sim -0.52$ ). All dimensions of the sports motivation scale were negatively associated with each dimension of athlete burnout ( $R = 0.24 \sim 0.44$ ). The confidence dimension in the mental toughness scale was negatively associated with reduced sense of accomplishment ( $R = -0.43$ ) and emotional and physical exhaustion ( $R = -0.36$ ). The constancy dimension was negatively associated with all dimensions of athlete burnout ( $R = -0.34 \sim -0.49$ ). The control dimension was negatively associated with emotional and physical exhaustion ( $R = -0.33$ ). Besides, there were significant correlations between social support, sports motivation, and mental toughness. The significant correlations provide better foundation for subsequent research hypotheses and mediation testing.

## The Regression Analysis of Social Support, Sports Motivation, Mental Toughness, and Athlete Burnout in Weightlifters

**Table 4** shows the following results: First, with social support as the independent variable and mental toughness as the dependent variable, the regression coefficient was statistically significant ( $\beta = 0.310$ ,  $P < 0.01$ ), indicating that social support significantly affected mental toughness. With social support and mental toughness as the independent variables and sports motivation as the dependent variable, the regression coefficient of social support was statistically significant ( $\beta = 0.349$ ,  $P < 0.01$ ), but the regression coefficient of mental toughness was not statistically significant ( $\beta = 0.099$ ,  $P > 0.05$ ). It showed that social support had a significant effect on sports motivation, but mental toughness had no significant impact on sports motivation. Taking social support, mental toughness, and sports motivation as independent variables and athlete burnout as the dependent variable, the regression coefficients of social support ( $\beta = -0.150$ ,  $P < 0.01$ ), mental toughness ( $\beta = -0.363$ ,  $P < 0.01$ ), and sports motivation ( $\beta = -0.354$ ,  $P < 0.01$ ) were statistically significant, indicating that social support, mental toughness, and sports motivation all had a significant impact on the burnout of athletes (for the relationship, see **Figure 1**).

Second, with social support, mental toughness, and sports motivation as independent variables and reduced sense of achievement as the dependent variable, the regression coefficients of social support ( $\beta = -0.145$ ,  $P < 0.01$ ), mental toughness ( $\beta = -0.344$ ,  $P < 0.01$ ), and sports motivation ( $\beta = -0.195$ ,  $P < 0.01$ ) were statistically significant, indicating that social support, mental toughness, and sports motivation all had a significant impact on the subdimension of athlete burnout (decreased sense of accomplishment). The regression weights of path analysis are listed in **Figure 2**.

Third, with social support, mental toughness, and sports motivation as independent variables and physical and emotional exhaustion as the dependent variable, the regression coefficients of social support ( $\beta = -0.130$ ,  $P < 0.01$ ), mental toughness ( $\beta = -0.442$ ,  $P < 0.01$ ), and sports motivation ( $\beta = -0.282$ ,  $P < 0.01$ ) were statistically significant, indicating that social

support, mental toughness, and sports motivation all had a significant impact on the subdimension of athlete burnout (physical and emotional exhaustion). The regression weights of path analysis are listed in **Figure 3**.

Fourth, with social support, mental toughness, and sports motivation as independent variables and devaluation of sports practice as the dependent variable, the regression coefficients of social support ( $\beta = -0.116$ ,  $P < 0.01$ ), mental toughness ( $\beta = -0.166$ ,  $P < 0.01$ ), and sports motivation ( $\beta = -0.403$ ,  $P < 0.01$ ) were statistically significant, indicating that social support, mental toughness, and sports motivation all had a significant impact on the subdimension of athlete burnout (devaluation of sports practice). The regression weights of path analysis are listed in **Figure 4**.

As shown in **Table 5**, SMT played a mediating role between PASS and AB (indirect effect =  $-0.113$ ; 95% CI:  $-0.1703$ ,  $-0.0631$ ). Also, SM played a mediating role between PASS and AB, and the mediating effect was  $-0.124$  (95% CI:  $-0.1751$ ,  $-0.0793$ ); SMT had no significant effect on SM, which led to the failure of the chain mediating effect of SMT and SM between PASS and AB (95% CI:  $-0.0269$ ,  $0.0037$ ). SMT played a mediating role between PASS and RSA (indirect effect =  $-0.107$ ; 95% CI:  $-0.1653$ ,  $-0.0566$ ); SM played a mediating role between PASS and RSA, and the mediating effect was  $-0.068$  (95% CI:  $-0.1166$ ,  $-0.0308$ ). SMT played a mediating role between PASS and PEE (indirect effect =  $-0.137$ ; 95% CI:  $-0.1914$ ,  $-0.0824$ ); SM played a mediating role between PASS and PEE, and the mediating effect was  $-0.098$  (95% CI:  $-0.1436$ ,  $-0.0599$ ). SMT played a mediating role between PASS and DSP (indirect effect =  $-0.051$ ; 95% CI:  $-0.1013$ ,  $-0.0092$ ); SM played a mediating role between PASS and DSP, and the mediating effect was  $-0.141$  (95% CI:  $-0.1945$ ,  $-0.0942$ ).

## DISCUSSION

### The Impact of Social Support on Athlete Burnout

The cognitive-affective stress model emphasizes that the cognitive assessment of the situation is one of the causes

**TABLE 2 |** Reliability and validity test of the questionnaire.

Construct	KMO and Bartlett's test	Items	% variance explained	% cumulative variance explained	Cronbach's $\alpha$
Emotional	0.79 $P < 0.01$	4	19.10	19.10	0.91
Esteem		4	23.14	42.24	0.92
Informational		4	15.10	57.34	0.84
Tangible		4	20.65	77.99	0.90
Physical and emotional exhaustion	0.84 $P < 0.01$	5	16	16	0.79
Reduced sense of achievement		5	12.97	28.97	0.72
Devaluation of sports practice		5	25.86	54.83	0.79
Confidence		5	24.53	24.53	0.73
Constancy	0.76 $P < 0.01$	3	16.61	41.14	0.74
Control		4	21.37	62.51	0.77
Approach tendency		3	45.30	45.30	0.83
Avoidance tendency		3	25.62	70.92	0.67

**TABLE 3 |** Descriptive statistics and correlation coefficients between social support, sports motivation, mental toughness, and athlete burnout.

	1	2	3	4	5	6	7	8	9	10	11	12
(1) Emotional support	15.36 (3.88)	1										
(2) Esteem support	14.72 (3.92)	0.72**	1									
(3) Informational support	14.88 (3.25)	0.52**	0.53**	1								
(4) Tangible support	16.74 (3.42)	0.25*	0.20*	0.07	1							
(5) Approach tendency	12.75 (2.06)	0.20*	0.09	0.07	0.29**	1						
(6) Avoidance tendency	6.77 (3.01)	-0.28**	-0.27**	-0.23*	-0.23*	0.17	1					
(7) Confidence	15.46 (3.61)	0.28**	0.39**	0.17	0.29**	-0.04	0.64**	1				
(8) Constancy	10.42 (2.02)	0.39**	0.47**	0.02	0.17	-0.17	0.04	0.12	1			
(9) Control	12.44 (3.38)	0.17	0.21*	-0.17	0.03	-0.11	-0.04	-0.39**	-0.11	1		
(10) Reduced sense of accomplishment	12.63 (2.58)	-0.29**	-0.38**	-0.11	-0.27**	0.24*	-0.43**	-0.49**	-0.33**	0.54**	1	
(11) Emotional/physical exhaustion	11.31 (3.46)	-0.34**	-0.52**	-0.03	-0.32**	0.35**	-0.36**	-0.34**	-0.18	0.49**	0.73**	1
(12) Devaluation of sports practice	9.91 (3.65)	-0.31**	-0.37**	-0.06	-0.30**	0.44**	-0.15	-0.34**				

M, mean; SD, standard deviation.

\* $P < 0.05$ , \*\* $P < 0.01$ .

of mental fatigue and mental exhaustion. This scenario includes the athlete's environment and the influence of environmental factors on it (Smith, 1986). Social support, as an essential social-environmental resource that athletes can obtain from coaches, family, teammates, and the organization, is an essential resource for coping with external pressure (Fisher, 1985). Nowadays, under the nation-level planned system, China continuously improves the system of on-the-job training for coaches based on the people-oriented principle, attaches great importance to the athletes' benefits (Personnel Department of General Administration of Sport of China, 2019), and provides athletes with competition, training, and living expenses (Wang et al., 2014). All these promote athletes to obtain more resources coping with stressful situations and then relieve or keep from athlete burnout. A survey on 163 elite athletes from 14 sport types by Zhou and Guo (2007) pointed out that athletes' mental health and perceived social support are essential predictors to sports fatigue. Their findings verified that social support can negatively affect athlete burnout (total effect =  $-0.398$ ; 95% CI:  $-0.3699$ ,  $-0.2184$ ), and this outcome is also valid on weightlifters alone. Thus, hypothesis I is established.

## The Mediating Role of Mental Toughness Between Social Support and Athlete Burnout

The literature on athlete burnout paid little attention to the association between environment and personality (Gustafsson et al., 2011) and showed that social support had an impact on athletes' mental toughness. Crust and Clough (2011) suggested that social support played an important role on the formation of athletes' mental toughness, enabling them to challenge difficulties and adversities and enhance their self-confidence constancy. The improvement in social support level means that athletes can get various forms of resources (i.e., care, trust, respect, and advice) from teammates, coaches, or family, and all these can help athletes develop a strong sense of belonging (Ding et al., 2016), provide a variety of coping strategies (Shen, 2015), and rebound from adversity, therefore, enhancing psychological resilience. The present study confirmed that athletes' social support could positively affect their level of mental toughness ( $\beta = 0.310$ ,  $P < 0.01$ ). In addition, mental toughness could have a negative effect on athlete burnout ( $\beta = -0.363$ ,  $P < 0.01$ ). As an essential psychological advantage, higher mental toughness level enables athletes to experience less physical and mental discomforts (Nicholls et al., 2008). Thus, athletes with high mental toughness have firmer beliefs against stressors and regard stressful situations as challenges rather than threats. This positive cognitive appraisal tendency can reduce stress perception, thereby suppressing burnout symptoms (Kaiseler et al., 2009). To sum up, we can see that social support can positively affect athletes' mental toughness and thereby alleviate athlete burnout. That is, mental toughness plays a mediating role

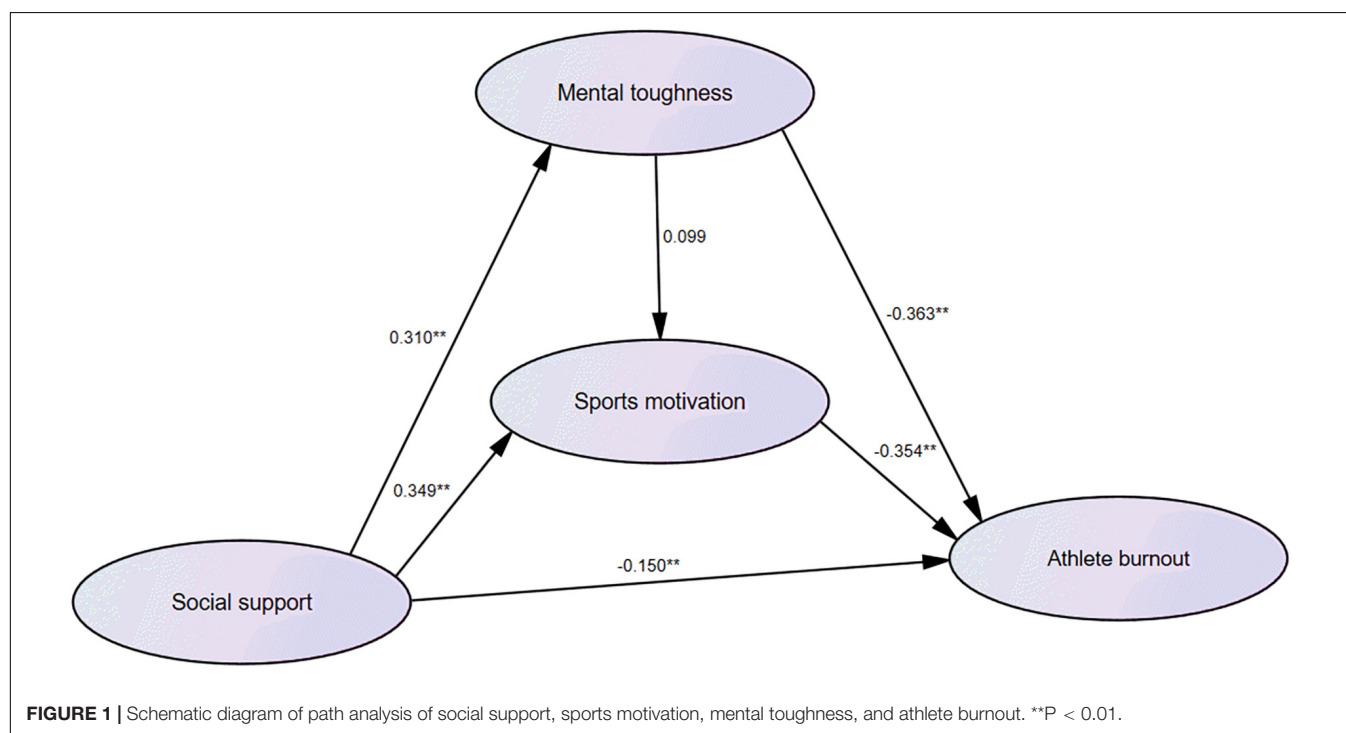


**TABLE 4 |** Regression analysis of social support, sports motivation, mental toughness, and athlete burnout in weightlifters.

	Social support		Mental toughness		Sports motivation		$R^2$
	$\beta$	$T$	$\beta$	$T$	$\beta$	$T$	
Mental toughness	0.310	5.77**					0.096
Sports motivation	0.349	6.37**	0.099	1.8			0.153
Athlete burnout	−0.150	−3.06**	−0.363	−7.85**	−0.354	−7.45**	0.406
RSA	−0.145	−0.27**	−0.344	−6.67**	−0.195	−3.37**	0.258
PEE	−0.130	−2.65**	−0.442	−9.57**	−0.282	−5.93**	0.406
DSP	−0.116	−2.15*	−0.166	−3.25**	−0.403	−7.69**	0.278

RSA, reduced sense of accomplishment; PEE, physical and emotional exhaustion; DSP, devaluation of sports practice.

\* $P < 0.05$ , \*\* $P < 0.01$ .

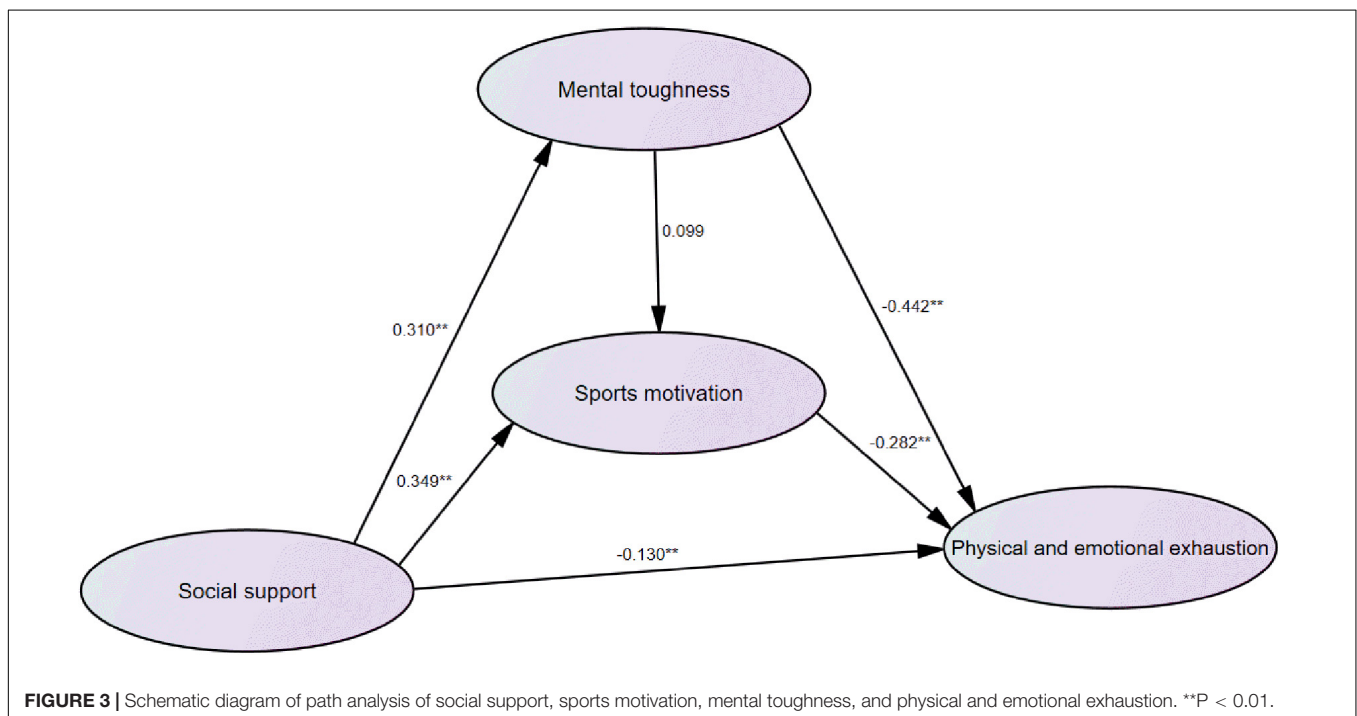
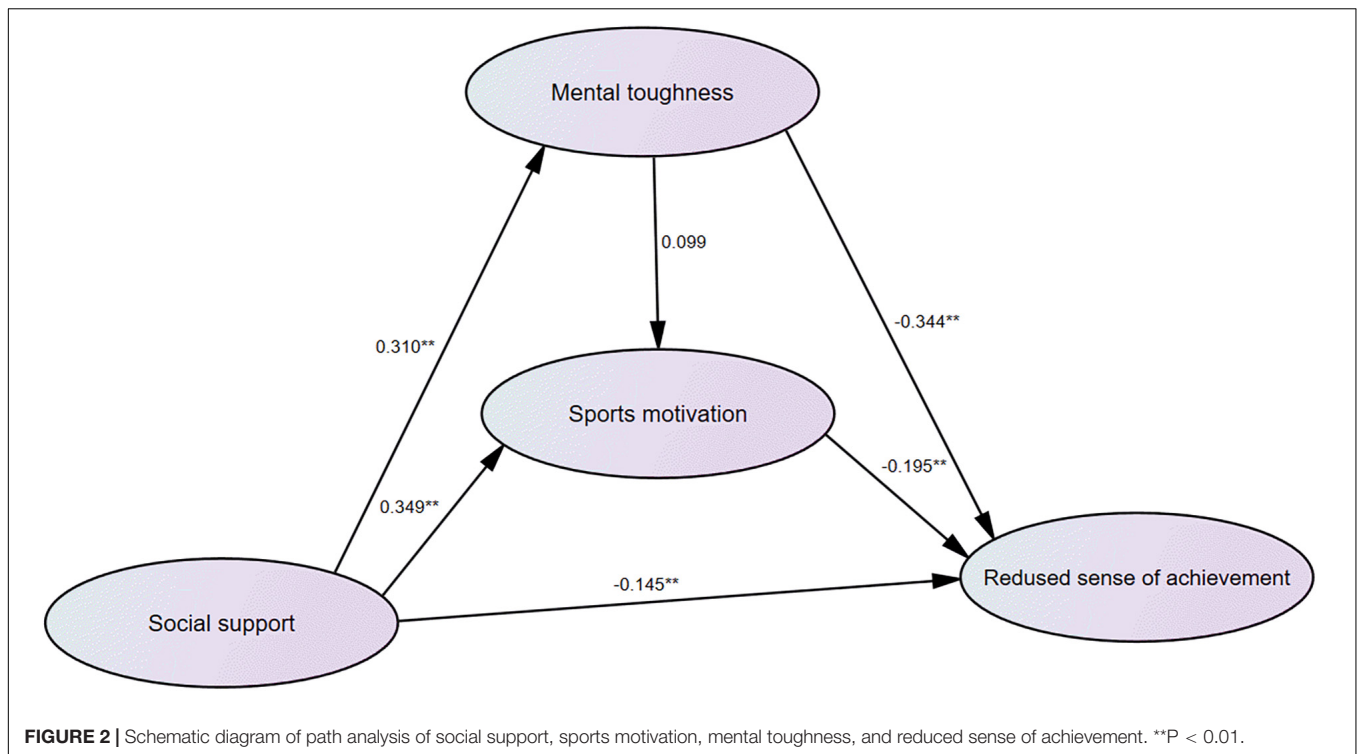


between social support and athlete burnout. Thus, hypothesis II is established.

## The Mediating Role of Sports Motivation Between Social Support and Athlete Burnout

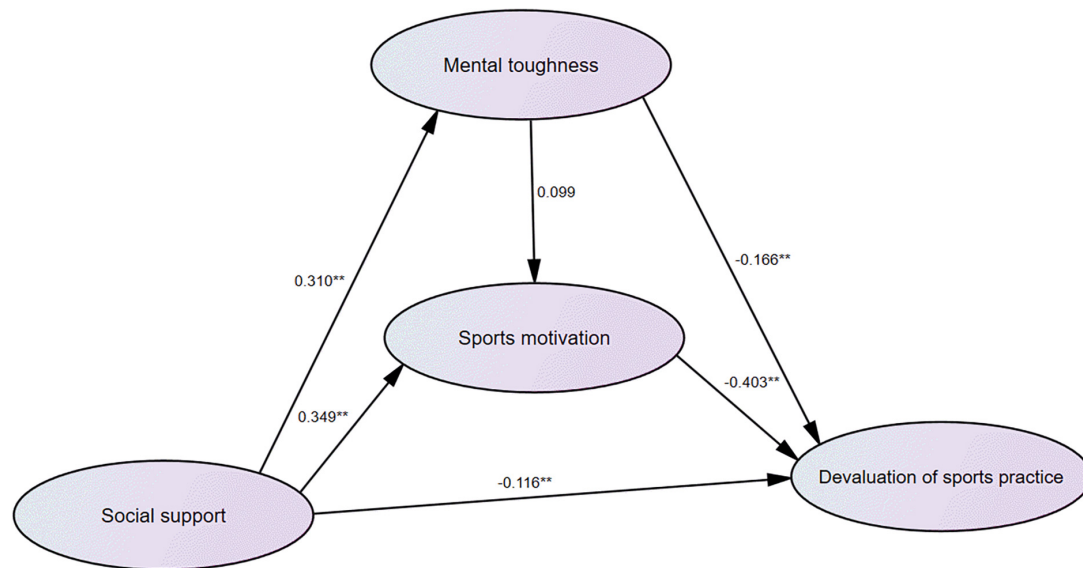
Generally speaking, the factors affecting the intensity and direction of motivation originate from one's internal needs and external conditions (Huang et al., 2018). The external conditions refer to environmental factors, that is, various stimuli outside the individual, including various biological and social aspects. For example, an athlete who participates in sports and desires success likes to get praise from his family and coaches or meet his own need of belonging by participating in a sports team. Social support has various forms and contents: not only objective forms of tangible support or specific technical guidance but also subjective forms of emotional warmth and personality respect,

which integrate a robust support system (Freeman et al., 2011) to help athletes gain a strong sense of belonging and identity (Ye et al., 2016), to devote themselves with full of enthusiasm, vitality, great self-confidence, and firm determination to sports. Vallerand and Losier (1999) stated that social factors such as coaches' behavior are one of the motivational factors that promote athletes to participate in sports. This study once again confirmed that athletes' social support could positively affect their level of sports motivation ( $\beta = 0.349$ ,  $P < 0.01$ ). In addition, sports motivation could have a negative effect on athlete burnout ( $\beta = -0.354$ ,  $P < 0.01$ ). However, the concept and classification of sports motivation have not yet reached an agreement. Vallerand (1997) divided motivation into three types: intrinsic motivation, extrinsic motivation, and amotivation. Zhang and Mao (2004) divided it into two parts: participation tendency and avoidance tendency. But no matter what kind of sports motivation, its relationship with athlete burnout has been verified (Cresswell and Eklund, 2005; Zhang et al., 2010).



If athletes regard sports as enjoyment, they will continue to invest in enthusiasm and maintain their sports career; on the contrary, if they regard sports as burden or constraints, they will experience burnout and exhaustion and withdraw from sports. Whether the athlete regards it as enjoyment or restraint is closely related to sports motivation (Raedeke, 1997). Therefore, the

decline of sports motivation can be regarded as one of the early symptoms of athlete burnout. It can be seen that more social support can help athletes improve their sports motivation and devote more enthusiasm to training and competition, thereby reducing the occurrence of burnout. That is, sports motivation plays a mediating role between social support and athlete burnout



**FIGURE 4 |** Schematic diagram of path analysis of social support, sports motivation, mental toughness, and devaluation of sports practice. \*\* $P < 0.01$ .

**TABLE 5 |** Summary of the mediating effect of mental toughness and sports motivation between social support and athlete burnout.

Effect	SC	Bootstrap SE	95% CI	RME (%)
<b>Overall athlete burnout</b>				
Total effect	-0.398	0.039	[-0.3699, -0.2184]	100
Direct effect	-0.150	0.036	[-0.1824, -0.0397]	37.69
Indirect effect	-0.248	0.032	[-0.3111, -0.1860]	62.31
PASS → SMT → AB	-0.113	0.028	[-0.1703, -0.0631]	28.39
PASS → SM → AB	-0.124	0.024	[-0.1751, -0.0793]	31.16
PASS → SMT → SM → AB	-0.011	0.008	[-0.0269, 0.0037]	2.76
<b>Reduced sense of accomplishment</b>				
Total effect	-0.326	0.012	[-0.0992, -0.0508]	100
Direct effect	-0.145	0.013	[-0.0582, -0.0087]	44.48
Indirect effect	-0.181	0.033	[-0.2517, -0.1195]	55.52
PASS → SMT → RSA	-0.107	0.027	[-0.1653, -0.0566]	32.82
PASS → SM → RSA	-0.068	0.023	[-0.1166, -0.0308]	20.86
PASS → SMT → SM → RSA	-0.006	0.005	[-0.0171, 0.0015]	1.84
<b>Physical and emotional exhaustion</b>				
Total effect	-0.374	0.016	[-0.1465, -0.0831]	100
Direct effect	-0.130	0.015	[-0.0694, -0.0103]	34.76
Indirect effect	-0.244	0.033	[-0.3080, -0.1808]	65.24
PASS → SMT → PEE	-0.137	0.029	[-0.1914, -0.0824]	36.63
PASS → SM → PEE	-0.098	0.021	[-0.1436, -0.0599]	26.20
PASS → SMT → SM → PEE	-0.009	0.006	[-0.0219, 0.0029]	2.41
<b>Devaluation of sports practice</b>				
Total effect	-0.320	0.018	[-0.1387, -0.0700]	100
Direct effect	-0.116	0.018	[-0.0723, -0.0032]	36.25
Indirect effect	-0.204	0.030	[-0.2661, -0.1476]	63.75
PASS → SMT → DSP	-0.051	0.023	[-0.1013, -0.0092]	15.94
PASS → SM → DSP	-0.141	0.026	[-0.1945, -0.0942]	44.06
PASS → SMT → SM → DSP	0.012	0.008	[-0.0295, 0.0041]	3.75

PASS, social support; SMT, mental toughness; SM, sports motivation; AB, athlete burnout; RSA, reduced sense of accomplishment; PEE, physical and emotional exhaustion; DSP, devaluation of sports practice; SE, standard error; SC, standardized coefficient; CI, confidence interval; RME, relative mediation effect.

(relative mediation effect accounts for 31.16%). Thus, hypothesis III is established.

## The Serial Mediating Effect of Mental Toughness and Sports Motivation

Mental toughness does not have a significant impact on sports motivation ( $\beta = 0.099$ ,  $P > 0.05$ ). In this study, the serial mediating role of weightlifters' mental toughness and sports motivation between social support and athlete burnout did not hold. Therefore, hypothesis IV is rejected. It may be that athletes' mental toughness varies along with different sports (Gucciardi, 2009).

In addition, this study found out that the mental toughness of weightlifters and sports motivation also played a mediating role on social support and each dimension of athlete burnout. However, **Figures 2–4** show differences in path coefficients of social support, mental toughness, and sports motivation on different dimensions of athlete burnout. This also suggests that we should consider the different symptoms and unique causes of athlete burnout in different dimensions in future research.

## Implications

With the continuous development of competitive weightlifting, athletes' training experience has extended, and the number of competitions has increased. Due to long-term physical and psychological pressures, athlete burnout has frequently occurred, and related research has been increasing. Although some studies consider social support, most of them focus on different projects as a whole and lack the internal mechanism research between social support and athlete burnout (Liu, 2012). This study confirmed the double mediating role of mental toughness and sports motivation between social support and athlete, providing ideas for further exploration of the alleviation mechanism of athlete burnout in the future.

The research further clarified the value of social support and reminded coaches to pay attention to perfect the athletes' social support system. In addition, research studies also proposed social support interventions, such as using commonly used remarks in the form of affirmative praise (Stragier et al., 2018) and group counseling with the theme of improving social support (Fan, 1996) to improve athletes' mental toughness and sports motivation level and relieve the occurrence of athlete burnout.

Bowe believed that to effectively improve the mental toughness of athletes, it is necessary to strengthen the training of six psychological skills in a psychological training plan: competition trait anxiety, psychological preparation skills, achievement motivation level, trait self-confidence, concentration, and leadership skills (Zeng and Liu, 2013). Zhou and Chen (2013) improved the mental toughness of Judo athletes through 4 weeks of mental skills training, and some scholars have suggested that attribution training and goal setting can effectively improve sports motivation (Huang et al., 2018). Determination of two intermediary factors of mental toughness and sports motivation also provides new ideas for the intervention of athlete burnout. Coaches can improve the efficiency of athlete burnout

relief through comprehensive interventions on social support, mental toughness, and sports motivation.

## Limitations and Future Research Directions

Although this study clarified the relationship across social support, sports motivation, mental toughness, and athlete burnout in weightlifters and confirmed the mediating role of mental toughness and sports motivation, it did not rule out the existence of other intermediary variables. For example, Shen (2015) found in a study on athlete burnout of college basketball players that social support can have an indirect impact on mental fatigue through emotional and stress-coping methods. It can be seen that emotions and coping styles may also be mediating variables between social support and athletes, which need to be further explored.

## CONCLUSION

The social support of weightlifters can negatively predict athlete burnout, suggesting the inhibitory effect of social support on athlete burnout. Current research showed that social support can impact athlete burnout through three paths: First, it directly affects athlete burnout; second, it has a mediating effect *via* mental toughness; and third, it has a mediating effect *via* sports motivation. The mediating role of mental toughness and sports motivation on social support and athlete burnout is established. Clarification of the path of social support, mental toughness, and sports motivation on burnout could provide ideas for further exploration of the alleviation mechanism of athlete burnout in the future and provide guidance for coaches in athlete burnout intervention programs.

## DATA AVAILABILITY STATEMENT

The original contributions generated for this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee at the Chengdu Sports University following the Declaration of Helsinki. The participants provided written informed consent to participate in the study.

## AUTHOR CONTRIBUTIONS

S-YY: conceptualization and resources. YS: methodology and software. YS and S-YY: analysis, data curation, and writing—original draft preparation. Both authors have read and agreed to the published version of the manuscript.



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# Educational Outcomes of Adolescents Participating in Specialist Sport Programs in Low SES Areas of Western Australia: A Mixed Methods Study

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Specialist Sport Programs (SSPs) are an underexamined activity that combines the best features of two different contexts for adolescent development: a sporting program and a secondary school. A mixed-methods study was conducted to determine the influence of participation in SSPs on the educational outcomes of lower secondary students in Western Australia. The results demonstrated a significant improvement in specialist students' mean grade for Mathematics over the course of a year, while their mean grade for all other subjects, and their level of engagement with school, remained stable over the same period of time. Semi-structured interviews were also conducted with key stakeholders (e.g., specialist students and their parents, as well as teachers and graduates of the SSPs). Overall, the participants felt that SSPs had a positive influence on students' engagement with school, and that this engagement had a positive impact on their academic achievement. Taken together, the results of this research suggest that there is a role for SSPs in promoting positive educational outcomes for lower secondary students attending public schools located in low SES areas.

**Keywords:** Specialist Sport Programs, adolescence, academic achievement, school engagement, low SES, mixed methodology

## INTRODUCTION

Engagement with learning is one of the four main goals of adolescence, which if achieved by the age of 15 years, sets an individual up for a successful transition into adult life (Blum et al., 2014). Research examining student-school engagement demonstrates that students' engagement with school can predict their grades in core subjects (Hazel et al., 2014). Although academic achievement is only one aspect of education, it is important with regard to students' future economic and social opportunity (Department of Education and Training, 2018). Other factors that may influence adolescents' educational outcomes include the socio-economic status (SES) of the adolescent and their participation in sport.

## Socio-Economic Status (SES)

Low SES has been found to have a negative association with adolescents' educational outcomes. In comparison to their higher SES peers, students from low SES backgrounds are more likely to experience school failure (Brownell et al., 2010). In Australia, it has been reported that students from low SES backgrounds have lower levels of school attendance (Hancock et al., 2013), academic achievement that is below the minimum national standard [Australian Bureau of Statistics (ABS), 2011], and lower levels of secondary school completion (Lamb et al., 2015).

## Participation in Sport

In contrast, sport participation during secondary school has been found to have a positive association with adolescents' educational outcomes, with sport participants reporting more positive educational outcomes than non-participants (Barber et al., 2001). Systematic reviews focusing on sport and physical activity conducted within schools have concluded that, as well as having a positive influence on adolescents' motor performance and self-concept, there is a positive association between adolescents' participation in sport and physical activity and their academic achievement (Rasberry et al., 2011; Demetriou and Honer, 2012).

However, negative outcomes have also been associated with adolescents' participation in sport (Garry and Morrissey, 2000; Scanlan et al., 2005), and some parents have voiced concerns that the time spent in physical education and school sport may interfere with students' academic achievement. These parents state that in order to improve students' educational outcomes, schools should focus on academic subjects and reduce the amount of time spent in physical education (Bailey et al., 2009).

It has been acknowledged that the structure and context of the sporting activity plays an important part in the development of either positive or negative outcomes (Mahoney and Stattin, 2000; Biddle and Asare, 2011). Therefore, it is important to investigate the educational outcomes associated with more specific sport contexts. An underexamined form of school-based sport is the Specialist Sport Program (SSP).

## Specialist Sport Programs (SSPs)

An SSP is a secondary school sport program through which students specialise in one sport in place of a range of elective subjects. The aim of the SSP is to develop the students' psychomotor, tactical, and physiological capabilities while the students continue their more conventional academic education (Gross and Murphy, 1990). SSPs are similar to both extracurricular and varsity sports. With all three types of sport program, adolescents specialise in one sport and dedicate a certain amount of time to their involvement in the sport. However, SSPs are also different to extracurricular and varsity sports. Specifically, SSPs are organised and delivered to the students mostly during school time in place of other elective subjects. In comparison, varsity sports, although delivered by the school, are conducted outside school hours; and extracurricular sports are delivered out of school hours through the community.

In the Australian context, enrolment in an SSP is open to all students, including those who live outside a school's catchment area (Harriss and Cibich, 1999). However, selection into an SSP is

generally based on the following criteria: a high level (or potential high level) of sporting ability, a high level of coachability, a positive attitude toward sport and school, and a good record of behaviour and school attendance (Harriss and Cibich, 1999). According to Goddard (1995), some SSPs can be very selective, while others will take any student who applies in order to maximise enrolment numbers. Schools usually allocate around 4 hours of class time per week to SSPs. In the lower secondary years (Years 7–10), this time is split evenly between practical and theoretical work; whereas in the upper secondary years (Years 11 and 12), there is roughly a 70–30% practical–theoretical split (Goddard, 1995).

As well as focusing on skill development, practical sessions aim to develop and maintain students' fitness levels and can also involve weight training and an injury prevention/management focus (Harriss and Cibich, 1999). Theoretical sessions cover topics such as biomechanics and physiology, rules and tactics, nutrition, and sport psychology; as well as time management, alternative sporting career options, and social skills development (Harriss and Cibich, 1999). Through the SSPs, it is also often possible for students to gain umpiring and coaching qualifications.

Broad claims are made suggesting the positive influence of such programs on adolescents' developmental outcomes. For example, the Department of Education in WA states that SSPs can “develop character, teach technical skills and self-discipline, and nurture a love of sport... [and]... enable children to compete at the highest levels and develop their skills as athletes both on the field and in the classroom” (Department of Education, 2018, online). However, only two studies have investigated the influence of participation in an SSP on adolescents' academic achievement.

Levacic and Jenkins (2006) used the General Certificate of Secondary School Examination (GCSE) results to compare the academic performance of schools with specialist programs (such as SSPs) to schools without specialist programs. The GCSE is a standardised measure of students' academic achievement in their final year of compulsory education. The GCSE results were used to rank order schools into league tables that distinguish between “successful” and “unsuccessful” schools. Although the effect size was modest, Levacic and Jenkins (2006) study demonstrated a significant difference in the academic performance between the school types. Specifically, there was a larger improvement over time in the GCSE results of schools with SSPs than schools with either specialist arts or language programs, or in schools without a specialist program.

Taylor (2007) also investigated the influence of specialist programs by examining the position of schools on a league table based on students' GCSE results. Students attending specialist schools were again found to have better academic achievement than those attending non-specialist schools. However, the margin of difference was less than that outlined by Levacic and Jenkins (2006). Additional analyses conducted by Taylor (2007) also revealed that the observed improvement in academic achievement over time for schools with SSPs was greater at schools with a high percentage of students from low SES backgrounds.



## The Current Study

Despite the broad claims that are made suggesting the positive influence of such programs on adolescents' developmental outcomes, and some research conducted internationally, there has been no research conducted on SSPs in Western Australian schools to support the Department of Education's assertion. With 33 SSPs in Western Australia (WA)—15 of which are in low SES areas—SSPs have the potential to influence many students, yet the impact of participation in an SSP remains largely underexamined.

Specifically, there has been no investigation of adolescents' academic achievement in relation to their participation in SSPs conducted within schools located in low SES areas of Australia. Nor has there been any investigation of students' academic achievement in relation to their participation in SSPs conducted earlier in their secondary school education. The existing studies (both conducted in the U.K.) examined students' academic achievement in relation to participation in SSPs using data from the students' final year of compulsory education. As such, the influence of SSPs on the academic performance of younger adolescents is unknown. Additionally, the existing studies analysed data at a school level, rather than at the level of the student. Although an improvement over time was observed, this was for a different cohort of students with a potential difference in level of academic achievement from their predecessors. It is therefore important to examine academic achievement in relation to SSPs at a student, rather than school, level.

Furthermore, students' engagement with school, which is considered to be an essential element for overcoming the educational disadvantage adolescents face due to their low SES (Parkville Global Advisory, 2014), has not previously been measured to determine if differences between specialist and non-specialist students exist. Additionally, as adolescence is a continual process of progress toward maturity, it is important to examine adolescents' educational outcomes over time. Therefore, it is important for research to investigate both the academic achievement and school engagement of students in relation to their participation in an SSP over time.

Thus, the purpose of the current study was to understand whether participation in an SSP can influence early adolescents' educational outcomes. Specifically, the current study sought to determine if participation in an SSP has a positive influence on the educational outcomes of adolescents attending schools located in low SES areas of WA. It was hypothesised that participation in an SSP would have a positive influence on adolescents' academic performance and that this positive influence of SSPs on adolescents' academic achievement would be due to higher levels of school engagement amongst specialist students.

## METHOD

The current study employed a mixed methods research design. The quantitative and qualitative strands of the current research were conducted independently and simultaneously as part of a larger study of work. Data for each strand were collected and

analysed independently and have only been combined at the point of interpretation.

Both quantitative and qualitative methods have numerous strengths, but also limitations. Quantitative analyses are criticised because the information they provide is detached from its real-world context; while qualitative research is often criticised for its small sample sizes and lack of generalisability (Castro et al., 2010). However, in combination these methods can negate some of the limitations that each method experiences on its own (Castro et al., 2010).

## Sampling

Purposive sampling was used to target schools offering an SSP located in a low SES area of WA. Schools that offer SSPs were identified through the WA Department of Education's webpage and the Index of Community Socio-Educational Advantage (ICSEA) score was used to define the SES of each of these schools. The ICSEA uses a compilation of information such as the students' home address, their parents' level of education, occupation, and income, and the school's location to provide each school with a number on a scale in comparison to other schools in WA [Australian Curriculum, Assessment and Reporting Authority (ACARA), 2013]. The scores on the index range from 500 (extremely educationally disadvantaged) to 1,300 (very educationally advantaged) and the median score on the index is 1,000 (S.D. 100). For the purpose of the current study, schools with an ICSEA score below the median were classified as low SES and it was assumed that students attending schools in low SES areas would come from a low SES background. Of the 32 schools in WA with an SSP, 15 were found to be in low SES areas and seven of the schools located in low SES areas agreed to participate in the research.

## Participants

Two groups of students were involved in the current research: those involved in an SSP (specialist students), and those attending the same school but not involved in the program (comparison students). Students in Year 7 through to Year 10 (12–15 years of age) were invited to participate. To recruit students into the study, the first author went to each of the schools involved to speak to the students during their physical education classes. The purpose of this visit was to provide students with information about the study and to explain what would be required of them if they chose to participate. It also provided students with an opportunity to ask the researcher any questions about the study prior to their involvement.

For the quantitative phase of the research, students could nominate to provide data relating to their academic achievement, their engagement with school, or both (achievement and engagement). With regards to academic achievement, 93 students (comprised of 68 specialist and 25 comparison students) provided informed consent. With regard to school engagement, 73 students (comprised of 64 specialist and nine comparison students) provided informed consent. The difference in participant numbers for each outcome is due to the way the data were collected. That is, to provide data for the analysis of

students' academic achievement, students simply had to provide permission for the school to release their grades to the researcher, whereas, to provide data relating to their engagement with school, students had to complete an online survey (as part of a larger research project) that combined five other scales measuring students' psychosocial development.

To be eligible to participate in the qualitative phase of this research, the participants had to meet the following criteria:

- The students must be currently involved in the SSP
- The parents must have a child who is currently involved in the SSP
- The teachers must have at least 1 year of experience as an SSP teacher, and
- The graduates of the SSP must have participated in the SSP for at least a year and completed their schooling at least a year prior to the interview.

These criteria were used to ensure the participants involved in the interviews had sufficient experience with the SSP to provide an in-depth perspective of the impact of participation in SSPs. Descriptive information relating to the 22 key stakeholders involved in the qualitative phase is presented in **Table 1**.

The teachers of the SSPs have relative autonomy over the program on offer at their school. As such, there are some differences between the schools involved in the current study. The main difference being the sport that is the focus of the SSP. Some of the sports that the schools involved specialised in were Soccer, Rugby, Australian Rules Football, and Netball.

## Measures

Adolescents' school grades are regularly reported to them and their parents through a grading scale (A being the best grade and E being the worst grade). This grading scale is thought to demonstrate the students' achievement in relation to a school subject. For the current study, the students' academic achievement was determined by examining their grades for English, Mathematics, Science, Society and Environment (S&E), and Health and Physical Education (HPE). The students' grades were assigned the following values: A = 5, B = 4, C = 3, D = 2, and E = 1. Thus, a higher score indicated a better grade.

The Student-School Engagement Measure (SSEM; Hazel et al., 2013) has 22 items across three factors: aspirations (4 items), productivity (12 items), and belonging (6 items). The survey uses a Likert-style scale ranging from 1 (strongly disagree)

to 10 (strongly agree). Scores from all items are combined to get an overall engagement score, with higher scores indicating greater engagement. Hazel et al. (2014) reported that this scale has good reliability. Tomaszek (2020) report that the Cronbach's alpha of the SSEM ranges from 0.76 to 0.84 for the factors of engagement and is 0.89 for the overall measure of engagement.

A semi-structured format was used for all interviews. Such a format allowed the participants to discuss what they felt was important regarding the benefits and challenges associated with participation. The interview included comparative, contrast, descriptive, evaluative, and structural questions, as well as probes and prompts (Smith et al., 2009). For example, the participants were asked "Can you tell me about the SSP you are involved in?" and "Can you list all the benefits of being involved in the SSP?". As the purpose of this study was to explore the breadth of impact that participation in an SSP can have on adolescents' educational outcomes it was important to keep the interview questions open.

## PROCEDURE AND ANALYSIS

Approval was received from the University Human Research Ethics Committee and the WA Department of Education's Evaluation and Accountability Directorate. Schools with SSPs were identified through the WA Department of Education's webpage and the ICSEA score was used to define the SES of each of these schools.

Once all consent forms were returned, the researcher provided each school with a list of students who had given permission for their grades to be collected. Schools collated the information required and provided it to the researcher either as a hard copy or as a PDF file that was sent via email. Students' grades were collected twice (Semester 1, Year 1 and Semester 1, Year 2) to allow for a repeated measures design. As such there was a 1-year gap between the baseline and final results.

The researcher also liaised with teachers to organise a time for the students to complete the SSEM. This survey was administered online through Qualtrics as part of a larger study. As such, the adolescents required access to a computer with internet access in order to participate. The online survey also collected information such as the students' name, age, school, and whether they participated in the SSP. Schools were asked to allocate an hour for the students to complete the survey, and it was completed twice with ~1 year between baseline and follow-up. The students' grades and engagement scores were de-identified as soon as the data for each year were collated.

There were two independent variables in the current study—participation (specialist or comparison students) and time (baseline and follow-up). For academic achievement, the grades for each of the five subjects (English, Mathematics, Science, S&E, and HPE) were the dependent variables. For engagement, there were four dependent variables: aspirations, belonging, productivity, and overall engagement.

A mixed repeated measures analysis of variance (ANOVA) was planned for each of the dependent variables with students' participation type as the between-groups factor. Students' scores were to be analysed across two time conditions: baseline and

**TABLE 1** | The number of participants (and their gender) from each school.

School	Students	Graduates	Teachers	Parents
1			1 (m)	
2	4 (f)	1 (m)	1 (f)	
3	3 (m)		1 (m)	1 (m) and 2 (f)
4	4 (m)		1 (m)	
5		1 (m)	1 (f)	
6		1 (m)		

f, female; m, male.

**TABLE 2 |** Descriptive statistics and *t*-test results for specialist students' academic performance.

Variables ( <i>n</i> )	Year	Mean (SD)	Mean difference	95% CI		<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
				Lower	Upper				
English (65)	1	3.25 (0.71)	0.10	−0.11	0.30	0.903	64	0.369	0.112
	2	3.15 (0.87)							
Mathematics (63)	1	3.08 (0.97)	−0.22	−0.44	−0.01	2.072	62	0.042*	0.261
	2	3.30 (0.96)							
Science (55)	1	3.44 (0.96)	0.19	−0.10	0.47	1.277	54	0.207	0.172
	2	3.25 (1.13)							
S & E (54)	1	3.17 (0.84)	−0.05	−0.29	0.18	0.476	53	0.635	0.065
	2	3.22 (0.88)							
HPE (57)	1	4.39 (0.70)	0.13	−0.10	0.34	1.123	56	0.266	0.149
	2	4.26 (0.81)							

\*Significant,  $p < 0.05$ .

follow-up. However, due to a discrepancy in sample sizes (there were substantially more specialist students than comparison students), a decision was made to focus solely on the specialist students' academic performance and engagement with school over time. As such, a dependent-samples *t*-test was conducted for each of the dependent variables. Alpha was set at 0.05 due to the exploratory nature of the research and SPSS (Version 24) was used to perform the analysis.

Interpretative Phenomenological Analysis (IPA) was used to analyse the qualitative data because the research sought to examine the perceptions of several key stakeholders of the SSPs. IPA involves a double hermeneutic process; the participant first makes sense of the experience and then the researcher makes sense of the participants' perceptions (Smith et al., 2009). IPA is also an inductive and idiographic approach. That is, during IPA, the researcher looks for patterns and themes from the raw data from which to develop a general theory of the phenomenon being investigated (Smith et al., 2009). IPA takes into consideration the perspectives of the individuals involved in the experience.

Interviews were audio recorded and then transcribed. Once transcribed, the author read through the interviews while listening to the recordings to ensure the accuracy of the transcriptions. NVivo qualitative data analysis software (Version 10) was used to organise and analyse the data. Data were de-identified to ensure confidentiality and each participant was assigned a code. Male students were assigned the letters MS and female students the letters FS. Graduates were assigned the letter G; teachers, the letter T; and parents, the letter P. Each participant was then assigned a number. For example, the first male student interviewed was coded MS1.

The guidelines for analysing data using the IPA framework are flexible and can be adapted depending on the objective of the investigation (Pietkiewicz and Smith, 2014). Three general steps of IPA used in the current study were: multiple reading and making notes, transforming notes into emerging themes, and seeking relationships and clustering themes.

There are four broad criteria used to determine the validity and quality of qualitative research and the current study attempted to meet each of them. The criteria are: sensitivity to context (includes the use of relevant literature and participants'

perspectives), commitment and rigour (includes methodological competence and skill), transparency and coherence (e.g., is there a good fit between the theory and method used? Are the methods and data presentation transparent?), and impact and importance (does the research enrich our theoretical understanding and does it have a practical impact?) (Yardley, 2000). As a professional courtesy, and a means of demonstrating trustworthiness of the research process, interview transcripts were sent to participants (via email) to check if they would like to make any amendments.

Once collected, the quantitative and qualitative data were analysed independently. As a form of triangulation, the findings from both phases of the research were then examined together. This allowed the authors to see how the findings from each phase could inform and validate each other.

## RESULTS

### Quantitative Results

The analysis demonstrated a statistically significant difference over time with regards to specialist students' mean grade for Mathematics,  $t_{(62)} = 2.072$ ,  $p = 0.042$ . The specialist students' mean grade for Mathematics significantly improved from Year 1 (3.08,  $SD = 0.97$ ) to Year 2 (3.30,  $SD = 0.96$ ). A small effect size ( $d = 0.26$ ) was indicated by the mean difference of 0.22 between specialist students' mean Mathematics grades for Year 1 and Year 2 (99% CI = 0.44, −0.01). There was no statistically significant difference over time with regards to specialist students' mean grade in the other four school subjects. Descriptive statistics and the results of the *t*-test on specialist students' academic performance are presented in **Table 2**.

The analysis demonstrated no statistically significant difference over time with regards to specialist students' aspirations, belonging, productivity, or overall engagement. Descriptive statistics and the results of the *t*-test on specialist students' school engagement are presented in **Table 3**.

### Qualitative Results

Analysis of the interviews revealed the positive influence of participation in an SSP for adolescents attending schools located

**TABLE 3 |** Descriptive statistics and *t*-test results for specialist students' school engagement.

Variables	Year	Mean (SD)	Mean difference	95% CI		<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
				Lower	Upper				
Aspirations	1	4.60 (1.12)	0.18	−0.23	0.60	0.872	64	0.387	0.109
	2	4.42 (1.14)							
Belonging	1	5.09 (1.25)	0.20	−0.17	0.60	1.057		0.294	0.132
	2	4.89 (1.02)							
Productivity	1	6.19 (0.92)	0.06	−0.20	0.32	0.445		0.658	0.056
	2	6.13 (1.03)							
Engagement	1	6.05 (0.80)	0.13	−0.13	0.39	1.019		0.312	0.127
	2	5.92 (0.81)							

in low SES areas of WA. The overarching theme discussed by all participants was the SSPs' ability to facilitate students' engagement with school. Specifically, the SSP was perceived to facilitate students' behavioural, cognitive, and emotional engagement with school.

### Behavioural Engagement

The SSP students' behavioural engagement was demonstrated through their compliance with the code of conduct; a prerequisite for them to remain in the program. The code of conduct outlined the teacher's expectations for the specialist students. While some schools had specific requirements for the students, such as a minimum 90% attendance rate at school and maintenance of "acceptable" grades in all subjects, other schools provided more general guidelines outlining what was expected of students in the SSP. For example, students should "be punctual, prepared, and well-presented for all classes" and "work responsibly and diligently on all activities" in school.

With regards to attendance, Participant T3 explained:

[SSPs] definitely increase the attendance of the kids... if we have it [the SSP] Period 1 [the start of the school day] and Period 5 [the end of the school day], they're [the SSP students] attending throughout the whole day.

T3 said that this structure accounted for an improvement in students' attendance in other classes as they could not be bothered to leave school in between their SSP classes. P2 concurred, "there are a lot of kids that the only reason they're still at school is because of the program—it gives them a reason to go [to school]." With regards to their behaviour and academic achievement, MS1 explained: "I'm focused on not getting into trouble, so I won't miss any games," while MS3 said he made more of an effort with his academic studies so as to remain in the program:

It made me think, it's going to affect your appearance in the program... it's made me think harder in maths and like... English and stuff like that so... I moved up from a C to a B in English from thinking about the program, and if I didn't think about the program, I would still have been on a C kind of thing.

### Cognitive Engagement

As well as being behaviourally engaged with their school, the SSP students were also cognitively engaged with their education. This was apparent when the students applied effort to their education because they wanted to, not because they felt they should (Sciarra and Seirup, 2008). Although it is difficult to observe cognitive engagement among students in compulsory education, this form of engagement was evident in the statements made by the teachers. For example, T2 spoke of past students who went on to tertiary level study despite it being optional: "I've kept in touch with a lot of students... saying you know 'now I'm at university doing teaching' or 'I've finished a masters in something else.'"

### Emotional Engagement

The SSP students also appeared to be emotionally engaged with their school through the SSP. This emotional engagement was evident in the positive feelings the students discussed in relation to their participation in the program and the positive relationships that they reported were developed through the program. All of the SSP students said that the program was their favourite subject at school. For example, MS5 explained that participating in the SSP was "fun... it's energetic and you just have a great time doing it." The students' positive views were echoed by the parents, with P2 saying "[my son] really enjoyed it [the SSP] and it was a good outlet for all of his energy." The enjoyment experienced through the SSP improved the students' feelings about school in general. For example, MS7 said: "I didn't want to come to [school] unless I got into the [SSP]"; and G3 said that attending school was "the best 5 years of my life."

It was apparent that participation in the SSPs helped to promote the students' behavioural, cognitive, and emotional engagement, with their school. Both male and female students felt that participation in SSPs positively influenced their engagement with school. However, only male students discussed specific aspects relating to engagement, such as attendance, behaviour, and academic achievement. This is a significant finding as previous research that has demonstrated gender differences in school engagement levels has found that girls were more engaged with school than boys (Dotterer et al., 2007). The graduates, teachers, and parents also discussed these aspects of engagement.



## Integration of Findings

The findings of the qualitative research add depth to the quantitative results. The quantitative research demonstrated a stability of the students' engagement scores over time and showed their engagement levels to be in the neutral zone. On face value this may not seem like a very positive outcome. However, all participants involved in the qualitative research indicated that the SSPs facilitated students' engagement with school. For many students, the SSP was the reason they attended school each day; furthermore, it was the reason they applied effort to their education. As such, the SSPs were seen to have a direct positive influence on students' engagement with school, which enabled an indirect positive influence on their academic performance. It is therefore thought that without the SSP, the students' engagement levels (and academic performance) would decrease, as is commonly reported in the literature.

## DISCUSSION

The aim of this study was to investigate the effect of involvement in SSPs on the educational outcomes of adolescents attending schools in low SES areas of WA. To achieve this, quantitative and qualitative research methods were used to examine the academic achievement and school engagement of specialist students over the period of a year.

The results of the quantitative phase of research demonstrate a statistically significant difference in the specialist students' mean grade for Mathematics over time. That is, over the period of a year, the specialist students' mean grade for Mathematics improved. There was, however, no significant difference over time with regards to specialist students' mean grade in the other four school subjects.

Interpretation of specialist students' academic achievement should consider the grade that the mean score represents. The students' grade in each subject describes the "expected level that the majority of students are achieving by the end of a given year of schooling" (School Curriculum and Standards Authority, 2016, p. 2). According to the School Curriculum and Standards Authority (2016), a C grade demonstrates a satisfactory level of achievement, while a B grade demonstrates a high level of achievement.

In the first year of data collection, specialist students' mean grade for English, Mathematics, Science, and S&E was a C. That means that despite the amount of time specialist students spend in the SSP, they were still achieving, on average, a satisfactory level for English, Mathematics, Science, and S&E subjects. Furthermore, the grade a student is awarded is based upon what is expected at that particular year level, so that as students move through the year levels, the expectations placed on them increase. Although specialist students' grades did not improve over the period of a year, they maintained a satisfactory level of achievement in English, Mathematics, Science, and S&E, despite an increase in the difficulty level of the content being taught.

The results of the current study showed an improvement in the specialist students' mean grade for Mathematics, but not their other school subjects. As such, the current study only provides

partial support for the results of Levacic and Jenkins (2006) and Taylor (2007). Levacic and Jenkins (2006) study demonstrated a larger improvement over time in the GCSE results of schools with SSPs than schools without specialist programs. This was confirmed by Taylor (2007) who also found that schools with a high percentage of students from low SES backgrounds had a greater improvement over time, than those with a higher percentage of students from high SES backgrounds.

Due to the lack of a non-SSP comparison group, the current study cannot claim a causal association between students' participation in an SSP and their Mathematics grades. However, the results may ease parents' concerns regarding the time spent in Physical Education classes detracting from students' academic achievement (Bailey et al., 2009).

The quantitative phase of research also demonstrated that the school engagement of specialist students remained stable over the period of a year. This was an important finding as engagement with school has previously been found to decrease in early adolescence (Brown and Larson, 2009).

Examination of the mean score for each of the engagement factors showed that the school engagement of specialist students was close to the neutral response. That is, out of a possible score of 10, specialist students' mean response ranged from 4 to 6. This, however, is not to say that the SSP did not have a positive influence on specialist students' engagement with school. Unlike previous research conducted by Brown and Larson (2009), the specialist students' level of engagement with school did not decrease. Additionally, all participants involved in the qualitative phase of the research reported that participation in the program had a positive influence on the students' engagement with school.

There are three types of engagement relevant to an examination of students' engagement with school: behavioural, cognitive, and emotional (Fredricks et al., 2004). Behavioural engagement refers to students applying effort to their education (Sciarra and Seirup, 2008); cognitive engagement refers to students applying effort to their education because they want to, not because they feel obliged to (Sciarra and Seirup, 2008); and emotional engagement refers to the affective reactions students have to their teachers, peers, and the school in general (Fredricks et al., 2004). All three types of engagement were alluded to by the participants in the current research.

The positive influence of SSPs on adolescents' engagement with school is an important result as engagement with learning is essential for overcoming the educational disadvantage adolescents face due to their low SES (Parkville Global Advisory, 2014). Students from low SES backgrounds have previously been found to have lower rates of school attendance (Hancock et al., 2013) and their academic achievement is below the minimum national standard [Australian Bureau of Statistics (ABS), 2011]. The improved outcomes of attendance, behaviour, and academic achievement for students in an SSP in a low SES area increase the students' likelihood of completing secondary school and continuing into further education, which is an important step toward breaking the cycle of disadvantage that currently exists for students from low SES backgrounds (Department of Education and Training, 2018).

## Strengths and Limitations

The key strength of this research is the comprehensive approach taken to investigate the influence of SSPs. Namely, a longitudinal design using both qualitative and quantitative methods, sampling participants from multiple schools and taking into account multiple perspectives. This study is the first study to examine the educational outcomes of Australian students in relation to their participation in an SSP. It is also the first study worldwide to examine both the academic achievement and the engagement levels of low SES adolescents involved in SSPs. This research will therefore serve as a base for future studies of adolescent development in relation to participation in youth sport and school-based programs.

One of the limitations of this research is the lack of a comparison group of students. Despite the author's best efforts to recruit both specialist and non-specialist students, there were not enough non-specialist students who provided informed consent to participate in the study. Consequently, it is difficult to confirm the influence of the SSP on the specialist students' academic achievement and school engagement.

Another limitation is the possibility of self-selection bias. Although all schools with an SSP located in low SES areas of W.A. were invited to participate in the research, only seven schools agreed to do so. It is possible that only those schools in which the SSP teacher was proactive and proud of the program's accomplishments agreed to be involved in the research. There may be other schools with SSPs that have vastly different results, and the participation of only a limited number of schools in the research may highlight a lack of accountability for these programs.

## CONCLUSION

The purpose of this investigation was to explore the influence of participation in SSPs on the educational outcomes of students attending schools located in low SES areas of WA. Although it is difficult to confirm the influence of the SSP on the specialist students' educational outcomes, the research is strengthened

by the mixed methods design that allowed for an exploration of the perspectives of multiple key stakeholders. Furthermore, the research sampled participants from seven different schools, thereby increasing the generalisability of the results because the SSPs at the schools involved focused on different sports, under the leadership of different teaching staff. As such, the results of this research make a significant contribution to the literature.

Although there is room for improvement with regard to specialist students' engagement with school, the results of the current study demonstrate that specialist students are making satisfactory academic progress despite the amount of time spent in the SSP. This is important because engagement with learning is one of the main goals of early adolescence (Blum et al., 2014). Overall, the findings of the present study point to the positive influence participation in an SSP can have for adolescents attending schools located in low SES areas.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because only the authors have ethics approval to access the dataset. Requests to access the datasets should be directed to Eibhlís O'Hara, e.ohara@ecu.edu.au.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Edith Cowan University Human Research Ethics Committee. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

EO'H, CH, and FM contributed to the conception and design of the research. EO'H was responsible for data collection, analysis and interpretation, and wrote the first draft of the article. CH, FM, and CS supervised the project. All authors provided feedback and helped to shape the research and manuscript.

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# Mood, Burnout, and Dispositional Optimism in Kayak Polo Players During Their Competitive Stage

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The main objective of performance sport is to obtain achievements at the highest level through the adequate development of the athlete. The scientific literature demonstrates the fundamental role played by the inclusion of certain psychological variables in the training plan. This study examined the psychological profile of kayak polo players through the variables of burnout, optimism, and mood in the hours prior to the competition, relating these to each other and to some sociodemographic data. A sample of 86 canoeists, 60 men (69.8%) and 26 women (30.2%), with an age measurement of  $24.4 \pm 9.1$  years belonging to the first male and female kayak polo division, completed the POMS-29, the LOT-R, and the IBD-R. Athletes' levels of optimism were found to be significantly correlated with mood. Optimism also influenced emotional exhaustion. In addition, seniority and internationality were decisive factors in the level of optimism and mood achieved.

**Keywords:** psychological variables, sport performance, training, IBD-R, LOT-R, POMS, kayak

## INTRODUCTION

High-level competitive sport is understood as a sport whose aim is for athletes to perform at their best. However, reaching the peak of an athlete's performance and maintaining it at the highest level for as long as possible is not an easy task, since, in addition to taking into consideration physical, technical, tactical, and strategic resources, it is necessary to introduce psychological variables into the formula for sporting success (Gould and Maynard, 2009; Mauss and Robinson, 2009; Barker et al., 2020). Many specialists conclude that competitive sport involves the intervention and inherent control of aspects such as motivation, attention, stress, anxiety, self-confidence, moods, self-control and self-regulation, cohesion, interpersonal skills, or emotional adjustment (Meyers et al., 1979; Garcia Quinteiro et al., 2006; Gimeno et al., 2007; Almagro et al., 2020).

Mastering and correctly training all these variables can contribute to the optimization of sporting performance, increasing the possibilities of improving results, and at the same time ensuring continuity in competitive sport for a prolonged period of time. In this sense, in order to find out the optimal relationship between the different psychological variables and their consequent positive effect on sporting results, numerous studies have focused their research on the analysis of these variables, sporting experiences, and the success achieved in the results (Kreinerphillips and Orlick, 1993; Vernacchia et al., 2000; Gould et al., 2002).

It is necessary to be meticulous with the training work carried out by athletes, in view of the fact that sports practice, in the first instance, is associated with pleasant effects for most of them.



However, working with high training loads and the competition itself can lead to a situation of chronic stress, which eventually results in the need for abandonment (Gustafsson et al., 2008, 2018). Intense and prolonged sporting efforts, accompanied by sporting failures, may be susceptible to sport dropout (Lemyre et al., 2008). Not achieving the expected results or not reaching the proposed objectives leads athletes to a situation of exhaustion, both physically and psychologically, giving rise to negative thoughts about their abilities to practice the sport (Raglin, 2001).

Having established the above provisions, it is therefore easy to conclude that, in the competitive field, it is necessary to carry out a psychological evaluation of the athlete, in order to be able to establish an objective and individualized assessment of the variables that may be most influential in each case. To this end, analytical tools such as questionnaires are required, which, together with other elements and instruments for recording and collecting data, can provide valuable and decisive information for the training of the athlete, as well as for their training for competition (Gimeno et al., 2007). In line with what has been described, the literature on the analysis of psychological variables, as well as the variety and typology of questionnaires for such analysis, is extensive (López Roel and Dosil, 2019); this has undergone a significant evolution in recent decades, from the use of more generic measurement instruments to the development and use of more specific instruments for sports (Biddle, 1992; Hall et al., 1998; Anshel and Sutarso, 2007; Fayos Ruiz et al., 2012; Andrade et al., 2013; Cano-García et al., 2015).

## Burnout Syndrome

Having described the statements in the previous paragraphs, it is necessary to specify that taking into account the burnout of the athlete as a result of training overload is to consider a multidimensional phenomenon where different factors come into play, such as emotional and physical fatigue, decreased achievement, and sport devaluation (Goodger et al., 2007a; Reche et al., 2018). Early studies on burnout defined the concept within the framework of feelings of failure and exhaustion in the face of excessive demands on energy, strength, and personal resources (Carlin and Garcés de los Fayos Ruiz, 2010). Other works highlighted emotional exhaustion, depersonalization, and low self-fulfillment (Jackson and Maslach, 1982; Byrne, 1993).

Furthermore, other researchers added that, in sports, the hours of training and the competition itself could be a source of chronic psychological stress, which was significantly related to the risk of burnout and abandonment of sports practice (Hall et al., 1998; Hill et al., 2010). This abandonment is qualified in certain studies as one of the most worrying effects of the syndrome for professional athletes (García-Parra et al., 2016), not only because of the psychological consequences but also because of the social consequences, which may involve a questioning of the identity acquired during their time as athletes (Coakley, 1992; Goodger et al., 2007a). Along these lines, athletes experiencing burnout have common characteristics, but the symptoms manifested may be completely different (Gustafsson et al., 2018). This highlights the need to develop analysis strategies through tools that allow personalizing and professionally treating athletes with individualized work plans.

In the context of sport, there are four fundamental lines of work in burnout research. First, the identification of predictor variables. Second, work aimed at analyzing the consequences of suffering from the syndrome. As a third line of research, the authors point to the development of models that help to better understand the syndrome. Finally, there is a line of research that collects epidemiological data allowing us to analyze the incidence of this syndrome in the context of sport (Carlin and Garcés de los Fayos Ruiz, 2010; García-Parra et al., 2016).

Thus, in the last decade, numerous studies can be found in which the authors measure burnout syndrome in different collective sports modalities such as football (Lopes Verardi et al., 2015), rugby (Cresswell and Eklund, 2005, 2006), and volleyball (Vieira et al., 2013). On the other hand, research on burnout in individual sports such as athletics (Reche et al., 2018), swimming (Larson et al., 2019), tennis and table tennis (Goodger et al., 2007b; Martinent et al., 2014, 2020), or olympic wrestling (Gil et al., 2015) stand out.

## Dispositional Optimism

The scientific literature provides information on the relationship between the dimensions of burnout syndrome and a more or less optimistic profile (Chen et al., 2008; García et al., 2014; Gil et al., 2015). Throughout their lives, human beings face a wide variety of situations, solving them with very different attitudes and actions. In this sense, the existence of two very different styles of resolution, optimistic and pessimistic, is postulated through the theory of explanatory patterns, where people give explanations to the events that happen to them (Abramson et al., 1978; Herzberg et al., 2006). In contrast, other researches defend another perspective, through dispositional theory, defined as the stable expectation or belief that positive things will happen in life, known as dispositional optimism (Scheier and Carver, 1987; Andersson, 2012).

Optimism is a cognitive construct related to motivation that reflects the degree to which people have generalized favorable expectations for their future. Higher levels of optimism have been prospectively related to better subjective well-being in times of adversity or hardship (Carver et al., 2010). The study of optimism was largely initiated in health contexts, finding positive associations between optimism and markers of better physical and psychological health. More recently, the scientific study of optimism shows that optimists have better social connections (Brisette et al., 2002; Carver and Scheier, 2014).

In line with what has been established, certain studies on sport confirm that optimism is negatively related to all the dimensions of burnout, so that as optimism increases, the scores in the different dimensions of burnout decrease. On the other hand, optimism is presented as a variable associated mainly with regular, continuous, and regulated sports practice, since the highest scores are found in older, federated athletes who compete and spend more hours per week and years of dedication to sports practice (Andersson, 1996; Gould et al., 2002; García et al., 2014).

In this line, there have been numerous investigations developed in recent years in relation to collective sports concerning optimism in the disciplines of football (Chirivella

et al., 2013), basketball (Gordon, 2008), and handball (Ortín-Montero et al., 2013) among other sports modalities. They have also been developed in relation to individual sports, in disciplines such as tennis (Gustafsson and Skoog, 2012), swimming (Norlander and Archer, 2002), or athletics (Vaamonde, 2018).

## Athlete's State of Mind

Having defined the variables of burnout and dispositional optimism, it is necessary to qualify that both can influence the mood with which people face different situations (Remor et al., 2006; Kim et al., 2009; Grobbelaar et al., 2010; Remor and Gómez, 2013; Sánchez-Hernández et al., 2014). Scientific evidence suggests that optimism can protect health at times of increased stress by influencing mood (Brydon et al., 2009). Precisely in relation to mood, it can be stated that a person suffering burnout syndrome is apathetic, easily irritable, with low frustration tolerance, and recurrent thoughts of incompetence. This can lead to absenteeism, the onset of addictive behaviors, and it can affect the social aspect by generating susceptibility to interpersonal contact. It is highly probable that, as a consequence, a person with burnout syndrome becomes socially isolated, as a functional interpersonal strategy, possibly facilitating the presence of mood and anxiety disorders, which could undoubtedly affect not only their work performance and development but also their personal development (Schaufeli et al., 1993).

In physical sporting activity, the emotional component acquires a multidimensional nature. Its study, knowledge, and treatment allow us to obtain a better approach to the reality of the athlete and to improve both their assessment and the design of appropriate training strategies. The athlete, throughout his activity and sporting life, presents different states, each of which is the result of various factors or variables. In the relationship between mood and performance in sport, one of the most relevant results in the sport psychology field refers to the perceptions that athletes have about their own moods, which can somehow influence their performance (Arce Fernández et al., 2000; de la Vega Marcos et al., 2008; Antonio Arruza et al., 2011). The importance of knowing the level of stability of moods lies in the need to offer specific guidelines to the professional in charge of achieving the maximum performance of the athlete, allowing him/her, first, to predict where more complications may arise in the competitive coping of sport and, second, to be able to intervene in order to optimize and benefit the athlete's performance (Hassmen and Blomstrand, 1995; Rietjens et al., 2005).

In the same way as for the variables of burnout and dispositional optimism, in the literature, there are multiple investigations carried out through measurement tools for the analysis of moods of athletes in collective disciplines such as basketball (Henderson et al., 1998; Hoffman et al., 1999) and football (Andrade et al., 2008; Saidi et al., 2020) or individual disciplines such as swimming (Santhiago et al., 2011) and cycling (Viana et al., 2016), among others. Hence, researching burnout, optimism, and moods together may be of interest, insofar as there are studies of these variables paired or separately, but not all three together, for the purpose of developing a psychological profile of the athlete as appropriate as possible and planning the

work according to the demands of the training loads or even the competition itself.

## Effects of Psychological Variables in Kayak Polo

Canoeing is a water sport in continuous evolution as a result of the emergence of new disciplines and modalities adapted to the originated demand, forcing to establish, in the field of competition, new methods and training systems, sensitive to the progress of research in the field (Zarodnyuk et al., 2019). These disciplines are mostly of an individual nature, although there are also those of a collective nature. Competitions, as a general rule, take place over several days, since it is common for many athletes to participate in more than one category (individual K1/C1, and in team boats, K2–K4/C2–C4) causing a greater workload and possible stress on the athlete. Specifically, kayak polo, as the only collective discipline of canoeing where several individual boats take part at the same time in the same team, also often presents competition systems by means of gatherings, tournaments, or scoring days of several matches, where the demands are high.

Taking into account the inequality of disciplines, as well as the typology of efforts in competition, canoeing can be classified as an endurance sport, in which good aerobic capacity, aerobic efficiency at the anaerobic threshold, and lactic anaerobic capacity, especially lactate tolerance, are required to obtain a good performance (Fry and Morton, 1991; Faina et al., 1997). Therefore, canoeing is a sport where strength and endurance are developed together to optimize the athlete's performance (Bishop et al., 2002; Garcia-Pallares et al., 2009), factors that entail a greater training load, which can have an impact on the psychological aspect of athletes (Isorna Folgar et al., 2019).

The present study arises from the need to delve a little deeper into kayak polo, a minority sport, since there are few empirical studies carried out with this discipline. The limited number of research studies found deals with anthropometric (Rodrigues Alves et al., 2012), physiological (Rodrigues Alves et al., 2012; Forbes et al., 2013; Sheykhlovand et al., 2018; Zwingmann et al., 2020), and psychological (Hill et al., 2010) aspects of sport performance. This scarcity of specific studies on psychology in this sport makes it even more interesting to develop studies on the subject. In this sense, the aim of this study is to evaluate the psychological profile of kayak polo players throughout three variables of burnout, dispositional optimism, and mood in the hours prior to a national and international competition, also relating these aspects with some sociodemographic data. The instruments used for this research are the Spanish version of the POMS-29 mood scale (Balaguer et al., 1993), the Spanish version of the Life Orientation Test Revised LOT-R (Cano-García et al., 2015), and the Inventory of Burnout in Athletes Revised IBD-R (Fayos Ruiz et al., 2012).

The analysis of these variables can provide valuable information on trait and state aspects of kayak polo players when facing potential stressful situations, as well as contribute to the planning of future intervention through psychological

skill training based on the outcome of the assessments and the establishment of the relationship between the constructs and variables assessed in order to optimize performance.

## MATERIALS AND METHODS

### Sample

**Table 1** shows the descriptive statistics of the sample. The sample was composed of a total of 86 kayak polo players, 69.8% were male and 30.2% female with a mean age of  $24.4 \pm 9.1$  years, who participated in the First Division male and female Spanish league. Regarding the category to which the athlete belonged, 60.5% were seniors, 39.5% were U21, and 44.2% were or had been international players. The majority of the players played in the defensive position of winger (44.2%), followed by the advanced and central positions with 24.4 and 17.4%, respectively. Goalkeeper was the least represented position with 14.0%. Approximately half of the players trained 5 days or more per week (48.8%), followed by those who trained 4 days (22.1%) and 3 days (18.6%). Regarding training hours, 44.2% spent more than 10 h per week and 34.9% trained between 6 and 10 h per week.

### Instruments

The optimism construct was assessed with the Spanish version of the LOT-R questionnaire (Cano-García et al., 2015). The LOT-R is a revision of the Life Orientation Test (Scheier and Carver,

1985), carried out to distinguish optimism from neuroticism (Scheier et al., 1994). In this sense, some authors carried out a psychometric analysis of the revised test, obtaining very similar properties with those of the original version. It is composed of 10 items using a five-point scale, where 0 means “strongly disagree” and 4 means “strongly agree” (Ferrando et al., 2002). Regarding the correctness and interpretation of the test, two options appear: On the one hand, the measurement of each disposition separately, and, on the other hand, the measurement of total optimism by reversing the items written in a negative sense. In this study, we decided to use the second option in line with previous work in the literature (Mroczek et al., 1993; Myers and Steed, 1999).

### Procedure

The data collection was carried out by an online survey using Google Forms. The distribution was carried out by sending an email to the different kayak clubs informing the purpose of the study and with the link to the questionnaire. The clubs that agreed with the study distributed the questionnaire among their athletes. Each athlete responded voluntarily and anonymously. Data collection was conducted before the end of the season between October and November 2016.

### Data Analysis

The statistical program SPSS v.24.0 (IBM, Armonk, NY, USA) was used for data analysis. Descriptive statistics and correlation analysis of the different items and Cronbach's alpha index (C- $\alpha$ ) were calculated. Then, a cluster analysis was carried out to identify possible groups of athletes with similar optimism level, taking as a dependent variable, the item “Optimism.” To obtain the cluster solutions, two methods were combined, hierarchical and non-hierarchical, with the aim of optimizing results. The cluster analyses were carried out using the guidelines proposed for computer programs (Milligan, 1985). The hierarchical cluster was analyzed taking the Ward's method, and for the similarity measures, the Euclidean distance squared was used. Then, a non-hierarchical cluster was done through the K-means method, taking as a reference the centroids of the cluster solutions of the hierarchical method for each period. Chi-square tests for qualitative variables and ANOVA test for quantitative variables were performed (Khalilzadeh and Tasci, 2017). Finally, a MANOVA test was carried out (Chapman, 2018), to analyze the relationship between the psychological variables (optimism, mood state, and burnout) as dependent variables, and the independent variables, if the athletes were a member of national team (yes/no) and the time spent training (<10 h a week/more than 10 h a week). The effect size was calculated according to the guidelines of the literature (Dominguez-Lara, 2018). The significance level was established at a value of  $p \leq 0.05$ .

## RESULTS

### Descriptive and Correlation Analysis

The general descriptive results of the psychological variables (**Table 2**) showed that the overall level of optimism of the kayak polo players was moderate ( $M = 2.76 \pm 0.6$ ). The mood state

**TABLE 1 |** Sociodemographics statistics of the sample.

	N	%
<b>Gender</b>		
Male	60	69.8
Female	26	30.2
<b>Category</b>		
Under21	34	39.5
Senior	52	60.5
<b>National team member</b>		
No	48	55.8
Yes	38	44.2
<b>Defensive player position</b>		
Advanced	21	24.4
Central	15	17.4
Winger	38	44.2
Goalkeeper	12	14
<b>Weekly sports practice days</b>		
1 day	3	3.5
2 days	6	7
3 days	16	18.6
4 days	19	22.1
5 or more days	42	48.8
<b>Weekly sports practice time</b>		
0–3 h	3	3.5
3–6 h	15	17.4
6–10 h	30	34.9
10 h or more	38	44.2

**TABLE 2 |** Descriptive and correlation analysis.

	M (SD)	1	2	3	4	5	6	7	8	9
1. Optimism	2.75 (0.6)	1								
2. Anger	1.18 (1.0)	−0.241*	1							
3. Fatigue	1.21 (0.9)	−0.115	0.445**	1						
4. Tension	1.86 (0.8)	−0.206	0.461**	0.285**	1					
5. Depression	0.68 (0.7)	−0.342**	0.674**	0.425**	0.557**	1				
6. Vigor	2.82 (0.6)	0.131	−0.333**	−0.419**	−0.002	−0.364**	1			
7. Emotional exhaustion	2.26 (0.8)	−0.231*	0.485**	0.569**	0.238*	0.424**	−0.446**	1		
8. Depersonalization	1.89 (0.6)	−0.100	0.397**	0.357**	0.337**	0.258*	−0.303**	0.538**	1	
9. Reduced efficacy	3.83 (0.6)	0.116	−0.310**	−0.390**	−0.212*	−0.346**	0.433**	−0.602**	−0.352**	1

\* $p \leq 0.05$ ; \*\* $p \leq 0.01$ .

profile indicated that they had high vigor ( $M = 2.82 \pm 0.6$ ), medium levels of tension, fatigue, and anger, and low levels of depression ( $M = 0.68 \pm 0.7$ ). In terms of burnout factors, the players had high values for reduced efficacy ( $M = 3.83 \pm 0.6$ ) and low depersonalization ( $M = 1.89 \pm 0.6$ ). Correlation analysis (Table 2) indicated that optimism alone was statistically significantly related to the mood states of anger and depression and the emotional exhaustion of burnout. Mood states and burnout dimensions correlated significantly with each other on all dimensions except the relation between tension and vigor.

## Cluster Analysis

### Group Identification

The cluster analysis was determined according to the variable of optimism (Table 3). Cluster 1, labeled “High Optimism,” made up 27.9% of the sample and represented the athletes who showed the high levels of optimism ( $M = 3.49 \pm 0.3$ ). Cluster 2 was designated “Moderate Optimism” because the level of optimism had middle scores ( $M = 2.71 \pm 0.2$ ) shown by athletes, represented 50.0% of the sample; and cluster 3, designated “Lower Optimism,” represented 22.1% of the athletes who showed the lower level of optimism ( $M = 1.92 \pm 0.4$ ). The mood state profile was similar in cluster 1 and cluster 2; they had high scores in vigor, moderate-lower scores in tension, fatigue, and anger, and lower scores in depression. Cluster 3 had a lower level of vigor than the other groups, moderate-high scores in tension, and moderate-lower scores in the other states. Burnout scores were similar in the three groups with high scores in reduced efficacy, moderate scores in emotional exhaustion, and lower scores in depersonalization. ANOVA test showed statistically significant differences in optimism between all groups, depression between cluster 1 “High Optimism” and cluster 3 “Low Optimism,” and emotional exhaustion between cluster 2 “Moderate Optimism” and cluster 3 “Low Optimism” ( $p \leq 0.05$ ).

### Profile of the Groups

Table 4 shows the sociodemographic profile of the athletes according to the cluster group to which they belong depending on their optimism level. Cluster 1 “High Optimism” were males with an average age of  $27.5 \pm 10.4$  years, who belonged to the senior category; half had been international players for some time and played in the winger defensive position. They went 5

or more days to training in a week and spent between 6 and 10 h of training per week. Cluster 2 “Moderate Optimism” was composed of males with an age of  $23.0 \pm 8.4$  years old, belonged to the Under21 category; the majority two thirds have not been international players, and half plays in winger defensive position. Sports habits indicated that almost half were training 5 or more days a week with more than 10 h of training per week. Finally, cluster 3 “Low Optimism” was made up of males with an average age of  $23.6 \pm 8.5$  years, belonging to the senior category and playing in the position of goalkeeper. Sports habits showed that they trained 5 days or more per week with a training time of more than 10 h per week. There were statistically significant differences in the category and defensive player position variables ( $p \leq 0.05$ ), while the effect of the variables was low in category position ( $V < 0.3$ ) and medium effect in the defensive position ( $V > 0.3$ ).

## MANOVA Test

MANOVA test (Table 5) showed that the independent variables “National team member” and “Weekly sports practice time” statistically significantly affected the combination of correlated dependent variables of psychological variables of optimism, mood state, and burnout (Pillai's Trace: 0.215,  $F = 2.25$ ,  $p \leq 0.05$ ,  $\eta_p^2 = 0.22$ ; Wilks' lambda: 0.785,  $F = 2.25$ ,  $p \leq 0.05$ ,  $\eta_p^2 = 0.22$ ). The effects between subjects were statistically significant in optimism ( $F = 7.03$ ;  $p \leq 0.01$ ) and the mood state of anger ( $F = 4.26$ ;  $p \leq 0.05$ ). The parameter estimates between subjects were significant in all variables, such as reduced efficacy ( $\beta = 3.66$ ;  $t = 30.59$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.92$ ), optimism ( $\beta = 2.76$ ;  $t = 23.13$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.87$ ), vigor ( $\beta = 2.73$ ;  $t = 22.02$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.86$ ), emotional exhaustion ( $\beta = 2.46$ ;  $t = 15.64$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.75$ ), depersonalization ( $\beta = 2.12$ ;  $t = 16.61$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.77$ ), tension ( $\beta = 1.83$ ;  $t = 11.50$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.62$ ), fatigue ( $\beta = 1.14$ ;  $t = 6.37$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.33$ ), anger ( $\beta = 1.07$ ;  $t = 5.61$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.28$ ), and depression ( $\beta = 0.69$ ;  $t = 4.62$ ;  $p \leq 0.001$ ;  $\eta_p^2 = 0.21$ ).

## DISCUSSION

According to the results, the general level of optimism of the kayak polo players was moderate, although the mood profile of the athletes did present a high value with medium levels



**TABLE 3 |** Average scores for each variable in the three clusters.

	High optimism ( <i>n</i> = 24)	Moderate optimism ( <i>n</i> = 43)	Low optimism ( <i>n</i> = 19)	F(df)	<i>p</i> -value	$\eta_p^2$
	M (SD)	M (SD)	M (SD)			
Optimism*	3.49 (0.3)	2.71 (0.2)	1.92 (0.4)	169.19 (2)	0.001	0.80
Anger	1.12 (1.1)	1.03 (0.8)	1.62 (1.1)	2.69 (2)	0.074	0.06
Fatigue	1.18 (1.1)	1.20 (0.7)	1.29 (0.9)	0.09 (2)	0.911	0.00
Tension	1.76 (0.9)	1.85 (0.8)	2.04 (0.6)	0.65 (2)	0.523	0.02
Depression <sup>#</sup>	0.52 (0.8)	0.62 (0.6)	1.05 (0.9)	3.22 (2)	0.045	0.07
Vigor	2.73 (0.8)	2.95 (0.6)	2.67 (0.6)	1.84 (2)	0.166	0.04
Emotional exhaustion <sup>§</sup>	2.27 (1.0)	2.08 (0.6)	2.64 (0.8)	3.52 (2)	0.034	0.08
Depersonalization	1.98 (0.9)	1.79 (0.5)	2.01 (0.4)	1.11 (2)	0.333	0.03
Reduced efficacy	3.83 (0.7)	3.90 (0.5)	3.66 (0.6)	1.06 (2)	0.353	0.03

\*Differences between all groups. <sup>#</sup>Differences between group 1 and group 3. <sup>§</sup>Differences between group 2 and group 3.  $\eta_p^2$ , partial squared eta; between  $\eta_p^2 < 0.01$  trivial effect, between  $0.01 < \eta_p^2 < 0.06$  small effect, between  $0.06 < \eta_p^2 < 0.14$  medium effect, and  $\eta_p^2 > 0.14$  significant effect.

**TABLE 4 |** Characteristics of the different cluster groups.

	High optimism ( <i>n</i> = 24)	Moderate optimism ( <i>n</i> = 43)	Low optimism ( <i>n</i> = 19)	F(df)	<i>p</i> -value	$\eta_p^2$
	M(SD)	M(SD)	M(SD)			
<b>Age</b>	27.5 (10.4)	23.0 (8.4)	23.6 (8.5)	2.04(2)	0.136	0.05
	<b>N (%)</b>	<b>N (%)</b>	<b>N (%)</b>	<b><math>\chi^2(df)</math></b>	<b><i>p</i>-value</b>	<b><i>V</i></b>
<b>Gender</b>						
Male	17 (70.8)	28 (65.1)	15 (78.9)	1.21 (2)	0.545	0.12
Female	7 (29.2)	15 (34.9)	4 (21.1)			
<b>Category*</b>						
Under21	5 (20.8)	22 (51.2)	7 (36.8)	6.00 (2)	0.050	0.26
Senior	19 (79.2)	21 (48.8)	12 (63.2)			
<b>National team member</b>						
No	12 (50.0)	29 (67.4)	7 (36.8)	5.46 (2)	0.065	0.25
Yes	12 (50.0)	14 (32.6)	12 (63.2)			
<b>Defensive player position*</b>						
Advanced	7 (29.2)	11 (25.6)	3 (15.8)	18.30 (6)	0.006	0.33
Central	3 (12.5)	8 (18.6)	4 (21.1)			
Winger	12 (50.0)	22 (51.2)	4 (21.1)			
Goalkeeper	2 (8.3)	2 (4.7)	8 (42.1)			
<b>Weekly sports practice days</b>						
1 day	1 (4.2)	1 (2.3)	1 (5.3)	2.95 (8)	0.938	0.13
2 days	1 (4.2)	4 (9.3)	1 (5.3)			
3 days	6 (25.0)	8 (18.6)	2 (10.5)			
4 days	6 (25.0)	9 (20.9)	4 (21.1)			
5 or more days	10 (41.7)	21 (48.8)	11 (57.9)			
<b>Weekly sports practice time</b>						
0–3 h	2 (8.3)	1 (2.3)	-	8.91 (6)	0.179	0.23
3–6 h	2 (8.3)	9 (20.9)	4 (21.1)			
6–10 h	11 (45.8)	16 (37.2)	3 (15.8)			
10 h or more	9 (37.5)	17 (39.5)	12 (63.2)			

\* $p \leq 0.05$ .  $\eta_p^2$ , partial squared eta; between  $\eta_p^2 < 0.01$  trivial effect, between  $0.01 < \eta_p^2 < 0.06$  small effect, between  $0.06 < \eta_p^2 < 0.14$  medium effect, and  $\eta_p^2 > 0.14$  significant effect. *V*, Cramer's *V*;  $V < 0.10$ : irrelevant effect, between  $0.10 < V < 0.30$ : small effect, between  $0.30 < V < 0.50$ : moderate effect, and  $V > 0.50$  large effect.

**TABLE 5 |** MANOVA analysis of the variables by weekly practice time and national member team.

	National member team				F(df)	p-value	$\eta_p^2$
	No		Yes				
	Weekly sport practice time		Weekly sport practice time				
	<10 h M (SD)	10 h or more M (SD)	<10 h M (SD)	10 h or more M (SD)			
Optimism*	2.95 (0.6)	2.42 (0.4)	2.54 (0.8)	2.76 (0.6)	7.03 (1)	0.010	0.08
Anger*	1.02 (0.9)	1.59 (1.1)	1.44 (1.0)	1.07 (1.0)	4.26 (1)	0.042	0.05
Fatigue	1.24 (0.9)	1.28 (0.8)	1.25 (0.8)	1.14 (1.1)	0.11 (1)	0.743	0.00
Tension	1.71 (0.9)	2.09 (0.6)	2.10 (0.6)	1.83 (0.8)	2.94 (1)	0.090	0.04
Depression	0.61 (0.8)	0.73 (0.7)	0.85 (0.6)	0.69 (0.8)	0.58 (1)	0.449	0.01
Vigor	2.84 (0.5)	3.12 (0.5)	2.68 (0.6)	2.73 (0.8)	0.56 (1)	0.457	0.01
Emotional exhaustion	2.11 (0.7)	2.18 (0.8)	2.34 (0.8)	2.46 (0.9)	0.02 (1)	0.893	0.00
Depersonalization	1.76 (0.5)	1.87 (0.6)	1.82 (0.5)	2.12 (0.9)	0.40 (1)	0.527	0.01
Reduced efficacy	3.87 (0.6)	3.99 (0.6)	3.90 (0.6)	3.66 (0.7)	1.70 (1)	0.195	0.02

\* $p \leq 0.05$ .  $\eta_p^2$ , partial squared eta;  $\eta_p^2 < 0.01$ , trivial effect;  $0.01 < \eta_p^2 < 0.06$ , small effect;  $0.06 < \eta_p^2 < 0.14$ , medium effect;  $\eta_p^2 > 0.14$ , significant effect.

of tension, fatigue, and anger and low levels of depression. The latter coincides with the findings of some studies, which found low levels of tension, depression, anger, and confusion for football players (Hassmen and Blomstrand, 1995), as well as with others, which found low levels of depression, confusion, and total mood disturbance for female basketball players (Henderson et al., 1998).

Inferential analysis showed that optimism was significantly related to the mood of anger and depression, as well as emotional exhaustion, consistent with findings from other research, where more optimistic individuals had smaller increases in negative mood and less reduction in mental vigor, suggesting the benefit of optimism in coping with potentially stressful situations (Brydon et al., 2009). Furthermore, other research showed that optimism had a significant negative relationship with both stress and burnout, with their mediation analyses indicating that perceived stress fully mediated the links between optimism, symptoms of emotional exhaustion, and sport devaluation, and also mediated the link between the optimism variable and a third symptom, the reduced sense of accomplishment. Thus, individual factors such as optimism may play a key role in the development of burnout by virtue of its association with stress (Gustafsson and Skoog, 2012; Gustafsson et al., 2018).

On the other hand, the correlation between mood and burnout was also significant, except for the relationship between the dimensions of tension and vigor. This was consistent with previous work, where perceived social support was generally associated with a lower degree of emotional exhaustion, whereas negative expectations of mood regulation were negatively correlated with burnout. Furthermore, negative expectations of mood regulation affected burnout more than social support. This finding suggests that burnout can be alleviated by controlling negative expectations of mood regulation through the intervention of training programs to improve such expectations (Kim et al., 2009).

In relation to the three levels of optimism that determined three groups depending on whether it was high, moderate, or

lower, the second was the most numerous, with half of the canoeists in this group, followed by the first, although the number of kayak polo players was similar to the group with the lower level of optimism. Precisely, the two groups with moderate and high levels of optimism obtained a similar mood profile, with moderate-low scores in fatigue, as occurred in other previous studies where they showed that mental fatigue had a significant effect on endurance, but not for strength, probably due to the greater prolongation in time in terms of effort in the former compared with the latter, especially in collaborative-opposition sports such as kayak polo. Similarly, these authors showed that fatigue could be influenced by the level of optimism, understanding it as a coping sub-factor along with endurance and strength (Sook, 2018).

However, in addition, for these two groups, the values of tension and anger were also moderate-low, in line with other studies (Gustafsson and Skoog, 2012; Chirivella et al., 2013) and low depression, as occurred with the research carried out by other authors, where a positive relationship was found between optimism and sports performance in football players, concluding that when faced with a defeat, optimistic athletes faced the situation better than pessimists, with the difference in positive or negative optimism not being significant when the result was a victory. Furthermore, these analyses suggested that the negative relationships observed were attributed to negative outcomes due to lack of effort, known as defensive pessimism vs. lack of ability, which was defined as depressive pessimism (Gordon, 2008). The opposite was true for vigor, being the values high for these two groups of higher optimism. The findings obtained could be influenced by the fact that the high optimism group was composed of the most veteran players, half of whom had been international players at some point. This situation was associated with a higher competitive demand in which a higher level of performance is required, in the same way that those with moderate optimism, although less veteran, were also composed of players who had been international players at some point.

On the other hand, the low optimism group had a lower level of vigor, with moderate-high stress scores and a significant difference in the emotional exhaustion variable with respect to the high optimism group, probably because this third group is in backward positions and with purely defensive functions such as the goalkeeper, with a low achievement motivation; these results coincide with those obtained in other studies (Avugos et al., 2020).

## CONCLUSION

The current work provides information regarding the psychological profile of kayak polo players, where from the analysis of the three variables under study, canoeists who presented moderate levels of optimism also presented medium-low values in the different negative factors of mood. Likewise, the findings showed that optimism significantly influenced the emotional exhaustion of the athletes, with the level of stress to which the canoeist could be subjected playing an important role in the adjustment of these two variables. In addition, seniority and experience with international competition proved to be influential factors in the level of optimism achieved, as well as in the moderation of negative moods. These results suggest the importance and need to develop psychological profile training strategies to be incorporated into their work plans. Thus, it would be interesting to carry out future research involving a larger sample size in order to confirm and contrast the findings of the present study, as well as an experimental intervention proposal through a program or work plan for the psychological variables under study.

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## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comisión de Ética de Investigación–Universidad de Murcia. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## AUTHOR CONTRIBUTIONS

FB-B conceptualized the study. SA and LS-B defined the purpose of the study. SA and FO-M formulated the methodology. SA performed the formal analysis. LS-B performed the data collection and investigation. FO-M, VM-B, and FB-B edited and revised the manuscript. VM-B provided supervision. All authors contributed to the writing of the study and the article and approved the submitted version.

## SUPPLEMENTARY MATERIAL

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# The Effect of Smartphone App-Use Patterns on the Performance of Professional Golfers

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Smartphone app-use patterns will predict professional golfers' athletic performance, and the use time of serious apps would be associated with improved performance. This longitudinal 4-week observation of 79 professional golfers assessed golf handicaps and smartphone app-use patterns at the start of the Korean professional golf season and 2 and 4 weeks later. We classified use as social networking, entertainment, serious apps, and others. Use time of entertainment apps increased for non-improved golfers but did not change for improved golfers. Use time of serious apps increased for improved golfers and decreased for non-improved ones. Changes in golf handicaps were positively correlated with changes in entertainment app use time and negatively correlated with changes in serious app use time. Professional golfers' sports performance was not associated with smartphone use time but was with the smartphone app type. The management of smartphone app-use patterns is important for professional golfers' performance.

**Keywords:** golf, smartphone, applications, performance, handicap

## INTRODUCTION

In recent decades, smartphones based on mobile networks have become indispensable in the regular lives of people, and the rate of their usage has continuously increased (Silver, 2019). In a survey of smartphone ownerships and internet usage rates in 39 countries, 75% of the participants used either the internet or their own smartphones (Joe and Knight, 2019). Among advanced economies, South Korea has the highest smartphone ownership rate of 96% (Kim et al., 2012; Silver, 2019). In 2011, smartphone ownership in Korea was 38.3%, ranking fourth in the world (Poushter et al., 2018). Over the past 10 years, the ownership of smartphones in Korea has rapidly increased, and smartphone usage very closely affects the general life of Koreans (Winskel et al., 2019). In the United States, smartphone ownership also rapidly increased, from 37% in 2001 to 92% in 2019 (Silver, 2019).

With the rapid increase in smartphone ownership and usage, the number and popularity of mobile applications (apps) has also increased tremendously. There were 150,000 apps and 350,000 activations in the Android market, as well as 350,000 apps and 10 billion activations in App Store on iOS (Schmidt, 2011). In an analysis of smartphone apps, Kim et al. (2014) suggested the types of apps as follows: book, business, education, entertainment, finance, games, healthcare, lifestyle, medical, music, navigation, news, photography, productivity, reference, social network service

(SNS), sports, travel, utilities, and weather. In addition, diverse uses of smartphone apps have been associated with geographic locations, similarity of contents, and interest of users (Xu et al., 2011).

Typically, people are motivated to use mass media and the internet to satisfy social support needs, including companionship, to pass time, out of habit, and escape, as well as for mood management, including relaxation, entertainment, arousal, and information (Papacharissi and Rubin, 2000; Aderibigbe and Armide, 2012). Recently, smartphone apps have been applied to health promotion, education, and human behavioral changes (Kratzke and Cox, 2012).

The sport of golf is uniquely challenging, because its duration, interrupted pace of play, and excessive idle time make the competitor vulnerable to external distractors (Singer, 2002), which can result from things in an athlete's physical environment, such as noise, people, television, and smartphones (Moran, 2016). The potential negative effects of smartphone apps on an athlete's performance have been suggested in recent years (Greco et al., 2017).

Specifically, entertainment apps, such as SNS, are closely linked with athletes' mood before competition. Some athletes have announced their decision to stop using entertainment apps during competition in order to minimize the potential for distraction (Logue, 2016). Emily Seeböhm, who was one of Australia's contenders for winning a gold medal in swimming at the London Olympics, conceded that her constant use of social media might have worsened her performance (Hayes, 2019). Several studies have reported adverse effects of smartphone use on athletes. Fortes et al. (2019) suggested that 30 min exposure to smartphone apps causes mental fatigue and impairs decision making in male soccer athletes. Park (2017) reported that excessive use of smartphones would worsen learning attitudes, relationships with others, and self-control in college golf players.

On the other hand, smartphone use can also improve athletic performance and general life. Smartphone apps are actively used to measure neuromuscular performance, assess vital signals, prevent injury, and improve skills (Kidman et al., 2016; Driller et al., 2017; Perrotta et al., 2017; Matos et al., 2019). Using these apps may improve the competition process and the quality of training in athletes. In fact, athletes and coaches have been using various apps to improve their performance. Driller et al. (2017) measured counter-movement jumps in recreational athletes using smartphone apps. Perrotta et al. (2017) estimated the immediate heart-rate variability in athletes using smartphone apps. Matos et al. (2019) suggested that a smartphone recommendation system could prevent potential risks of injury for athletes. Kidman et al. (2016) found that wearing a device with inertial-motion tracking and vibro-tactile feedback increased the accuracy of diving movements in athletes. In a review of studies of performance support apps, Peart et al. (2019) reported various mobile apps supporting improvement of performance by measuring heart rate, range of motion, barbell velocity, vertical jump, running mechanism, and distances during walking, jogging, and running. Lim (2020) proposed an application that helps prevent injuries by analyzing the performance, fatigue, and weakness by using a camera-based

mobile interface to measure the athlete's movements. Previous research on sports psychology has suggested that behavioral patterns accompanied by self-management plans are closely related to confidence improvement (Bell, 1983). A study on athletes' well-being and confidence provided by digital coaching in mobile applications (Kettunen et al., 2018) and on athletes' motivation provided by applications that support athletes' sleep monitoring and management (Halsen, 2019) verified the effectiveness of self-management based on sports psychology. In video games, "serious" was prepended to refer to games used for education, scientific exploration, health care, and politics in contrast to entertainment (Lugmayr et al., 2017). As with video game, we classified apps that were used for education, scientific exploration, and health care as serious apps.

## Hypothesis and Aims

We hypothesized that smartphone app-use patterns would predict athletic performance for professional golfers. In particular, we believe that the use time of serious apps is closely associated with improved performance in professional golfers.

Our main aim in this study is to identify crucial factors for improving performance in professional golfers between smartphone use time and app-use patterns. Our secondary aim is to confirm the usefulness of serious apps for improving performance in professional golfers.

## MATERIALS AND METHODS

### Participants

At the start of the Korean Professional Golfers Association (PGA) and Korean Ladies Professional Golfers Association (LPGA) season in 2020, we recruited 27 PGA golfers and 52 LPGA golfers to participate in this study. Given that we planned to compare two categories (golf handicaps and smartphone use time) between the two groups (improved group vs. non-improved group), we assessed the data of the 84 participants using GPower 3.1 software (effect size = 0.2,  $\alpha$  error = 0.05, power = 0.95; Faul et al., 2007). The mean  $\pm$  standard deviation of age, education years, and golf career years in participants (male vs. female; 27 vs. 52) were  $23.8 \pm 4.2$  years,  $11.9 \pm 1.8$  years, and  $8.5 \pm 2.7$  years, respectively. There were 55 participants who had iPhones and 24 who had Android phones. The participants' mean smartphone use time per week was  $29.2 \pm 10.1$  h/week. We explained the goals and procedures of the study to all the golfers who agreed to participate in the research. The study was approved by the Chung Ang University Institutional Review Board (reference number: 1041078-202009-HRSB-290-01), and all participants completed and signed consent forms. We conducted this study in accordance with the principles of the Declaration of Helsinki.

### Study Design

We designed the study as a 4-week observation. At the start of the Korean professional golf season, male and female professional golfers agreed to participate in the study. They responded to questions on age, sex, years of education, golf career, golf scores, and smartphone model. The pattern of smartphone use time is

described below. They were asked to provide their smartphone use time for 3 weeks. After 4 weeks, we classified all the golfers into two groups: the performance improvement group (improved golfers) and the performance non-improvement group (non-improved golfers).

The performance-improvement group was defined as the golfers who had the mean modified golf score of the total rounds at week 4 as being less than that at baseline (week 1). The baseline modified golf score was defined as the mean modified golf score of all rounds in the last year (2019). To adjust for the difficulty of the golf course, we calculated modified golf scores by adapting the World Handicap System (Driller et al., 2017). The modified golf score could be calculated as follows: subtracting the course rating from the participant's score, multiplying the result by 113, then dividing it by the slope rating. At 4 weeks, 41 golfers showed improved golf handicap scores, from  $72.2 \pm 2.1$  to  $69.8 \pm 2.0$  (Improved golfers), and 38 golfers showed non-improved golf handicap scores, from  $73.2 \pm 4.1$  to  $76.2 \pm 3.5$  (Non-improved golfers).

## Smartphone App-Use Patterns

All the golfers voluntarily provided their smartphone use time. In the “total screen time” on the iPhone and digital “well-being use time” on Android phones, the use time of all apps for 1 week was captured and sent to the research team every Friday night (21:00/9:00 pm) for 3 weeks.

Based on use time and frequency, Xu et al. (2011) classified 3,500 apps into 20 categories such as book, business, education, entertainment, finance, games, healthcare, lifestyle, medical, music, navigation, news, photography, productivity, reference, social network service (SNS), sports, travel, utilities, and weather. Most studies of mobile apps and sports suggested that social-networking apps could affect sports competition (Smith and Sanderson, 2015; Encel et al., 2017). Considering those reports, we simplified the 20 categories into 4 app types: social networking (SNS, blog, café, face time), entertainment (YouTube, music, Netflix, pop-cast, webtoon, media apps, games), serious apps (internet browser, books and reference, creativity [camera, photo, video], education, golf form analysis apps, diary), and others (banking, shopping, delivery apps).

## Statistical Analysis

We tested the normality of all data using the Kolmogorov-Smirnov test (K-S test), calculated skewness and kurtosis, and analyzed the demographic characteristics, golf career, and smartphone use of improved and non-improved golfers using an independent *t*-test or chi-squared test. We assessed the effect size of independent *t*-tests with Cohen's *d*, which we interpreted as follows:  $0.0 < d < 0.2$ , small;  $0.3 < d < 0.5$ , medium;  $d > 0.6$ , large (Cohen, 1988). We analyzed sex distribution between the two groups using a chi-squared test. We assessed the effect size of the chi-squared tests using Cramer's *V* and interpreted it as follows:  $0 < V < 0.5$ , no or very weak;  $0.05 < V < 0.10$ , weak;  $0.10 < V < 0.15$ , moderate;  $0.15 < V < 0.25$ , medium; and  $V > 0.25$ , very strong (Cramér, 1946). We analyzed the changes in modified golf scores, as well as the total use time of smartphones and of each app of the two groups using a

repeated measure ANCOVA considering age and golf career. In a *post hoc* test applied by correcting  $p < 0.05$  for the number of comparisons, the significance was set at  $p < 0.0125$  ( $0.05/4$ ). We assessed the effect size of ANCOVA with partial eta-squared and interpreted it as follows: partial  $\eta^2 = 0.01$ – $0.09$ , small;  $\eta^2 = 0.09$ – $0.25$ , medium; and  $\eta^2 > 0.25$ , large (Bakeman, 2005). In a multiple hierarchical regression analysis of smartphone use patterns, we added a discrete set of hierarchical variables: Model 1, social network services; Model 2, social network services + entertainment apps; Model 3, social network services + entertainment apps + serious apps; and Model 4: social network services + entertainment apps + serious apps + other apps. The dependent variable of “improved golfers” was coded as “1” and “non-improved golfers” was coded as “0.” As mentioned above, we defined the improved golfers as golfers whose modified golf scores of total rounds at week 4 were less than those at the baseline (week 1).

Hierarchical regression analysis can show a significant amount of variance in the dependent variable considering all other variables. We verified the overall fit of each step of the logistic regression model with  $\chi^2$ -values (model  $\chi^2$  and step  $\chi^2$ ) as well as goodness-of-fit indices represented with “-2 log likelihood.” The  $\chi^2$  values showed the improvement observed in the model, with the predictors relative to the constant-only model or the model preceding the current model. To evaluate the practical usefulness of each model, we also used tables of classification accuracy to assess the relative success of each model in predicting the correlations with improved golfers. In addition to the indices of the overall model fit, we assessed Nagelkerke's  $R^2$  as an approximate estimate of how variance in the dependent variable was accounted for by the model. To test whether each individual factor had a significant relationship with improved golfers, we used Wald statistics. When a significant relationship was detected by the Wald test, we interpreted the coefficient by finding the odds ratio, that is, the ratio between the probability that the event (i.e., improved golfers) would occur and the probability that it would not.

## RESULTS

### Testing for Normality of Data

None of the data differed significantly from the normal distribution. These included:

- age (Improved golfers: K-S test statistic (*D*) = 0.13,  $p = 0.48$ , skewness  $z = -0.01$ , kurtosis  $z = -0.18$ ).
- Non-improved golfers:  $D = 0.18$ ,  $p = 0.17$ , skewness  $z = 1.82$ , kurtosis  $z = 1.69$ ).
- golf career length (Improved golfers:  $D = 0.18$ ,  $p = 0.14$ , skewness  $z = 0.44$ , kurtosis  $z = 0.84$ ).
- Non-improved golfers:  $D = 0.15$ ,  $p = 0.34$ , skewness  $z = 0.85$ , kurtosis  $z = 0.80$ ).
- golf scores at baseline (Improved golfers:  $D = 0.15$ ,  $p = 0.32$ , skewness  $z = 0.35$ , kurtosis  $z = 1.385$ ).



- Non-improved golfers:  $D = 0.20$ ,  $p = 0.07$ , skewness  $z = 0.20$ , kurtosis  $z = -1.16$ , and
- smartphone use time (Improved golfers:  $D = 0.13$ ,  $p = 0.44$ , skewness  $z = 0.56$ , kurtosis  $z = -0.24$ .
- Non-improved golfers:  $D = 0.11$ ,  $p = 0.70$ , skewness  $z = 0.52$ , kurtosis  $z = -0.19$ ).

## The Comparison of Demographic Data and the Changes in Handicaps Between Improved and Non-improved Golfers

There were no significant differences in age, sex distribution, education year, golf career, or modified golf score between the improved and non-improved golfers (Table 1). Over the course of 4 weeks, the modified golf scores of the improved golfers decreased more than those of the non-improved golfers ( $F = 57.76$ ,  $p < 0.01$ ) (Figure 1).

During the 4-week period, there were no significant differences in total smartphone use time between improved and non-improved golfers ( $F = 2.84$ ,  $p = 0.09$ ,  $\eta^2 = 0.123$ ). There were no significant differences in the time spent using SNS ( $F = 2.69$ ,  $p = 0.08$ ,  $\eta^2 = 0.262$ ) or other apps ( $F = 1.11$ ,  $p = 0.30$ ) between improved and non-improved golfers. However, there were significantly different changes in the use time of entertainment and serious apps between improved and non-improved golfers. During the 4-week period, the use time of entertainment apps of non-improved golfers increased, although that of improved

golfers did not change ( $F = 5.03$ ,  $p = 0.01$ ). Furthermore, improved golfers' use time for serious apps increased, whereas that of non-improved golfers decreased ( $F = 5.25$ ,  $p < 0.01$ ) (Figure 1).

## The Comparison of Smartphone Use Time and Smartphone Use Patterns Between Improved and Non-improved Golfers

There were no significant differences between the two groups in the smartphone model, total smartphone use time, SNS use time, entertainment app use time, serious app use time, or other app use time.

Of the four models we suggested, models 2, 3, and 4 were significantly associated with improved golfers. In model 2 (model 1 + entertainment apps), model  $\chi^2$  (12.4,  $p = 0.03$ ), and Nagelkerke's  $R^2$  (0.252, 25.2% of the variance in the dependent variable of the improved golfers) indicated that the model was adequate for predicting improved golfers. With step  $\chi^2$  (8.0,  $p = 0.04$ ), entertainment apps could predict improved golfers. In model 3 (model 2 + serious apps), model  $\chi^2$  (27.8,  $p < 0.01$ ), and Nagelkerke's  $R^2$  (0.458, 45.8% of the variance in the dependent variable of the improved golfers) indicated that the model was adequate for predicting improved golfers. With step  $\chi^2$  (15.3,  $p = 0.02$ ), serious apps could predict improved golfers. In model 4 (model 3 + other apps), model  $\chi^2$  (34.7,  $p < 0.01$ ), and Nagelkerke's  $R^2$  (0.579, 57.9% of the variance in the dependent variable of the improved golfers) indicated that the model was adequate for predicting improved golfers. However, with step  $\chi^2$  (6.9,  $p = 0.07$ ), other apps could not predict improved golfers.

According to the Wald test for all independent variables, increased use time of serious apps at week 4 and decreased use time of entertainment apps at week 4 were significant predictors of improved golfers (Table 2).

## DISCUSSION

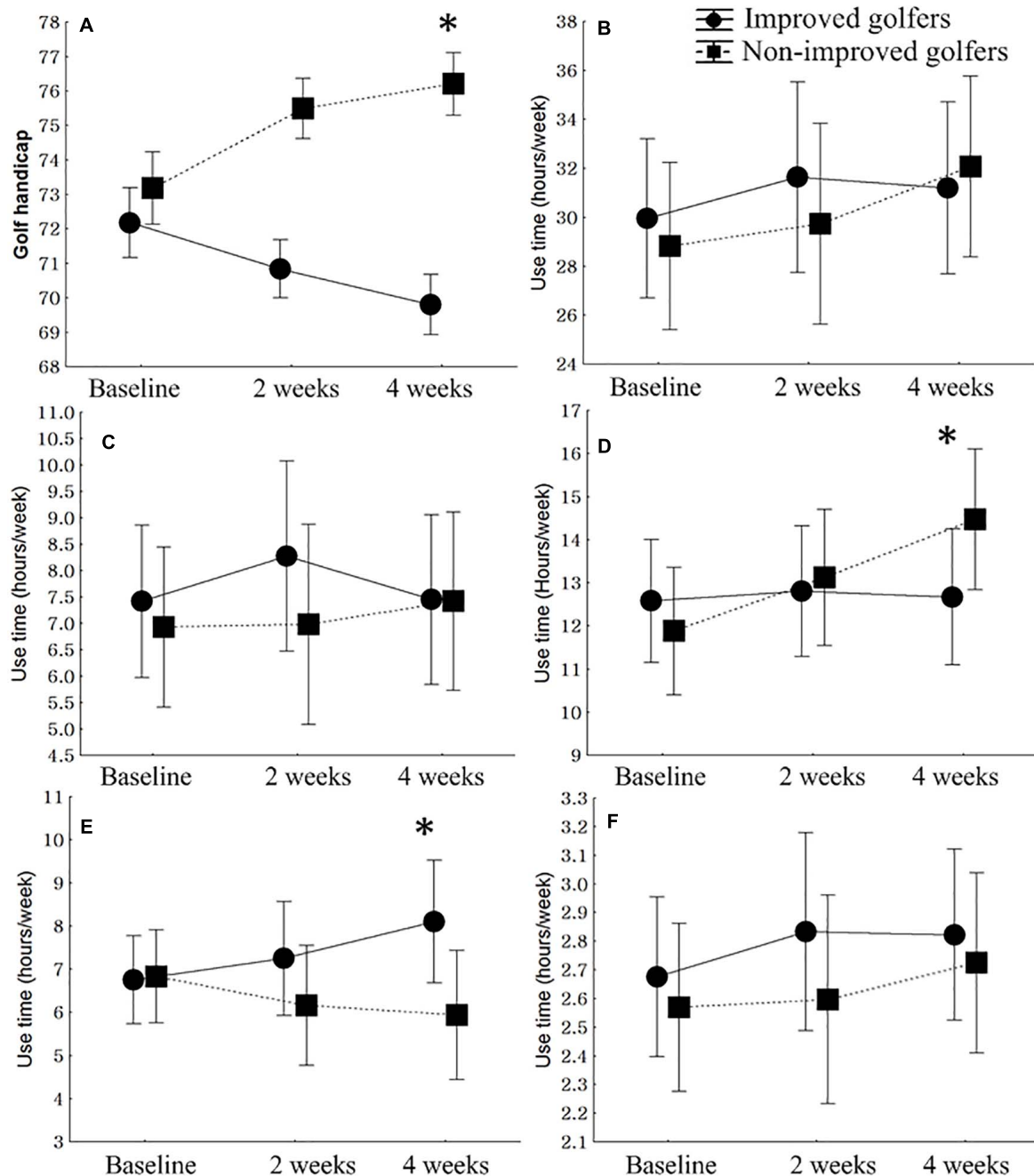
In this study, sports performance was not associated with smartphone use time. We found that the usage time, one of the smartphone usage patterns, could not predict the performance of a professional golfer. However, the improved golfer group showed increased use time for serious apps, whereas the non-improved golfer group showed increased use time for entertainment apps during the 4 weeks. In addition, the improvement of golf scores was correlated with serious app use time and the worsening of golf scores with entertainment app use time.

We found that the effect of SNS use on competition was not significant; SNS usage, one of the smartphone usage patterns, could not predict the performance of professional golfers. Previous studies are divided on whether the association between SNS and athletes' performance is negative or positive. Encel et al. (2017) reported that SNS use immediately before sports competitions could increase sports anxiety. In addition,

**TABLE 1 |** Demographic data and smartphone use time.

Variables	Improved golfers ( $n = 41$ )	Non-improved golfers ( $n = 38$ )	Statistics
Age (years)	23.5 $\pm$ 3.3	24.0 $\pm$ 5.0	$t = -0.55$ , $p = 0.58$ , $ES = 0.12$
Sex (male/female)	13 / 28	14 / 24	$\chi^2 = 0.23$ , $p = 0.63$ , $ES = 0.01$
Education years	11.5 $\pm$ 1.7	12.3 $\pm$ 1.7	$t = -1.87$ , $p = 0.06$ , $ES = 0.47$
Golf career (years)	8.8 $\pm$ 2.6	8.3 $\pm$ 2.9	$t = 0.87$ , $p = 0.38$ , $ES = 0.18$
Golf scores at baseline	72.1 $\pm$ 2.2	73.2 $\pm$ 4.1	$t = -1.49$ , $p = 0.13$ , $ES = 0.33$
Smartphone model (iOS/Android)	32 / 9	23 / 15	$\chi^2 = 2.86$ , $p = 0.09$ , $ES = 0.01$
Smartphone use time (hours/week)	29.9 $\pm$ 10.7	28.8 $\pm$ 10.2	$t = 0.48$ , $p = 0.63$ , $ES = 0.11$
SNS	7.4 $\pm$ 3.9	6.9 $\pm$ 5.3	$t = 0.46$ , $p = 0.64$ , $ES = 0.11$
Entertainment	12.6 $\pm$ 5.3	11.9 $\pm$ 3.7	$t = 0.62$ , $p = 0.53$ , $ES = 0.15$
Serious apps	6.8 $\pm$ 3.4	6.8 $\pm$ 3.0	$t = -0.10$ , $p = 0.91$ , $ES < 0.01$
Other apps	2.7 $\pm$ 1.0	2.6 $\pm$ 0.8	$t = 0.53$ , $p = 0.60$ , $ES = 0.11$

SNS, social network service; apps, applications; ES, effect size.



**FIGURE 1 |** Comparison of changes in modified golf scores and smartphone use time of improved and non-improved golfers. **(A)** Golf handicap,  $F = 57.76$ ,  $p < 0.01$ ,  $\eta^2 = 0.4513$ . **(B)** Total smartphone use time,  $F = 2.84$ ,  $p = 0.09$ ,  $\eta^2 = 0.123$ . **(C)** Social network service,  $F = 2.69$ ,  $p = 0.08$ ,  $\eta^2 = 0.262$ . **(D)** Entertainment apps (media applications including listening to music and watching movies and dramas, webtoons, games),  $F = 5.03$ ,  $p = 0.01$ ,  $\eta^2 = 0.308$ . **(E)** Serious apps (internet browsers, books and reference apps, camera, swing analysis apps, schedule apps, education),  $F = 5.25$ ,  $p < 0.01$ ,  $\eta^2 = 0.353$ . **(F)** Other apps (shopping, delivery service, etc.),  $F = 1.11$ ,  $p = 0.30$ ,  $\eta^2 = 0.007$ .

Smith and Sanderson (2015) found that players spent much time on media exposure and communication, or that their concerns about media exposure naturally led to long-term use of smartphones.

On the other hand, Hayes (2019) saw that players can receive support by communicating via SNS

activities themselves. If this becomes a routine before and after the game, it can have a positive effect on their sports performance. Altogether, studies show different perspectives on the degree of helpfulness of SNS for performance, based on the individual's disposition. In other words, it is difficult to see

the use of SNS as the criterion for predicting athletes' performance.

## Negative Correlation Between Negative Effect of Smartphone App and Performance in Professional Golfers

In this study, entertainment apps were negatively correlated with golf performance. Entertainment app usage, one of the smartphone usage patterns, is expected to worsen the performance of professional golfers. The longest smartphone game-playing time ( $\geq 3$  h) was significantly associated with musculoskeletal pain in student athletes (Sanderson et al.,

2020). In other words, smartphone games can increase the smartphone usage time itself and can disturb daily life, including performance itself.

In addition, Bagherianfar et al. (2017) reported that the time spent on mobile messenger software on smartphones was associated with mental-health problems, including anxiety and depression, in physical-education students. In a survey of 333 university student athletes, internet addiction was negatively correlated with group cohesion and social support (Cao and Chi, 2016). Grall-Bronnec et al. (2016) reported that internet gambling problems negatively affect training and sleep in some players. In other words, the isolation from social relationships while using the internet and the poor physical condition caused

**TABLE 2 |** Hierarchical logistic regression analysis of the four models.

App category		Model 1			Model 2		
		B	Wald	OR	B	Wald	OR
Social network services	Baseline	0.001	0.000	1.001	0.072	0.460	1.074
	2nd week	0.196	3.365	1.216	0.128	1.434	1.137
	4th week	−0.197	2.750	0.821	−0.153	1.730	0.858
Entertainment apps	Baseline				0.073	1.265	1.076
	2nd week				0.071	0.349	1.074
	4th week				−0.207	3.854	0.829*
Indices		Model 0	Model 1		Model 2		
−2 log likelihood		107.891	103.491		95.488		
Step $\chi^2/p$		N/A	4.4/0.22		8.0/0.04		
Model $\chi^2/p$		N/A	4.4/0.22		12.4/0.03		
Nagelkerke's $R^2$		N/A	0.074		0.252		
Classification accuracy (%)		52.6	53.8		63.3		
		Model 3			Model 4		
		B	Wald	OR	B	Wald	OR
Social network services	Baseline	0.082	0.565	1.086	−0.209	1.647	0.811
	2nd week	0.084	0.607	1.088	0.079	0.392	1.082
	4th week	−0.106	0.764	0.900	−0.099	0.464	0.906
Entertainment apps	Baseline	0.171	3.711	1.187	0.175	2.951	1.370
	2nd week	0.034	0.062	1.034	0.281	2.535	1.324
	4th week	−0.203	3.872	0.817*	−0.265	4.829	0.767*
Serious apps	Baseline	−0.118	1.157	0.888	−0.132	0.976	0.877
	2nd week	−0.043	0.101	0.958	−0.080	0.303	0.923
	4th week	0.421	7.383	1.547**	0.378	7.002	1.460**
Other apps	Baseline				0.398	3.590	0.397
	2nd week				−0.976	3.538	0.377
	4th week				−0.390	1.810	0.677
Indices		Model 3			Model 4		
−2 log likelihood		83.174			73.236		
Step $\chi^2/p$		15.3 / 0.02			6.9 / 0.07		
Model $\chi^2/p$		27.8 / < 0.01			34.7 / < 0.01		
Nagelkerke's $R^2$		0.458			0.579		
Classification accuracy (%)		79.2			84.2		

OR, odds ratio. Dependent variable: Improved golfers. Model 1: social network services, Model 2: social network services + entertainment apps. Model 3: social network services + entertainment apps + serious apps. Model 4: social network services + entertainment apps + serious apps + others. \* $p < 0.05$ , \*\* $p < 0.01$ .

by irregularities in life rhythms seem to cause problems in the psychological and mental aspects that determine performance.

Notably, in our study, SNS did not show a significant correlation with the sports performance of professional golfers. However, long-term use of SNS by athletes has been found to worsen their performance (Billings et al., 2016; Geurin-Eagleman and Burch, 2016). In a study of male soccer athletes, 30 min of smartphone apps, including SNS, caused mental fatigue and impaired decision making (Fortes et al., 2019). It is worth looking into the types of content shared on SNS. SNS apps such as Facebook, Instagram, and Snapchat are services that help in sharing photos and videos. Athletes may spend time uploading videos and photos or viewing other people's media content rather than communicating via text messages (Shreffler et al., 2016). In this study, it was difficult to confirm what specific activities and contents have been enjoyed from SNS, but we found that the use of smartphones using media (photos, videos, music, etc.) in the category of entertainment apps showed a significant decline in performance.

### Positive Relationship Between Positive Effect on Smartphone App and Performance in Professional Golfers

Among the smartphone application types, serious apps, which the professional golfer group mainly used, had a positive and significant correlation with performance. In contrast to the negative effects of smartphone apps on sports performance, several apps have been used to improve it. In particular, smartphone apps have been applied to control sleep time schedules and sport performance analyses (Roos, 2014; Voight et al., 2017; Balsalobre-Fernández et al., 2018; Budiono et al., 2018, 2019; Harris et al., 2018). Harris et al. (2018) reported that smartphone learning apps could improve sports performance by encouraging identity, goal awareness, positive reinforcement, and the need for convenience with limited time. Athletes who did dietary planning using the diet education app Nutriatlet showed an increase in energy consumption level  $\geq 10\%$  per time unit compared to athletes who did not use it (Budiono et al., 2018). In addition, Nutriatlet improved energy consumption, body mass index, and body fat percentage in martial-arts athletes (Budiono et al., 2019). In other words, the continuous use of the educational apps, which our study included in the category "Serious Apps," leads to improvement in behavior, lifestyle, and health, thereby contributing directly and indirectly to improving performance. Moreover, athletes' performance can be improved by means of the apps that assist in scheduling, which more conveniently support self-management and condition management, which can be difficult or overlooked by a busy player.

The effectiveness and validity of smartphone apps for sport performance analyses are similar to those of software programs on laptop computers (Balsalobre-Fernández et al., 2018). In an analysis of surveys of golfers and golf coaches, a video analysis app for golfers helped to improve overall golf performance, including stance, balance, and swing (Roos, 2014). A neuromuscular training program smartphone app improved

jump-correcting lower-limb alignment during drop-jump, take-off, and landing tasks in volleyball players (Voight et al., 2017). Performance analysis apps can be highly specialized for the different components of athletes' performance. If they are actively used, they can directly and indirectly contribute to the performance of pro golfers.

Taken together, time consumed by using entertainment apps worsened golf performance, but using serious apps increased productive behaviors in professional golfers. Based on these results, we suggest that the management and control of smartphone app-use patterns may be important for the golf performance of professional golfers. In addition, we cautiously suggest that large data and information about smartphone app-use patterns may predict golf performance.

### Limitations

This study had several limitations. First, the classification of smartphone apps was arbitrary, although we modified and applied other researchers' classifications. In addition, we did not use formal scales with validation to assess smartphone use patterns. Second, we evaluated golf performance using golf handicaps. Finally, our having only a few subjects and only one type of sport (golf) means that our results cannot be generalized to all athletes. Future studies should include various methods, such as swing, distance, and form analyses in a large population.

### CONCLUSION

For professional golfers, sports performance was not associated with smartphone use time, but the type of smartphone apps was. Hence golfers' interests, represented by smartphone apps, could predict golfers' performance. Self-monitoring or team monitoring of the use pattern of entertainment apps and serious apps could help golfers improve their performance. Future studies should focus on the management of smartphone app use to encourage sports performance in other sports.

### DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

### AUTHOR CONTRIBUTIONS

JWL, JJN, and DHH contributed to conception and design of this study. JWL and JJN collected the database. DHH produced the statistical analysis. JWL and KDK wrote sections of the manuscript and contributed to the manuscript revision, read, and approved the submitted version.

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# Psychological Influence of Self-Management on Exercise Self-Confidence, Satisfaction, and Commitment of Martial Arts Practitioners in Korea: A Meta-Analytic Approach

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This study aimed to meta-analyze the relationship between self-management and exercise self-confidence, satisfaction, and commitment in both modern and traditional martial arts among Korean practitioners. We examined the level of sports participation and different martial arts sports as potential moderating variables. In total, 22 studies yielded 299 individual effect sizes and were included in the final meta-analytic pool. The analyses revealed a moderate effect of self-management on exercise satisfaction and self-confidence; and a large effect self-management on exercise commitment. Especially, the effect of the training dimension of self-management was large on exercise commitment and satisfaction, while that of the mental dimension was large on exercise self-confidence. The effects of self-management on exercise satisfaction, commitment, and self-confidence were large in judo, Ssireum, and wrestling, respectively. Finally, the use of self-management was relatively more effective for non-elite participants than for elite practitioners. Our results highlight the effectiveness of self-management to enhance Korean martial arts practitioners' exercise self-confidence, commitment, and satisfaction, findings that may potentially be extended internationally and to other types of sports; further, they showcase the importance of the promotion of interventions and educational programs on how to incorporate/employ self-management in athletes' sports training.

**Keywords:** martial arts, self-regulation, psychological state, psychological skills training, Korean athletes

## INTRODUCTION

Athletes are often exposed to various stressors either during training or competition (Sarkar and Fletcher, 2014). These stressors may come from many psychological, environmental, physical, and other internal/external sources. Athletes' stressors may originate from performance achievement, health concerns, weather, relationship, or leadership issues with coaches and peers (Hanton et al., 2005; Evans et al., 2012; Sarkar and Fletcher, 2014). In competitive martial arts in

particular, stressors such as injuries, poor fitness condition, weight, subpar performances, and coach/teammates-athlete relationship concerns, physical pain, and cognitive/somatic state anxieties are normally encountered (Massey et al., 2015; Cintineo and Arent, 2019; Son et al., 2020). If athletes perceive these stressful demands to be threatening and with no capability to control the strains placed on them, it would lead them to negative physical and psychological responses (Fletcher and Sarkar, 2012) resulting in poor performance outcomes and psychological breakdown (Papacosta et al., 2016; Cintineo and Arent, 2019). It is therefore important for athletes to be aware of these stressful situations and have the appropriate skills or strategies on how to properly regulate undesirable thoughts, feelings, and behavioral reactions to stress that may negatively influence performance (Green and Svinth, 2010; Arnold et al., 2017).

Self-management is a concept used in many fields of study (Lorig and Holman, 2003; Gerhardt, 2007; Grady and Gough, 2014; Jung and Takeuchi, 2018) including sports. In the sports field, this term—which is analogous to self-regulation—is defined as people's capacity to effectively monitor, control, and manage thoughts, emotions, and behaviors that could facilitate goal accomplishment (Weinberg and Gould, 2015; Furlonger et al., 2017). The goals may be monitoring physical development, regulating anxiety and arousal levels, or developing focus and concentration. If these goals are accomplished, in turn, may assist athletes in enhancing their positive psychological state and/or sports performance.

Generally, athletes have various self-management strategies at their disposal during periods of training and/or competition; for example, goal setting, arousal regulation, coping, mental training, self-confidence, and motivation (Weinberg and Gould, 2015; Arnold et al., 2017; Furlonger et al., 2017), all of which can enhance athletes' control over the mental, emotional, technical, and physical dimensions of their sports performance. Most training programs typically have a set of pre-established goals. This goal may be improvement of tactical offense/defense movements through simulation training (Massey et al., 2015) or incorporating breathing techniques or positive self-talk to manage arousal and anxiety levels (Hatzigeorgiadis et al., 2011). Thus, we can infer that programs which integrate self-management strategy learning/practice with sports training can allow for the enhancement of athletes' self-monitoring, -evaluating, and -reinforcing psychological and physiological skills related to essential facets of their sports performance. These learned strategies, thereby, allow athletes to modify their behaviors toward gaining desired outcomes (Critchfield and Vargas, 1991; Polaha et al., 2004; Collins and Durand-Bush, 2014; Furlonger et al., 2017). That is, athletes with well-developed self-management skills are capable to initiate, modify, and complete sport-related tasks (i.e., which require the development of higher levels of sports performance) with confidence, thereby making them less dependent on coaches/sports psychologists' constant instruction/support to achieve higher levels of sports performance (Im et al., 2015).

Concurring with this inference, studies have shown that the application of self-management strategy learning programs (i.e., to teach athletes how to utilize such strategies) can effectively

improve the performance and psychological states of athletes in different sporting situations. For example, Vesković et al. (2019) investigated the effects of two psychological strategies on anxiety and self-confidence levels in Karate athletes and found improved self-confidence and decreased cognitive anxiety among elite Karate players who underwent modified autogenic and imagery trainings compared to those who did not. O'Brien et al. (2009), on the other hand, examined whether a goal-setting program could improve sports performance behaviors, competition outcomes, competitive anxiety, and self-confidence of elite and non-elite boxers; they found that, during and after the implementation of the goal-setting program, the boxers showed the following outcomes: improvements in their success rates of landed and defended punches; in their percentage of fights won; in their self-confidence; and their experienced anxieties were interpreted as facilitative rather than debilitating. Schwab Reese et al. (2012) endeavored to review the effectiveness of different self-management strategies to increase the self-management of injured athletes; they reported that imagery, goal-setting, and relaxation were useful to decrease negative psychological consequences, re-injury anxiety, and increase coping.

Summarizing, these citations underpin the effectiveness of self-management to facilitate positive outcomes in athletes' performance and mental state in the sports field. These outcomes find consonance in Bandura's self-efficacy theory (Bandura, 1977, 1997), which assumes that people's beliefs can influence their ability to perform a behavior; nonetheless, the theory also remarks that the belief of being able to successfully perform a behavior depends on the strength of that belief and on the level of conduciveness of the environment. Accordingly, athletes with high beliefs in their self-management ability (e.g., to control their negative thoughts; plan their trainings to improve their physical and tactical skills; regulate their anxiety levels; and manage positive relationships with others on their own; etc.) may feel more confident to pursue behaviors based on specific goals. In this regard, a study showed that successfully achieving goals while employing self-management strategies could enhance athletes' self-confidence (i.e., their beliefs on themselves; Dishman et al., 2005). Deci and Ryan (1985)'s self-determination theory is another approach to explain athletes' positive sport performance through self-management. This theory claims that self-determined types of motivational regulations will affect behavior if the three basic psychological factors of relatedness, competence, and autonomy are more or less satisfied. It also suggests that depending on the level of satisfaction from the three psychological needs, different cognitive, affective and behavioral outcomes will occur. Moreover, autonomy and competence are found to be associated with self-regulation (Deci and Ryan, 2000; Guillet et al., 2002). Following these points in martial arts, if athletes (e.g., Korean athletes) participate in sport for their own pleasure and satisfaction (autonomy), personal goals achievement (competence), and team support/acknowledgment (relatedness), their motivation to perform sport-related tasks is more intrinsically determined. Intrinsically motivated martial arts athletes are then more likely to practice self-regulation via deliberate and consistent use of various strategies of self-management that would promote achievement of performance



goals leading to positive psychological outcomes. In contrast, martial arts players who feel that they are not part of the team, often gets negative feedback from peers and coaches, and have no choice in the decision-making, their motivation to perform the behavior tends to be less self-determined (externally regulated) and concurrently impair their self-regulation capacity resulting to negative consequences such as decrease in self-satisfaction, self-confidence and commitment. Therefore, a relationship exists between self-management and psychological outcomes. That is, the use of self-management may facilitate athletes' psychological responses and it may function to regulate different dimensions (i.e., psychosocial, physical, and tactical) of athletes' sports participation, thus influencing not only their behaviors but also their cognitive states.

For the last few decades, various researchers have focused on exploring both traditional and new forms of martial arts (e.g., Green and Svinth, 2010) examining athletes' employment of self-management and its associated outcomes. While martial arts can be described in several ways, we define martial arts as combat or self defense techniques with the use of either bare hands/feet or weapons (bow and arrow, stick, and sword). Martial arts can be categorized in various approaches such as armed with weapon or unarmed, traditional or modern, or practice orientation (combat or spiritual). Hence, each form of martial arts may fall into several categories depending on the established criteria such as: armed with weapon (encing-foil, épée, and saber swords, archery (bow and arrow), kumdo (wooden stick) vs unarmed (judo, taekwondo, and wrestling); traditional (ssireum-Korea, taekwondo-Korea, and judo-Japan) vs modern (kumdo; fencing; archery; and mixed martial arts); or combat (archery; wrestling, boxing) vs spiritual (hapkido, aikido, and tai chi; Green and Svinth, 2010; Cynarski, 2019). In South Korea, scholars have been interested in martial arts education and its importance in a practitioners' life and well-being (Kim J. et al., 2011; Choi, 2017). Further, due to the rise of competitive martial arts, researchers have shown increased interest in examining this topic such as concept of self-management of Korean athletes from various martial arts for they achieved many sporting successes in various international competitions particularly in the Olympic Games such as archery, taekwondo, judo, wrestling (Greco-Roman and freestyle), fencing, and boxing. These martial arts sports have made consistent and significant contributions to South Korea's Olympic dominance accounting for 63% of the total medals won in the Summer Olympic Games (Olympic Games, 2021). For instance, Choi et al. (2009) reported that a high level of self-control is an essential psychological characteristic for taekwondo practitioners to achieve higher skill levels in techniques related to the martial arts and higher self-confidence. Similarly, competitive players in ssireum, judo, and wrestling with high levels of self-confidence, performance, and task orientation were found to frequently employ different self-management strategies (Han, 2008; Kim and Chun, 2010; Kim et al., 2015). Lim et al. (2015) found taekwondo athletes who practiced self-management positively influenced their sport commitment and exercise satisfaction.

Furthermore, qualitative studies provide evidences about the effectiveness of self-management in improving sport

performance of athletes. Park (2000) described that training hard, yelling, singing, listening to music, and ignoring the actual date of competition were some thought- and emotional-regulating strategies employed by a judo athlete who won a gold medal in the Olympics. Lim and O'Sullivan (2016) did a case study about the effect of a systematic mental skills program on the psychological state and performance of a taekwondo Olympian and found positive changes in the athlete's psycho-emotional condition and behaviors. Increased physical effort, positive mentality, self-confidence, decreased negative thoughts, anxiety level, and perceived stress, and improved competition performance style were observed after employing several strategies to regulate the player's feelings, thoughts and actions. They reported that a systematic mental skills program helped the player how to better control the stressors of competition that subsequently facilitated the taekwondo athlete's gold medal success in the Olympic Games.

Based on the results, the authors of these cited studies concluded that self-management may play a determinant role in practitioners' psychological characteristics. Specifically, the self-management of martial arts practitioners might be the main influential factor of their exercise self-confidence, satisfaction, and commitment (Huh, 2003; Han, 2008; Chun, 2011; Kim, 2015; Kim and Cho, 2017; Kim and Kim, 2018). Here, we define satisfaction as cognitive evaluation of one's athletic participation (Riemer and Chelladurai, 1998) while commitment is a person's motivational desire and determination to continue sports participation (Scanlan et al., 1993).

Notwithstanding, despite the multitude of studies verifying the relationships between athletes' self-management and exercise self-confidence, satisfaction, and commitment, no attempt has been made to systematically investigate these variables and consolidate the findings in the literature through a meta-analytic approach. We believe that a meta-analysis on the relationships between self-management and these psychological characteristics in the sports field could serve to bridge theoretical knowledge and practical implications; specifically, the provision of systematic data can help coaches/sports psychologists to identify/develop effective training interventions targeted at the development of athletes' self-management skills—thereby potentially helping enhance athletes' psychological well-being. Such a study could also serve to provide additional knowledge on the self-management phenomenon, thus enriching interdisciplinary literature on the topic in general and South Korea in particular. Likewise, a greater understanding of this phenomenon—and its benefits—can help athletes with no access to professional sports/mental coaches by providing information on specific aspects of their training that they can directly modify; this could potentially help them achieve an optimal psychological state, which could, in turn, allow for longer sports participation and higher performance.

Accordingly, this study aimed to meta-analyze studies on the relationships between athletes' self-management and exercise self-confidence, satisfaction, and commitment. The following are the research questions of this study: (1) What are the overall effect sizes (ES) of the relationships among self-management and the outcome variables (i.e., exercise self-confidence, satisfaction, and

commitment)? (2) What are the ES of different dimensions of self-management on the outcome variables? (3) What are the ES of the relationships among self-management and the outcome variables in different martial arts sports? and (4) What are the ES of the relationships among self-management and the outcome variables in different levels of sports participation?

## MATERIALS AND METHODS

### Procedure

In the late twentieth century, narrative reviews and content analyses were popular when researchers aimed to synthesize knowledge on heterogeneous findings on certain issues, constructs/variables, and relationships (Higgins and Thompson, 2002; Kim and Cruz, 2016; Grewal et al., 2018). Compared with these two which considered to be more subjective method, meta-analyses are known to be a more rigorous alternative for synthesizing the robustness of findings in any scholarly field; namely, the meta-analytic approach has helped scholars to satisfy the needs for knowledge accumulation and development in many field (Borenstein et al., 2009; Palmatier et al., 2017; Grewal et al., 2018). Additionally, this sophisticated method allows researchers to empirically compare and combine findings across studies on specific issues and research domains.

Despite this design being valid to systematically identify empirical findings, it also presents limitations; specifically, it has some issues regarding its extracting and coding procedures and the judgements on the relevance of studies. Thus, to ensure that we found relevant and reliable answers to the research questions of the current study, we strictly followed the guidelines for meta-analyses set forth (Hunter and Schmidt, 2004; Cohen et al., 2007; Borenstein et al., 2009).

We selected electronic databases (i.e., Google Scholar, SPORTDiscus, National Library of Korea, National Digital Science Library, PubMed, PsycINFO, KERIS, National Assembly Library) to search for scholarly publications and documents. We used the following keywords: self-management; self-confidence; commitment; satisfaction; and martial arts. These were used together with the following words: sports; exercise; traditional; modern; psychological; and performance.

We used the following exclusion criteria to exclude studies in the preliminary search: (1) no or low relevance to our outcome variables and population; (2) dual publication of a single study (e.g., unpublished thesis or dissertation concomitantly published as journal articles); (3) not a referred journal article (e.g., case reports, narrative review, conference proceedings, and abstracts); and (4) no full-text availability (see **Figure 1**).

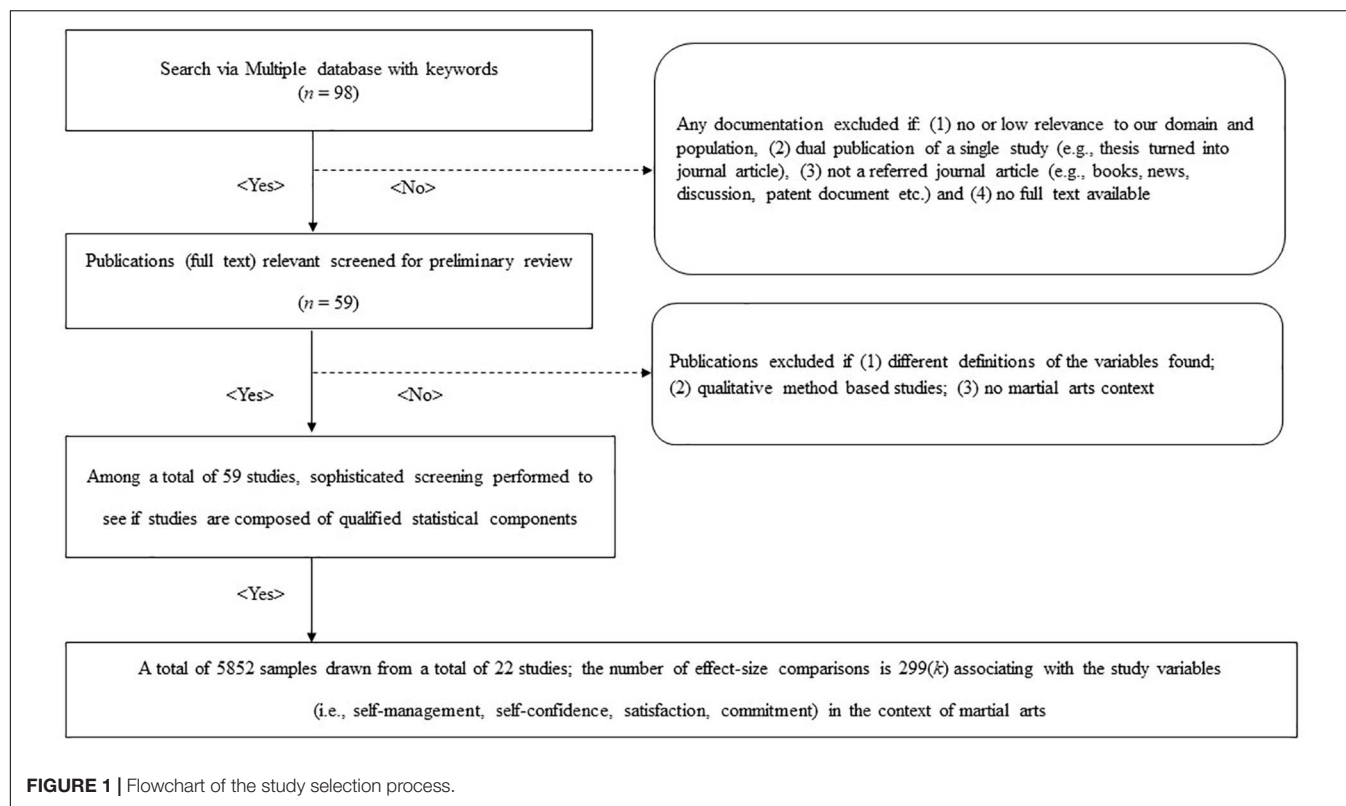
Through this preliminary search and review process, we found a total of 59 studies. To determine their eligibility, we used the following inclusion criteria: (1) theoretical relevance (e.g., meanings of operational definitions); (2) population similarity (i.e., sample description); (3) completeness and adequacy of statistical reports; and (4) acceptance status of the Official Korean Citation Index approved by the Korea National Research

Foundation. In total, 22 articles—totalizing 5852 participants—were included in this meta-analysis (see **Table 1**). From the included articles, the featured martial arts were boxing, judo, fencing, wrestling, archery, taekwondo, kumdo, and ssireum. Taekwondo, ssireum and kumdo are martial arts developed in Korea. Ssireum is a traditional martial art wherein players wear a cloth-sash (satba) around their waist and right thigh, and opponents lock on to each other's satbas. In order to win, ssireum players have to throw their opponents to the sandy ground using their strength and various skills (Noh et al., 2015). Kumdo is a modern martial art adopted from Japanese kendo that uses a bamboo sword to strike opponents (Green and Svinth, 2010). Taekwondo is the representative martial art of Korea with emphasis on kicking techniques targeting the body and head. It evolved as a competitive sport and has been part of the Olympic Games since its debut in 1988 (Green and Svinth, 2010; Olympics, 2021d). Boxing and wrestling are combat unarmed sports included in both ancient and modern Olympic games. The former uses striking skills using the hands, while the latter focuses on grappling and pinning movements to attack opponents (Olympics, 2021b,e). Judo is a martial art originated from Japan and an official event in the Olympics. It mostly comprises of throwing techniques to subdue rivals (Green and Svinth, 2010; Olympics, 2021c). Fencing is a sword fighting style of martial art originated in Europe (Windsor, 2018) whereas archery is originally a form of combative martial art used for hunting and war before it became a competitive sport during the middle ages (Green, 2001). As a modern Olympic sport, the archer uses a weapon of bow and arrows to shoot a 122 cm diameter target 70 m away (Tokyo 2020, 2020; Olympics, 2021a).

### Data Analysis

To compute ES based on the correlation of the study variables, we converted the sample size ( $n$ ) and correlation coefficient values  $r$  of each study into Fisher's  $z$ -scores; this was performed based on the meta-analytic procedure outlined in previous research (Higgins and Thompson, 2002; Borenstein et al., 2009; Kim and Cruz, 2016). Furthermore, we considered the following as moderator variables: level of sports participation [i.e., middle/high school student athletes and recreational participants (MHR); and collegiate student and professional athletes (CEPA)], and type of martial arts sport. Owing to the lack of studies in non-elite sports practitioners, we chose to combine the high school and recreational players into one group, while the collegiate and professional athletes into another group.

To accurately estimate the ES from the selected studies, we used the Comprehensive Meta-Analysis version II program. Since the target population has unique and specific characteristics, we followed Borenstein et al. (2009)'s recommendations, thereby ensuring that the basic assumption of accepting the random effect model (i.e., a single population assumption) was adequately met. We assessed publication bias using funnel plots. The plot results were distributed horizontally, which signified rejection of publication bias. We

**TABLE 1 |** Summary of Korean self-management studies in martial arts.

#	References	n	Martial arts type	Participants	DV
1	Chun, 2011	221	Judo	MH recreational participant	Satisfaction and commitment
2	Lim et al., 2015	281	Taekwondo	MH recreational participant	Satisfaction and commitment
3	Kim J. P. et al., 2011	150	Boxing	MH recreational participant	Satisfaction
4	Lim et al., 2010	255	Taekwondo	Professional	Satisfaction
5	Kim and Kwon, 2018	269	Taekwondo	Collegiate athlete	Satisfaction
6	Seol and Choi, 2019	275	Taekwondo	MH elite athlete	Satisfaction
7	Lee and Nam, 2018	295	Taekwondo	Collegiate athlete	Satisfaction and commitment
8	Park and Shin, 2015	323	Kumdo	Collegiate athlete	Satisfaction
9	Park et al., 2018	300	Kumdo	Collegiate athlete	Satisfaction
10	Moon and Park, 2008	199	Archery	MH elite, collegiate and professional	Self-confidence
11	Song and Lee, 2015	231	Taekwondo	Collegiate athlete	Satisfaction and self-confidence
12	Kim, 2017	297	Taekwondo	Collegiate athlete	Commitment
13	Kim, 2010.	235	Judo	Collegiate athlete	Self-confidence
14	Kim et al., 2017	218	Fencing	Collegiate and professional	Commitment
15	Kong, 2017	339	Ssireum	MH elite athlete	Commitment
16	Kim and Cho, 2017	228	Mudo	Collegiate athlete	Self-confidence
17	Hur et al., 2011	147	Ssireum	Collegiate athlete	Self-confidence
18	Kim, 2015	206	Taekwondo	Collegiate athlete	Self-confidence
19	Kim and Kim, 2018	276	Wrestling	Collegiate and professional	Commitment
20	Han, 2008	409	Wrestling	MH elite and professional	Self-confidence
21	Kim and Chun, 2010	360	Ssireum	MH elite athlete	Self-confidence
22	Kim et al., 2015	338	Judo	MH elite, collegiate and professional	Self-confidence

MH, mid-high school athletes; n, sample size; and DV, dependent variable.

followed Borenstein et al. (2009)'s and Cohen et al. (2007)'s recommendations on the interpretation of ES levels, which are the following: an ES of 0.10 equals to a small; an ES of 0.25 equals to a medium; and an ES of 0.40 to a large heterogeneity.

By estimating the  $I^2$  statistic ( $I^2 = 100\% \times (Q - df)/Q$ ; where  $Q$  is the Cochran's heterogeneity statistic), we assessed the homogeneity of all relationships between the outcome variables. Based on Higgins et al. (2003), the  $I^2$  index values of 25, 50, and higher than 75% were interpreted as small, moderate, and large levels of heterogeneity of individual effects, respectively. We conducted the heterogeneity assessment of all accepted studies because, as remarked by Hunter and Schmidt (2004), this is one of the essential procedures of a meta-analysis.

## RESULTS

### What Are the Overall Effect Sizes of the Relationships Between the Outcome Variables (i.e., Exercise Self-Management, Self-Confidence, Satisfaction, and Commitment)?

Table 2 presents a summary of the overall ES for the relationships between self-management and exercise self-confidence, satisfaction, and commitment. The results for the overall ES of self-management showed positive moderate effect on athletic satisfaction (ES = 0.329) and self-confidence (ES = 0.359) and positive large effect on exercise commitment (ES = 0.407).

### What Are the ES of Different Dimensions of Self-Management on Exercise Self-Confidence, Satisfaction, and Commitment?

Table 3 presents the ES for the effect of the dimensions of self-management on the outcome variables. Results showed that all four dimensions of self-management had the highest ES for exercise commitment (CIs ranged from 0.357 to 0.445), followed by exercise self-confidence (CIs ranged from 0.325 to 0.378) and satisfaction (CIs ranged from 0.237 to 0.375). Moreover, the effects of all dimensions of self-management on the outcome variables were generally moderate except the mental and training dimensions on exercise commitment that yielded positive large effects.

### What Are the ES of the Relationships Between the Outcome Variables (i.e., Self-Management and Exercise Self-Confidence, Satisfaction, and Commitment) in Different Martial Arts Sports?

Table 4 presents the ES for the effect of self-management on the outcome variables by type of martial arts (i.e., as a moderator). Results showed that the effect of self-management on exercise satisfaction in judo was larger than all other martial arts; in Kumdo, this effect was also significant, albeit relatively lower. The effect of self-management on exercise commitment in Ssireum

**TABLE 2 |** Overall effect size levels of self-management on psychological outcomes.

Variable	<i>n</i>	ES	-95%CI	+95%CI	<i>p</i>	<i>Q</i>	$I^2$	Tau
Athletic satisfaction	83	0.329	0.288	0.369	0.000	971.746	91.561	0.2035
Exercise commitment	52	0.407	0.375	0.439	0.000	268.411	80.999	0.128
Self-confidence	164	0.359	0.346	0.371	0.000	378.335	56.9165	0.0071

*n*, Number of selected studies; ES, Effect Size; and CI, Confidence interval.

**TABLE 3 |** Effects of aspects of self-management on psychological outcomes.

Aspects (SM)	Variables	<i>k</i>	ES	-95%CI	+95%CI	<i>Q</i>	$I^2$	Tau
Interpersonal	Athletic satisfaction	21	0.358	0.263	0.447	292.3	93.500	0.234
	Exercise commitment	13	0.391	0.343	0.438	32.74	63.347	0.081
	Self-confidence	41	0.376	0.353	0.400	80.90	50.558	6.32E
Physical	Athletic satisfaction	21	0.237	0.160	0.311	180.74	88.935	0.175
	Exercise commitment	13	0.357	0.291	0.419	57.42	79.102	0.120
	Self confidence	41	0.325	0.302	0.347	68.56	41.66	5.28E
Mental	Athletic satisfaction	21	0.345	0.267	0.418	210.73	90.509	0.191
	Exercise commitment	13	0.434	0.368	0.496	65.524	81.686	0.1307
	Self confidence	41	0.378	0.359	0.396	50.891	21.401	0.032E-02
Training	Athletic satisfaction	21	0.375	0.301	0.446	205.138	90.250	0.188
	Exercise commitment	13	0.445	0.369	0.514	86.559	86.137	0.154
	Self confidence	41	0.359	0.325	0.392	154.498	74.109	0.106

*k*, Number of comparisons; CI, Confidence interval; and SM, Self-Management.



**TABLE 4 |** Effects of self-management on psychological outcomes based on different martial arts.

Variables	TM	k	ES	−95%CI	+95%CI	Q
Athletic satisfaction	Boxing	8	0.309	0.157	0.446	73.675
	Judo	12	0.413	0.337	0.483	58.448
	Kumdo	24	0.284	0.219	0.347	215.127
	TKD	39	0.335	0.265	0.400	580.009
Exercise commitment	Boxing	4	0.448	0.307	0.569	12.455
	Fencing	8	0.388	0.301	0.469	31.121
	Judo	4	0.419	0.309	0.518	10.954
	Ssireum	4	0.582	0.537	0.624	4.589
Self confidence	TKD	24	0.370	0.334	0.404	69.208
	Wrestling	8	0.410	0.313	0.499	50.337
	Archery	16	0.395	0.351	0.436	31.090
	Fencing	4	0.364	0.290	0.434	4.691
	Ssireum	36	0.335	0.317	0.353	32.797
	Judo	32	0.342	0.317	0.367	58.147
	TKD	40	0.328	0.297	0.358	99.967
	Wrestling	20	0.416	0.385	0.446	51.752

k, Number of comparisons; CI, Confidence interval; TM, Type of martial arts; and TKD, Taekwondo.

**TABLE 5 |** Effects of self-management on psychological outcomes based on level of sports participation.

Variables	MIL	n	ES	−95%CI	+95%CI	Q	I <sup>2</sup>	Tau
Athletic satisfaction	MHR	36	0.362	0.305	0.416	325.784	89.256	0.183
	CEPA	47	0.304	0.246	0.361	621.054	92.593	0.213
Exercise commitment	MHR	20	0.448	0.394	0.499	105.806	82.042	0.135
	CEPA	32	0.380	0.342	0.418	135.853	77.181	0.112
Self confidence	MHR	68	0.369	0.353	0.386	141.042	52.496	5.83E-02
	CEPA	96	0.349	0.331	0.369	232.047	59.060	8.32E

MIL, Martial arts involvement level; MHR, Middle and high School athlete and recreational participants; and CEPA, Collegiate elite and professional athletes.

was the largest, followed by boxing, and judo. The effect of self-management on exercise self-confidence showed similar levels across different martial arts sports (CIs ranged from 0.328 to 0.416), and it was the largest in wrestling (95% CIs = 0.39 to 0.45, ES = 0.416, and  $p = 0.05$ ).

## What Are the ES of the Relationships Between the Outcome Variables (i.e., Self-Management and Exercise Self-Confidence, Satisfaction, and Commitment) in Different Levels of Sports Participation?

Table 5 shows the differences in ES levels by level of sports participation. Results showed that the effect of self-management was greater in the MHR group (CIs ranged from 0.362 to 0.448) than the CEPA group on all outcome variables.

## DISCUSSION

This study conducted a meta-analysis to examine the overall ES of the relationships between self-management and exercise self-confidence, satisfaction, and commitment of martial arts practitioners in Korea. We also examined the influence of each dimension of self-management on the outcome variables, and the effects of self-management on the outcome variables in different martial arts sports and in different levels of sports participation.

Overall, the results showed moderate to strong effects between self-management and exercise self-confidence, satisfaction, and commitment. Specifically, exercise commitment was shown to be greatly influenced by self-management, whereas exercise self-confidence and satisfaction were only be moderately influenced; namely, martial art practitioners who practiced self-management (i.e., on the physical, interpersonal, mental, and training dimensions of their athletic career) not only felt higher exercise satisfaction and self-confidence but also higher exercise commitment. Coaches, sports practitioners, and sports psychologists should, hence, implement self-management training not only to athletes who want to sustain or enhance their positive mental state but also to those who tend to lack exercise self-confidence and satisfaction, and even more so to those who display diminished commitment in their sports participation.

## The Influence of Different Dimensions of Self-Management on Exercise Self-Confidence, Satisfaction, and Commitment

By analyzing the contributions of each dimension of self-management on the three psychological outcome variables, we observed that the interpersonal dimension had a moderately positive impact on exercise commitment, followed by exercise self-confidence and satisfaction. Namely, martial arts practitioners who employed interpersonal self-management (i.e., managed their interactions/communication with their teammates and coaches) moderately enhanced their commitment, their beliefs in the ability to successfully perform a sports-related behavior, and their satisfaction. Hence, to promote exercise commitment, self-confidence, and satisfaction, athletes should be proficient at directly regulating their interpersonal relationships with teammates and coaches; this can be done by having greater awareness over the need to treat those surrounding the athlete nicely and to display behaviors that are expected/desired by each team member, coach, or the group. Especially, coaches and teammates who are casted in the roles of leadership positions should demonstrate support for an acceptance and mindfulness-oriented intervention during the practice circumstance.

The physical dimension of self-management had a moderately positive effect on exercise commitment and self-confidence, but only a small positive effect on exercise satisfaction. Namely, martial arts practitioners who self-monitored the physical aspect of their training had higher exercise commitment and self-confidence, but not high satisfaction with the exercise. The

small effect found in the relationship between physical self-management and exercise satisfaction may be attributed to the goal of sports participation—of winning. We deem feasible to think that many athletes do not perceive the self-management of their sleep regimen and eating patterns as an essential part of a successful sports performance, and this may explain the aforementioned small effect. Another reason might be the leadership style of the coach and its consequence on satisfaction (Chelladurai, 1993; Kim and Cruz, 2016). Specifically, Kim and Cruz (2016) conducted a meta-analysis on the relationship between leadership behavior and exercise/athletic satisfaction, finding that an autocratic style contributed to a small positive effect of leadership behavior on athletic satisfaction. In Korea, athletes' daily activities and training schedules are generally controlled by the coach; accordingly, the autocratic style of coaches might have prevented athletes from fully controlling the physical dimension of their training by themselves, thereby leading to diminished satisfaction with their sports participation. Hence, coaches may need to provide an autonomy-supportive environment to their players, namely, give them freedom to control even their activities outside training; these may lead to higher levels of satisfaction in athletes.

The mental dimension of self-management had a large positive effect on exercise commitment and moderate positive effects on exercise self-confidence and satisfaction. Namely, martial art practitioners who could directly manage their negative thoughts, stress, and anxiety had moderate levels of satisfaction and self-confidence, while concomitantly reporting considerably high levels of exercise commitment. It is possible that participants in this study used self-management strategies such as self-talk and imagery to manage their mental concerns, and these may have led not only to increased self-confidence and satisfaction but also increased commitment. This idea corroborates that found in Hatzigeorgiadis et al. (2011); they conducted a meta-analytic review on the effects of self-talk on task performance, reporting that self-talk (i.e., a self-instructional strategy) was effective in enhancing learning and sports performance owing to its various functions in people's mental state (Theodorakis et al., 2008). Similarly, motivational general-arousal imagery was shown to decrease athletes' anxiety (Strachan and Munroe-Chandler, 2006), while motivational general-mastery imagery increased their self-confidence (Callow and Hardy, 2001; Callow et al., 2001). Nonetheless, these two latter studies only partially corroborate our findings because the magnitude of the relationship between the mental dimension of self-management was large for exercise commitment and moderate for self-confidence and satisfaction. Therefore, martial arts players who want more persistence in their sports participation, better trust in their own skills and abilities, and higher sense of sports fulfillment should consider practicing positive self-talk rather than negative self-talk and learning imagery training to alleviate their cognitive concerns prior to, during, and even after sports training and competition.

The training dimension of self-management showed a moderate effect on exercise satisfaction and self-confidence and a large effect on exercise commitment. Namely, martial arts practitioners who were capable of developing and organizing

their own practice sessions for physical and skill improvements, and to self-assess their training efforts and performance, demonstrated increased exercise satisfaction, self-confidence, and even greater exercise commitment. The large influence of the training dimension of self-management on exercise commitment might be explained by study participants' personality; they might have had high levels of self-confidence. Self-confidence was found to affect how people choose and chase their goals, promoting positive emotions, enhancing concentration, and increasing persistence (Theodorakis, 1995; Bandura, 1997; Weinberg and Gould, 2015). Thus, martial arts practitioners, who had high self-confidence about self-management may have used appropriate self-management skills to help them focus on achieving their target training and competition goals, thereby resulting in higher levels of commitment (Kim, 2010; Hur et al., 2011; Jeon, 2016; Kong, 2017). Moreover, participants included in the current study were mostly engaged in competitive sports, which denote that they aspire to achieve valuable opportunities and to become successful. Previous studies have shown the effect of athletes' subjective outcomes on intrinsic motivation. When athletes focus on the performance outcomes of competition rather than actual result, they tend to feel more intrinsically motivated (Weinberg and Gould, 2015) which can directly affects their commitment (Scanlan et al., 1993; Weiss and Aloe, 2019).

Summarizing, all dimensions of self-management showed a moderate effect on exercise self-confidence. Regarding the relationship between self-management and exercise commitment, the mental and training dimensions of self-management had a large contribution, while the interpersonal and physical dimensions had a moderate contribution. Regarding the relationship between self-management and exercise satisfaction, the interpersonal, mental, and training dimensions showed a moderate contribution, while the physical showed a small contribution.

## Self-Management and Outcome Variables in Different Martial Arts Sports

The influence of self-management on the outcome variables ranged from moderate to large ES across different martial arts sports. Specifically, self-management had large effects on exercise satisfaction in judo, exercise self-confidence in wrestling, and exercise commitment in Ssireum, boxing, judo, and wrestling. This result might be explained by players' achievement orientation, level of experience, and level of success. Previous studies showed that successful and highly experienced wrestlers and judo players were mostly driven toward achieving task-oriented goals such as personal mastery and higher competence attainment (Han, 2008; Park, 2018). Likewise, successful Ssireum players generally focused on regulating their cognitive and emotional states to build their physical and mental competence (Kim and Chun, 2010; Phillips, 2011; Meyer and Bittman, 2018). These personal factors of athletes could have had positively affected their use of self-management strategies and consequently led to substantially higher exercise satisfaction, self-confidence, and commitment. The findings suggest that the positive effects of self-management on psychological outcomes may be moderated

by individuals' characteristics and confirms the notion that successfully achieving goals while employing self-management could also enhance self-confidence (Dishman et al., 2005). Meanwhile, athletes' autonomy-supportive coaches may also explain these positive results. In an in-depth interview with Korean Olympic archers, several players stated that when their coach supported the goals they decided to pursue and gave them permission to express their views about the training schedule, they felt more dedicated and accountable to achieve their set goals (Kim and Park, 2020). This finding corroborates our results, demonstrating that commitment can significantly and positively be affected by athletes' control over their training environment and interpersonal communication with their coach. Still, we remark that future studies should examine the specific self-management strategies (e.g., coping skills, mental imagery, etc.) that these practitioners use to regulate their thoughts, emotions, and experiences in various dimensions of their sports participation. This would help pave the pathway for well-informed decision-making regarding interventions to enhance martial arts practitioners' exercise commitment, self-confidence, and satisfaction.

## Self-Management and Outcome Variables Based on Level of Sports Participation

Our results showed that the effects of self-management on exercise satisfaction, commitment, and self-confidence were moderate to large in both groups; still, the ES were higher in the MHR than in CEPA. This means that MHR martial arts practitioners who were capable of managing their relationships with others, control their emotions, and plan their training goals to achieve athletic success reported higher perceived satisfaction, confidence, and exercise commitment. The diminished influence of self-management in CEPA (i.e., elite practitioners) may be explained by external factors that might inhibited their capacity to practice self-management, thereby lowering their levels of exercise satisfaction, commitment, and self-confidence.

Elite or professional (CEPA) level competition is a sporting environment that provokes tremendous amount of physiological and psychological stresses for players (Jeon, 2016). These stressors can be winning expectation and injury. For example, Taekwondo is considered one of the most injury prone martial arts sport. In elite players, the injury incidence rate ranged from 21 to 140 per 1000 athlete exposures overall, whereas 79.0 per 1000 athlete exposures during competition were recorded (Son et al., 2020). Moreover, Taekwondo has been in the top 5 sports with highest rate of injury prevalence in the Olympics since 2008 (Son et al., 2020). It is therefore vital for players to be cognizant of ways to avoid injuries and even cope when injury occurs. Without the ability to manage unpleasant responses concerning injury-related stressors, athletes' perception of competence, satisfaction and commitment are likely to diminish. This notion coincides with previous research in taekwondo elite athletes (Im et al., 2015) in which interpersonal, mental, training, and physical aspects of self-management were found to be significant predictors of exercise satisfaction and commitment. In contrast,

lower level competition players may have had focused on skill mastery and personal satisfaction to learn new things as their main objectives in sport participation. While participating, high school and recreational players (MHR) might had felt positive social support from peers and coaches that led to their higher interest, control and commitment to endure the challenges of training and competition as well as sport fulfillment. This reason coincides with Bandura's (1997) self-efficacy and Deci and Ryan's (1985) self-determination theories explaining how self-efficacy and the kind of motivation regulation may affect one's psychological outcomes.

The results highlights how self-regulation of thoughts, feelings, and behaviors to affect performance outcomes is dependent on athletes' level of competition. More so, it appears that as level of competition becomes more competitive or more focused on the objective outcomes rather than performance outcomes, higher level athletes' capacity to self-regulate aspects of their sports participation during training and competition is likely to be more challenging than lower level players owing to a more stressful sport environment. Hence, we argue that a negative association exist between these two variables and therefore warrants further investigation. Nonetheless, to further enhance Korean practitioners' exercise self-confidence, satisfaction, and commitment, stakeholders (coaches, sport psychologists, team physicians, and athletic trainers) should devise educational interventions that underscore the importance of self-management in sports. For instance, since the training and mental dimensions of self-management were found to greatly increase practitioners' exercise satisfaction, commitment, and self-confidence, stakeholders could devise interventions to teach athletes, particularly elite players (e.g., Kumdo and Taekwondo, which showed the lowest ES) how to independently plan training goals that are specific, achievable, and relevant to their needs. This can be overlearning sets of taekwondo kicking combinations during practice which may help in stronger memory retention and automatic processing for the learned motor skills (Schmidt and Lee, 2011) that can be positively transferred in competitive setting. Likewise, taekwondo players can use self-management strategies like positive self-talk, breathing techniques or meditation to regulate their arousal level and physical pain during training and up to the time prior to a match.

## Limitations and Future Directions

This meta-analysis study has potential limitations. Even though this study provides valuable input on understanding psychological influence of self-management on those underlying variables, the studies selected for this meta-analysis were mainly Korean articles and the results may therefore not be applicable to martial arts athletes/practitioners outside of this setting. However, the practice of martial arts is part of Korea's rich culture and history and understanding its philosophical values and cultivation in Korean people's lives is therefore a worthy endeavor. More so, South Korea is one of the few countries in the world where higher education institutions have fully-operating martial arts-related departments and colleges. These departments and colleges underpin that understanding the

various reasons as to why groups of people embrace martial arts in their lives is one of the core objectives of academic scholars and practitioners of martial arts. Lastly, as some martial arts evolved and became competitive sports, a new set of South Korean martial arts participants (competitive athletes) emerged and insights about their involvement such as the use of self-management and its corresponding psychological outcomes warrant attention. We believe that these reasons underscore the importance and uniqueness of the current meta-analysis study. For future research, more studies from other continents or countries and other type of sports are warranted to gain a better insight into self-management in martial arts athletes and its effects on exercise self-confidence, satisfaction, and commitment. Although martial arts tend to have opponents in a competitive setting, martial arts without opponents (archery, martial arts as demonstration sport) can be another topic to consider particularly how various psychological variables can be affected based on the type of self-management employed.

The ES estimations for the moderator analyses can be another limitation because we had a small number of samples; unfortunately, it is common to observe larger effects when the samples are small. In the current study, particularly when analyzing different martial arts sports as a moderator, some sports with a small number of comparisons ( $k = 4$ ; e.g., boxing, fencing) yielded large ES. Hence, results from these sports should be evaluated with caution, and studies that examine athletes' cognitive responses toward the use of self-management on these sports are warranted.

## CONCLUSION

Overall, this meta-analysis showed the following: the effectiveness of self-management for enhancing exercise self-confidence, satisfaction, and commitment in Korean martial

arts practitioners; the moderate to large contributions among different dimensions of self-management on the outcome variables—particularly exercise commitment; and how different martial arts sports and level of sports participation moderate the relationships between self-management and exercise self-confidence, satisfaction, and commitment. These results further advance our knowledge on self-management and underscore the importance of self-management interventions in sports. They also extend our knowledge concerning martial arts, particularly regarding martial arts practice of Korean participants.

To our knowledge, this was the first study to systematically consolidate, review, and analyze—using a more rigorous quantitative method—relevant studies on self-management and the three analyzed cognitive outcomes. Summarizing, for athletes to show higher self-confidence in—and commitment and satisfaction with—their sports, coaches, sports psychologists, and sports practitioners should incorporate the concept of self-management in their respective sports practice.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## AUTHOR CONTRIBUTIONS

H-DK and AC conceptualized the research project and contributed to the writing of the manuscript (from the initial draft to the final manuscript). H-DK analyzed the data. Both authors contributed to the article and approved the submitted version.

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# Basic Psychological Need Profiles and Correlates in Physical Activity Participation: A Person-Centered Approach

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Guided by Basic Psychological Need Theory, we investigated the combined associations between need satisfaction and need frustration (*i.e.*, need profiles) and their relations with theoretically relevant correlates including mindfulness, physical literacy, physical activity enjoyment, and physical activity. The participants were Singapore-based school students ( $N = 844$ ,  $M_{\text{age}} = 12.45$ ,  $SD_{\text{age}} = 1.99$ , boys = 53.1%) who completed a cross-sectional survey. The results of the latent profile analysis identified four distinct need profiles: profile 1—average satisfaction and frustration ( $n = 364$ , 44.1%); profile 2—low satisfaction ( $n = 251$ , 29.7%), above average frustration; profile 3—very high satisfaction, very low frustration ( $n = 144$ , 17.1%); and profile 4—high satisfaction, very high frustration ( $n = 85$ , 10.1%). Among these, profile 3 was the most adaptive one; it had the highest levels of mindfulness, physical literacy, physical activity enjoyment, and moderate-to-vigorous physical activity. Experiences of need satisfaction countered the negative effects of need frustration on these correlates. These findings enhance our understanding of students' psychological need experiences and highlight the need for investigating the combined associations between need satisfaction and need frustration.

**Keywords:** need satisfaction, physical exercise, latent profile analysis, students, wellbeing

## INTRODUCTION

Basic Psychological Need Theory (BPNT; Deci and Ryan, 2000), one of the mini-theories in Self-Determination Theory, has been widely used for understanding human functioning (Vansteenkiste et al., 2020). BPNT posits that humans will achieve optimal functioning and well-being *via* the satisfaction of three basic psychological needs. By contrast, frustration of the three psychological needs will lead to human dysfunction and ill-being (Vansteenkiste and Ryan, 2013; Vasconcellos et al., 2019). Although these tenets are widely supported by a wealth of empirical evidence derived from variable-based analyses such as multiple regression, little research has examined the combined associations between need satisfaction and need frustration (*i.e.*, need profiles) and their relations to human functioning (Rouse et al., 2020; Vansteenkiste et al., 2020; Warburton et al., 2020). To address this literature gap, we used person-centered analyses to examine need profiles and their

associations with selected theoretically relevant correlates including mindfulness, physical literacy, physical activity (PA) enjoyment, and PA in school students.

Basic Psychological Need Theory posits that humans universally possess three basic psychological needs, which are the needs for autonomy, competence, and relatedness (Deci and Ryan, 2000). Humans satisfy their need for autonomy when they experience control over tasks, while the need for competence is satisfied when humans feel effective and capable of completing valued tasks. Lastly, the need for relatedness is satisfied when humans experience closeness and connection with significant others. According to BPNT, satisfaction of the three basic psychological needs (*i.e.*, “bright side”) is essential for growth and positive development of humans. Recent advancements in BPNT have specified a “dark side”, in which the three basic psychological needs are actively frustrated or thwarted (Bartholomew et al., 2011). Hence, it is important to differentiate the difference between low need satisfaction and need frustration (Bartholomew et al., 2011; De Francisco et al., 2018). In the latter case, the three basic psychological needs are frustrated when humans are asked to do tasks against their will, experience a sense of failure and low confidence, and experience feeling excluded and rejected by others. Frustration of these needs are found to ensue dysfunction and ill-being, such as low levels of motivation and mental problems (Deci and Ryan, 2000; Vansteenkiste and Ryan, 2013; De Francisco et al., 2018). Furthermore, in comparison to low need satisfaction, need frustration is considered a better predictor of negative outcomes such as burnout, depression, and sedentary time, supporting the different roles of need satisfaction and need frustration in understanding human functioning (Bartholomew et al., 2011; Vansteenkiste et al., 2020; Warburton et al., 2020).

The establishment of the distinct concept of need frustration has spurred research to simultaneously examine need satisfaction and need frustration. However, most of the research so far have only explored this through variable-centered approaches such as multiple regression analysis (Warburton et al., 2020). Although the use of variable-centered approaches can shed light on explaining the relationships between a set of basic psychological needs and related variables, they provide limited information on the combined associations between need satisfaction and need frustration (Rouse et al., 2020). In other words, it is difficult to answer research questions such as “How are need satisfaction and need frustration combined to predict outcomes through the variable-centered approach?” As a supplement to the variable-centered approach, researchers have also employed person-centered approaches such as cluster analysis and latent profile analysis (LPA), focusing on identifying subgroups within a heterogeneous sample based on the shared similarities on a set of variables (Howard and Hoffman, 2018). Specifically, by employing the person-centered approach, we are able to identify subgroups with different combinations of need satisfaction and need frustration scores (*i.e.*, need profiles) rather than “slicing” the participants into different need-related dimensions.

Indeed one proposition of BPNT is that there is an asymmetrical relationship between need satisfaction and need frustration (Vansteenkiste and Ryan, 2013), that is, while the

presence of low need satisfaction does not imply the presence of need frustration, the presence of high need frustration necessitates the existence of low need satisfaction. There is, however, little evidence to support this proposition, as most of the studies conducted to identify need profiles are based only on need satisfaction scores (Vansteenkiste et al., 2020). Two recent studies examined need profiles based on need satisfaction and need frustration scores in the contexts of work, sport, and physical education (Rouse et al., 2020; Warburton et al., 2020). Findings from the two studies identified three to five need profiles (*e.g.*, high satisfaction–low frustration profile, low satisfaction–very high frustration profile). While the findings, based on the domains of physical education and sport, provide support to the asymmetrical proposition, it is only partially supported in the work context given the presence of high competence satisfaction–high frustration profile. Therefore, future studies are warranted to investigate this proposition in the work context.

Identification of different need profiles has implications on the understanding of human functioning. For example, Rouse et al. (2020) found that firefighters from more adaptive need profiles (*e.g.*, high satisfaction–low frustration profile) experienced fewer symptoms of anxiety, depression, and stress than those from less adaptive profiles (*e.g.*, low satisfaction–very high frustration profile). Similarly, athletes from more adaptive profiles reported higher levels of well-being and enjoyment in sport training and lower levels of burnout than their counterparts from less adaptive profiles (Warburton et al., 2020). The findings unveiled some relevance of human functioning through experiencing varying combinations of need satisfaction and need frustration. In extension of the existing literature, we examined several need-relevant correlates, which include mindfulness, physical literacy, PA enjoyment, and PA. In addition to the theoretical relevance to the three basic psychological needs, these correlates are also important determinants of physical and psychological health (Raedeke, 2007; Cairney et al., 2019; Kee et al., 2019).

Mindfulness, a dispositional and trainable quality, refers to “paying attention in a particular way: on purpose, in the present moment, and non-judgmentally” (Kabat-Zinn, 2001). Mindfulness is believed to facilitate need satisfaction and decrease need frustration (Schultz et al., 2015). For example, in a PA setting, the receptive and non-judgmental awareness that characterizes mindfulness would help individuals to act in a way that is in line with their inner-value (autonomy), regulate attention and emotions to cope with physical challenges (competence), and attend to social interactions (relatedness). Indeed results derived from the variable-centered approach have indicated positive associations between mindfulness and need satisfaction as well as a negative relationship between mindfulness and need frustration across different contexts (Campbell et al., 2015; Schultz et al., 2015; Li et al., 2019a,b), yet none of the earlier research has examined the links between mindfulness and need satisfaction/frustration through a person-centered approach.

Physical literacy is defined as “a disposition acquired by individuals encompassing the motivation, confidence, physical competence, knowledge, and understanding that establishes purposeful physical pursuits as an integral element of their



lifestyle” (Whitehead, 2013). According to the tenet of BPNT, experience of need satisfaction will lead to positive development and functioning, while frustration of basic psychological needs will result in negative outcomes (Deci and Ryan, 2000). In line with this tenet, need satisfaction in physical education was found to positively predict physical literacy in university students (Wang et al., 2020). Similarly, evidence has shown that satisfaction of basic psychological needs is positively related to positive outcomes such as intrinsic motivation, positive affect, enjoyment, and PA across health, physical education, and PA contexts, whereas need frustration is a negative predictor (Gunnell et al., 2013; Huhtiniemi et al., 2019; Vasconcellos et al., 2019). It is worthy to note that the empirical evidence from these studies were mainly based on the variable-centered approach (Vansteenkiste et al., 2020). To our best knowledge, no research examining how the need profiles would relate to varying levels of PA enjoyment and PA has been conducted.

As an extension of earlier research, the current cross-sectional study was undertaken to examine the combined associations between need satisfaction and need frustration (*i.e.*, need profiles) and their relations with theoretically relevant correlates including mindfulness, physical literacy, PA enjoyment, and PA in school students. By employing a person-centered analytic approach while basing on the findings from previous research (Rouse et al., 2020; Warburton et al., 2020), we anticipated that at least two need profiles characterized by differences in need satisfaction and need frustration scores would emerge (*e.g.*, high need satisfaction–low need frustration and low need satisfaction–high need frustration). We, however, did not expect a high need satisfaction and need frustration profile given that they are suggested to be asymmetrical (Vansteenkiste and Ryan, 2013). Finally, we expected that more adaptive need profiles would have a greater level of positive correlates (*i.e.*, mindfulness, physical literacy, PA enjoyment, light PA, and moderate-to-vigorous PA) and a lower level of sedentary time as compared to less adaptive profiles (Rouse et al., 2020; Warburton et al., 2020).

## METHODS

### Participants

To be eligible for this cross-sectional study, the participants must be fulltime students studying at a public school in Singapore. A sample of 844 school students were recruited from 19 primary schools ( $n = 384$ ) and 20 secondary schools ( $n = 460$ ). There were more boys ( $n = 448$ , 53.1%) than girls, and there was no gender difference across school levels [ $\chi^2(1) = 0.33$ ,  $p = 0.56$ ]. The participants had a mean age of 12.45 years ( $SD = 1.99$ ; range = 9–17).

### Measures

We used five standardized scales to measure predictors and outcomes of interest. The predictors were six types of need satisfaction and need frustration. The outcome variables were mindfulness, physical literacy, PA enjoyment, sedentary time, light PA time, and moderate-to-vigorous PA time.

### Need Satisfaction and Frustration

We adopted the Basic Psychological Needs Satisfaction and Frustration Scale (Chen et al., 2015) to measure the participants’ need satisfaction and need frustration in PA participation. The scale has six four-item subscales, with each subscale measuring one type of need satisfaction and frustration (*e.g.*, “I feel confident that I can do things well”). The participants were asked to report their need experiences in PA participation and rate the items using a seven-point scale (1 = not true at all, 7 = completely true). We computed the six subscale scores for further analysis. A higher score would indicate a higher level of need satisfaction and need frustration.

### Mindfulness

We employed the Child and Adolescent Mindfulness Measure (Greco et al., 2011) to assess the participants’ dispositional mindfulness level. The scale consists of 10 items (*e.g.*, “At school, I walk from class to class without noticing what I’m doing”). The participants provided responses on a five-point scale (0 = never true, 4 = always true). A total mean scale score was computed, and a higher scale score would suggest a greater level of mindfulness.

### Physical Literacy

We utilized the Perceived Physical Literacy Instrument (Sum et al., 2018) to measure the participants’ physical literacy. The participants used a five-point scale (1 = strongly disagree, 5 = strongly agree) to provide responses on the nine scale items (*e.g.*, “I am physically fit, in accordance with my age”). A mean scale score was calculated. A higher mean scale score would suggest a greater level of physical literacy.

### Physical Activity Enjoyment

We borrowed four scale items from the PA Enjoyment Scale (Raedeke, 2007) to measure the participants’ PA enjoyment. The participants were asked “How do you feel recently about the physical exercise you have been doing?” Four seven-point semantic scale items were used for responses (*e.g.*, from “I enjoy it” to “I hate it”). A mean scale score was computed, where higher scale scores would represent greater levels of enjoyment in PA participation.

### Physical Activity

We used the International PA Questionnaire-Short Form (Craig et al., 2003) to assess the participants’ subjective PA level across a week. This nine-item scale records four intensity levels of PA: vigorous PA, moderate PA, light PA, and sedentary time. According to the data analysis guideline<sup>1</sup>, sedentary time, light PA time, and moderate-to-vigorous PA time were computed and represented as total minutes per week.

### Data Collection

Recruitment of potential participants and data collection took place from March to December 2019. Upon receiving ethics approval from Nanyang Technological University (ID: IRB-2018-12-009) and the Ministry of Education (ID: 39926), an invitation

<sup>1</sup>www.ipaq.ki.se

email was sent to 40 school principals to participate in this survey. Of those invited, 39 school principals agreed to invite their students to participate in this survey. After obtaining the written informed consent forms from 1,066 participants and their parents/guardians, the anonymous survey forms were administered to the participants in a quiet sports hall or classroom. The participants were encouraged to give honest responses. A total of 844 participants completed the survey and were included in the analysis.

## Data Analysis

We used the following approaches to clean our data. We identified missing data points in some of the scale items (up to 1.9% in each item) and replaced them using expectation-maximization algorithm. We recoded univariate outliers to the nearest acceptable values ( $Z < 3.29$ ). We did not identify any extreme multivariate outliers based on the results of Mahalanobis distance ( $p < 0.001$ ; 25). Following the data cleaning process, we conducted a series of confirmatory factor analyses to examine the factorial validity of the psychological measures used. We applied the method of maximum likelihood estimation with robust standard errors for correcting bias induced by multivariate non-normality (Satorra and Bentler, 2010). We used comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) to evaluate model fit. According to Hu and Bentler (1998), values for CFI/TLI greater than 0.90, values for RMSEA less than 0.06, and values for SRMR less than 0.08 are deemed acceptable. Furthermore, we computed internal reliability (Cronbach's  $\alpha$ ), descriptive statistics ( $M$  and  $SD$ ), and bivariate correlations for the major study variables.

Lastly, we used a person-centered approach (*i.e.*, LPA) to identify the optimal number of need profiles. We specified and estimated models with one to seven profiles using the six need satisfaction and need frustration subscale scores (*i.e.*, six need indicators). We used several fit measures to identify the best model: Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), Sample-Adjusted BIC (SABIC), Lo–Medell–Rubin Adjusted Likelihood Ratio Test (LALRT), and the bootstrap likelihood ratio test (BLRT). Lower values of AIC, BIC, and SABIC would suggest a better model fit. A statistically significant finding of LALRT and BLRT would suggest that the model ( $k + 1$  profile) is preferred to the model with one less profile ( $k$  profile). It is worthy to note that the BLRT result may always be statistically significant (Masyn, 2013). In addition to using these fit indices, we also considered values of entropy and average posterior probability, number of cases in a profile, and interpretability of the model for determining the optimal number of need profiles. Values for entropy higher than 0.60 and values for average posterior probability greater than 0.80 are considered acceptable (Nagin, 1999). A model containing a profile with less than 5% of the total sample was discarded (Masyn, 2013). To increase the interpretability of the six need indicators, we calculated their  $z$ -scores. Values of  $\pm 0.49$  SD were classified as average,  $\pm 0.5$  to  $0.99$  SD as high/low, and  $\pm 1$  SD as very high/low (Rouse et al., 2020).

Following the identification of the optimal number of need profiles, we conducted a series of Wald chi-square test to examine whether the identified need profiles were related to theoretically relevant correlates, including mindfulness, physical literacy, PA enjoyment, sedentary time, light PA time, and moderate-to-vigorous PA time (Asparouhov and Muthén, 2014). We cleaned our data and conducted preliminary analyses using IBM SPSS Statistics 25 (IBM, Armonk, NY, United States). We conducted the confirmatory factor analyses and LPA using Mplus 8 (Muthén and Muthén, 1998–2017).

## RESULTS

### Measurement Model

The results of confirmatory factor analysis supported the factorial validity of the psychological measures used. Specifically, the unidimensional model of the Child and Adolescent Mindfulness Measure had an adequate model fit:  $\chi^2(24) = 200.37$ , CFI = 0.927, TLI = 0.897, RMSEA = 0.079 [90% CI (0.069, 0.090)], SRMR = 0.052. The adequacy of the first-order six-factor measurement model of the Basic Psychological Needs Satisfaction and Frustration Scale was supported:  $\chi^2(237) = 600.36$ , CFI = 0.949, TLI = 0.940, RMSEA = 0.043 [90% CI (0.038, 0.047)], SRMR = 0.044. The second-order three-factor measurement model of the Perceived Physical Literacy Instrument demonstrated an adequate model fit:  $\chi^2(24) = 72.01$ , CFI = 0.984, TLI = 0.976, RMSEA = 0.049 [90% CI (0.036, 0.062)], SRMR = 0.024. Finally, the data fit the one-factor measurement model of PA Enjoyment Scale well:  $\chi^2(1) = 4.85$ , CFI = 0.999, TLI = 0.992, RMSEA = 0.0768 [90% CI (0.018, 0.133)], SRMR = 0.003.

### Descriptive Statistics

Table 1 shows the internal reliability estimates, means, standard deviations, and bivariate correlations for the major study variables. The scales/subscales demonstrated adequate to excellent internal reliability with the current sample ( $\alpha = 0.70$ – $0.95$ ). The participants reported a moderate level of need satisfaction and physical literacy, a slightly below average level of need frustration, an average level of mindfulness, and a relatively high level of PA enjoyment. Over a 1-week period, the participants reported 3,180.71 min of sedentary time, participated in 767.95 min of light PA, and engaged in 449.32 min of moderate-to-vigorous PA. In line with our expectation, need satisfaction subscale scores were positively related to physical literacy, PA enjoyment, and moderate-to-vigorous PA. However, there was a negative and weak association between autonomy satisfaction and mindfulness. The need frustration scale scores, as expected, were negatively associated with mindfulness.

### Need Profiles

Table 2 shows the model parameters of LPA. The six- and seven-profile models that contained a group size with less than 5% of the total sample were subsequently dropped. Although all the results of BLRT were significant, the result of BALRT only reached significance in the two-, three-, and four-profile models.

**TABLE 1 |** Descriptive statistics and zero-order correlations of the study variables.

	$\alpha$	M (SD)	Scale	1	2	3	4	5	6	7	8	9	10	11
Autonomy satisfaction	0.71	3.67 (0.71)	1–7	–										
Competence satisfaction	0.85	3.67 (0.80)	1–7	0.63**	–									
Relatedness satisfaction	0.84	3.93 (0.77)	1–7	0.53**	0.50**	–								
Autonomy frustration	0.70	2.72 (0.82)	1–7	–0.06	–0.10**	–0.09**	–							
Competence frustration	0.80	2.65 (0.94)	1–7	–0.09*	–0.30**	–0.19**	0.61**	–						
Relatedness frustration	0.81	2.29 (0.93)	1–7	–0.03	–0.07*	–0.28**	0.61**	0.64**	–					
Mindfulness	0.85	2.03 (0.80)	0–4	–0.14**	–0.001	–0.03	–0.31**	–0.44**	–0.34**	–				
Physical literacy	0.89	3.74 (0.71)	1–5	0.45**	0.64**	0.38**	–0.01	–0.18**	–0.02	–0.12**	–			
PA enjoyment	0.95	5.39 (0.71)	1–7	0.30**	0.34**	0.21**	–0.09**	–0.18**	–0.06	–0.04	0.42**	–		
Sedentary time	–	3,180.71 (1523.32)	–	–0.11**	–0.12**	–0.06	–0.01	0.05	–0.02	0.02	–0.13**	–0.12**	–	
Light PA	–	767.95 (925.31)	–	0.001	0.02	0.06	–0.001	0.02	0.04	–0.07*	0.06	0.09*	0.07*	–
Moderate-to-vigorous PA	–	449.34 (421.38)	–	0.18**	0.31**	0.15**	0.01	–0.09**	0.01	–0.05	0.41**	0.27**	–0.09**	0.18**

PA, physical activity.

\*\* $p < 0.01$ ; \* $p < 0.05$ .

The four-profile model had relatively lower values of AIC, BIC, and SBIC than the two- and three-profile models. Taking into further consideration factors of interpretability and its acceptable entropy and average posterior probability values, the four-profile model was finally selected.

**Figure 1** presents the characteristics of the four-profile model. Profile 3 was the most adaptive profile and was described as “very high satisfaction, very low frustration” ( $n = 144$ , 17.1%). In contrast, profile 2 was the least adaptive profile with “low satisfaction, above average frustration” ( $n = 251$ , 29.7%). Profile 1 was described as “average satisfaction and frustration” ( $n = 364$ , 44.1%). Finally, profile 4 was described as “high satisfaction, very high frustration” ( $n = 85$ , 10.1%).

## Correlates of Need Profiles

**Table 3** summarizes the descriptive statistics for need satisfaction or need frustration and correlates. The four identified profiles differed significantly in mindfulness, physical literacy, PA enjoyment, and moderate-to-vigorous PA (overall Wald  $\chi^2 = 5.67$ – $69.03$ ,  $p < 0.05$ ). The results of pairwise comparisons confirmed that profile 3 was the most adaptive profile, which had the highest levels of mindfulness, physical literacy, PA enjoyment, and moderate-to-vigorous PA. Profile 2 was the most maladaptive profile, which reported the lowest levels in three out of four significant correlates. Unexpectedly, there were no significant differences in sedentary time (overall Wald  $\chi^2 = 1.83$ ,  $p = 0.18$ ) and light PA (overall Wald  $\chi^2 = 0.05$ ,  $p = 0.82$ ) across the four identified profiles.

## DISCUSSION

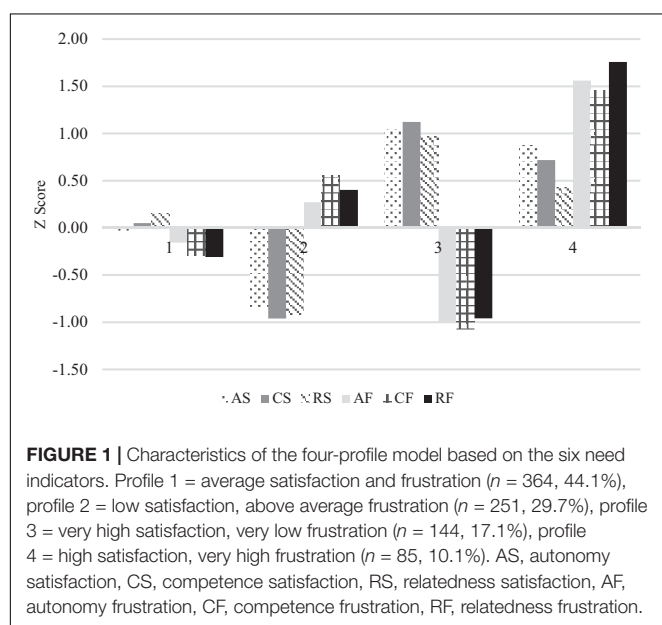
In extension of previous research, we examined the need profiles and their associations with theoretically relevant correlates in Singapore school students. Our findings revealed four distinct need profiles in the context of PA participation, including profile 1–average satisfaction and frustration; profile 2–low satisfaction, above average frustration; profile 3–very high satisfaction, very low frustration; and profile 4–high satisfaction, very high frustration. A more adaptive profile was characterized by a stronger presence of need satisfaction over need frustration (e.g., profile 3), whereas a less adaptive profile was characterized by need frustration prevailing over need satisfaction (e.g., profile 2). Furthermore, the participants from a more adaptive need profile generally reported a greater level of positive correlates than those from a less adaptive one.

In line with our expectations, more than two (*i.e.*, four) distinct need profiles emerged from LPA. The finding is similar to previous studies conducted in the contexts of work, physical education, and sport (Rouse et al., 2020; Warburton et al., 2020). In these studies, three to five need profiles were identified. The contextual differences may have contributed to the varied number of profiles that emerged across these studies. The emergence of several typical need profiles (e.g., high satisfaction–low frustration profile, low satisfaction–high frustration profile), however, suggests that there is a degree of stability and generalizability of the need profiles across the

**TABLE 2 |** Summary of model parameters for latent profile analysis.

<i>k</i>	AIC	BIC	SABIC	LALRT <i>p</i> -value	BLRT <i>p</i> -value	Group size ≤ 5%	Entropy	APP
1	12,431.11	12,487.96	12,449.86	–	–	0	–	–
2	11,681.20	11,771.23	11,710.89	0.04	<0.001	0	0.72	0.92
3	10,971.36	11,094.56	11,011.99	<0.001	<0.001	0	0.83	0.92
4	10,789.97	10,946.33	10,841.53	0.01	<0.001	0	0.78	0.88
5	10,671.48	10,861.00	10,733.98	0.61	<0.001	0	0.75	0.85
6	10,589.06	10,811.76	10,662.50	0.21	<0.001	1	0.78	0.86
7	10,505.45	10,761.31	10,589.82	0.17	<0.001	1	0.79	0.87

*k*, number of profiles; AIC, Akaike's Information Criterion; BIC, Bayesian Information Criterion; SABIC, sample-size-adjusted BIC; LALRT, Lo-Medell-Rubin adjusted likelihood ratio test; BLRT, bootstrapped likelihood ratio test; APP, average posterior probability.



contexts. While these typical need profiles provide some support for the asymmetrical hypothesis, there is still limited empirical evidence to fully support this proposition. For example, profile 4 (high satisfaction, very high frustration) was with both need satisfaction and need frustration scores above average, failing to support the asymmetrical hypothesis. The study of Rouse et al. (2020) also found a similar issue (e.g., very high competence satisfaction, high frustration). Hence, more studies are needed to test the asymmetrical hypothesis given the limited empirical evidence for it.

Previous research has shown that different need profiles were uniquely associated with varied levels of correlates such as anxiety, depression, motivation, and life satisfaction (Vansteenkiste et al., 2020). In line with and as an extension to previous research (Vansteenkiste and Ryan, 2013; Rouse et al., 2020; Vansteenkiste et al., 2020; Warburton et al., 2020), each of the four identified need profiles in the present study was found to have unique associations with mindfulness, physical literacy, PA enjoyment, and moderate-to-vigorous PA. However, the identified four need profiles showed no difference in light PA and sedentary behavior. Although mounting evidence

shows that moderate-to-vigorous PA leads to multiple health-related outcomes, there is still limited evidence supporting the association between light PA/sedentary behavior and its outcomes (Chaput et al., 2020). Thus, it could be possible that light PA and sedentary behavior are not a sensitive correlate of need profile in comparison to moderate-to-vigorous PA. More studies are warranted to confirm this possibility.

The present findings showed that profile 3 (very high satisfaction, very low frustration) was the most adaptive, which had the highest level of mindfulness, physical literacy, PA enjoyment, and moderate-to-vigorous PA among the four identified profiles. In contrast, profile 2 (low satisfaction, above average frustration) was the least adaptive profile, as it had the lowest levels of mindfulness, PA enjoyment, and moderate-to-vigorous PA. Interestingly, although profile 4 (high satisfaction, very high frustration) had the highest need frustration score, it is still more adaptive than profile 1 (average satisfaction and frustration) and profile 2 (low satisfaction, above average frustration). Further inspection of the need scores across these three profiles indicated that profile 4 (high satisfaction, very high frustration) had the highest need satisfaction score albeit with the highest need frustration score. This would suggest that a high need satisfaction score might be necessary for optimal human functioning. This finding further suggests that high need satisfaction could protect or offset the negative effects of very high need frustration on human functioning. According to Warburton et al. (2020), experiences of high need frustration were less detrimental to enjoyment and well-being when athletes experienced moderate levels of need satisfaction. Thus, experiences of need frustration may not necessarily be maladaptive, and it is important to simultaneously examine the interplay between need satisfaction and need frustration.

## Practical Implications

There are significant implications that we can recommend based on the findings and discussion outlined above. The use of the person-centered approach can help practitioners identify student groups that are at risk of dysfunction. In our study, about one-third (29.7%) of the participants was from profile 2 (low satisfaction, above average frustration), the least adaptive profile. To facilitate optimal student functioning, it is recommended to alter the PA environment to reduce students' experiences of need frustration. Furthermore, given the



**TABLE 3 |** Descriptive statistics for need satisfaction/frustration and correlates.

Variables	Profile 1 Average satisfaction and frustration		Profile 2 Low satisfaction, above average frustration		Profile 3 Very high satisfaction, very low frustration		Profile 4 High satisfaction, very high frustration		Pairwise comparisons between profiles <sup>a</sup>
	<i>M</i> (SD)	<i>Z</i>	<i>M</i> (SD)	<i>Z</i>	<i>M</i> (SD)	<i>Z</i>	<i>M</i> (SD)	<i>Z</i>	
Indicators									
Autonomy satisfaction	3.64 (0.52)	−0.04	3.07 (0.54)	−0.85	4.43 (0.44)	1.07	4.30 (0.50)	0.87	–
Competence satisfaction	3.71 (0.57)	0.05	2.90 (0.55)	−0.96	4.57 (0.42)	1.12	4.24 (0.55)	0.72	–
Relatedness satisfaction	4.04 (0.55)	0.15	3.22 (0.67)	−0.92	4.67 (0.44)	0.97	4.25 (0.55)	0.43	–
Autonomy frustration	2.60 (0.58)	−0.16	2.95 (0.62)	0.27	1.91 (0.63)	−1.00	4.00 (0.64)	1.56	–
Competence frustration	2.37 (0.63)	−0.30	3.17 (0.71)	0.56	1.63 (0.52)	−1.08	4.01 (0.64)	1.45	–
Relatedness frustration	2.01 (0.60)	−0.31	2.67 (0.68)	0.40	1.40 (0.50)	−0.96	3.93 (0.69)	1.76	–
Correlates									
Mindfulness	2.14 (0.74)	–	1.94 (0.74)	–	2.30 (0.78)	–	1.42 (0.95)	–	3 = 4 > 1 > 2
Physical literacy	3.77 (0.56)	–	3.24 (0.68)	–	4.24 (0.51)	–	4.24 (0.64)	–	3 > 1 > 2 > 4
PA enjoyment	5.45 (0.64)	–	4.74 (1.43)	–	6.19 (1.32)	–	5.74 (1.63)	–	3 > 4 <sup>b</sup> = 1 > 2
Sedentary time	3,153.38 (1411.11)	–	3,418.43 (1683.15)	–	3,064.74 (1441.19)	–	2,792.26 (1538.76)	–	– <sup>c</sup>
Light PA	737.97 (836.70)	–	783.18 (1002.34)	–	795.09 (990.83)	–	805.35 (947.95)	–	– <sup>c</sup>
Moderate-to-vigorous PA	444.99 (421.45)	–	327.53 (372.38)	–	607.57 (445.26)	–	559.55 (405.62)	–	3 = 4 > 1 > 2

PA, physical activity.

<sup>a</sup>All the differences are significant at the level of  $p < 0.05$  (two-tailed) if not otherwise specified.

<sup>b</sup>There is a trend that profile 3 has a higher level of PA enjoyment than that of profile 4 ( $p = 0.05$ ).

<sup>c</sup>The result of the overall Wald test is not significant.

protective role of need satisfaction in alleviating the negative effects of need frustration on student functioning, it is more important to enhance the students' need satisfaction. Approaches such as use of non-controlling language that conveys freedom of choice, acknowledging one's perspective, and assisting in identifying realistic goals can be used to prompt need satisfaction (Teixeira et al., 2020).

## Limitations and Future Research

Despite contributing to the BPNT literature and providing practical implications, the present study is subject to some limitations. Firstly, we examined need profiles in the context of PA participation with Singapore school students; generalization of our study findings is therefore limited. Further studies should examine the different life domains, countries, and school levels to collaborate and extend the present study findings. Secondly, the use of a cross-sectional survey design prevents us from inferring casual associations between need profiles and their correlates. Future research can use a prospective survey design to examine the predictability of need profiles on the same and additional correlates that are important for human functioning. By employing this approach, we can also examine how need satisfaction and need frustration associate and influence each other. Future research can even use an experimental approach to examine the causal associations. Finally, we exclusively relied on using self-report measures that would potentially bias the results of the study. It is therefore useful for future research to employ objective measures to assess some of the study variables (e.g., use heart rate monitors or accelerometers to measure PA).

## CONCLUSION

In summary, our person-centered analyses revealed four combinations of need satisfaction and need frustration in a PA setting (*i.e.*, profile 1—average satisfaction and frustration; profile 2—low satisfaction, above average frustration; profile 3—very high satisfaction, very low frustration; and profile 4—high satisfaction, very high frustration). The identified combinations (need profiles) were strongly related to several correlates, including mindfulness, physical literacy, physical activity enjoyment, and moderate-to-vigorous physical activity. Although the

asymmetrical relationship between need satisfaction and need frustration was not fully supported, experiences of need satisfaction countered the negative effects of need frustration on the correlates. These findings enhance our understanding of psychological need experiences. The findings also highlight the need for further investigation of the combined associations between need satisfaction and need frustration, which could provide unique and complementary explanations to human functioning.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Nanyang Technological University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

All authors were involved in manuscript preparation and approved the final version for submission.

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# Influence of Psychological Factors in Federated Futsal and Lifeguard Athletes, Differences by Gender and Category

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This research aims to analyse the differences in optimism, resilience, engagement and competitive anxiety as a function of the sport modality practiced in lifeguarding (individual sport) and futsal (team sport); the sport category by age (cadet or youth) and gender. The LOT-R optimism questionnaire, the Connor-Davidson Resilience Scale (CD-RISC-10), the Utrecht Work Engagement Scale (UWES) and the Competitive Anxiety Scale (SAS-2) were applied to a sample of 189 participants (139 men and 50 women) aged between 14 and 17 years. The following statistical tests are performed: Cronbach's alpha, Pearson's linear correlation, Student's t-test, Kolmogorov-Smirnov test, Levene's test and multivariate linear regression. The data indicate that there are significant gender differences in total anxiety ( $p < 0.001$ ) and all its dimensions (somatic, worry, worry-free), also in optimism and pessimism ( $p < 0.001$ ), as well as in total engagement ( $p = 0.051$ ) and the absorption dimension ( $p < 0.001$ ). When comparing the sample by sport categories, there are statistically significant differences in somatic anxiety ( $p = 0.036$ ) and deconcentration ( $p = 0.034$ ), as well as in LOT-total ( $p \leq 0.001$ ) and pessimism ( $p \leq 0.001$ ). In relation to the sport modalities, lifeguards show more anxiety 38.39 (0.49) and more commitment 4.58 (0.87) while futsal athletes reach higher scores in deconcentration 8.45 (2.29). It is concluded that the variables of commitment and resilience had a statistically significant positive effect, and the category of  $< 16$  years had a statistically significant negative effect, so the lower the category, the higher the optimism.

**Keywords:** optimism, competitive anxiety, engagement, resilience, sport, federated

## INTRODUCTION

Sport research related to stress and well-being factors has been widely developed in recent years (López, 2015; Barbosa and Urrea, 2018), considered as important in different sports (Moreno-Murcia et al., 2006; Cano et al., 2019). Previous studies have highlighted the importance of optimism as a facilitating aspect of resilience (Ferrando et al., 2002; Aranzana et al., 2016; Martínez-Moreno et al., 2020), and competitive stress as a possible inducer of specific development in sport training stages, while also predicting how combinations of other variables could influence the athlete. It is the resilience and optimism of the individual coping strategies, which the athlete uses,



that most help him or her (Galli and Vealey, 2008; Fletcher and Sarkar, 2012; García et al., 2014). Some research (Almagro et al., 2011) has indicated the importance of the perceived climate, in training or with peers, of motivation to improve results, as well as the importance of resilience in sport (García et al., 2014). However, they jointly neglect, from a positive point of view, feelings of resilience, optimism and engagement, as well as from a negative point of view, competitive anxiety and perceived stress in sport.

The present study contributes to the literature on psychological elements affecting athletes by examining the competitive context in the disciplines of lifeguarding, individual sport and futsal team sport.

First, the constructs, anxiety, resilience, optimism and engagement are analyzed in the sport domain.

## Anxiety, Types and Effects on Sportsmen and Sportswomen

Athletes during competitions are exposed to an environment conducive to generate anxiety symptoms. Anxiety can be defined as a future emotional state characterized by a sense of apprehension, worry and lack of control over one's emotional response (Otto et al., 2010). The term competitive anxiety was coined by Martens (1977) to refer to sport-specific anxiety. Competitive anxiety, which has been examined globally, is now considered an emergent and transient property of the athlete with respect to competition (Anshel, 1995), with two levels of response, which are cognitive and somatic (Ramis et al., 2010). In this direction, Weinberg and Gould (2010) differentiate on the one hand trait anxiety is seen as an acquired behavioral tendency or inclination and is part of the personality or character of athletes. On the other hand, state anxiety is seen as a constantly changing emotional component. These different dimensions of competitive state anxiety may be independently and differentially related to performance (Liştea et al., 2017). Anxiety is considered an endogenous determinant of attention (Castillo, 2009). Therefore, attention should be considered essential as competitive situations will always generate a degree of anxiety in athletes that may affect their performance due to the impairment of the attentional process (Moran, 2012). The study of competitive anxiety is very relevant given its impact -especially when negative- on athletes' performance and has a long history in sport psychology from its beginnings (Smith et al., 1990) to more recent research (Ponseti et al., 2016; González et al., 2017; Castro-Sánchez and Zurita-Ortega, 2019; Castro-Sánchez et al., 2020; Jaramillo et al., 2020; Núñez et al., 2020). Anxiety responses are accompanied by increased physiological arousal, mediated by the autonomic nervous system (Cashmore, 2008). Anxiety in sport has been extensively analyzed in different studies (Hamidi and Besharat, 2010; Correia and Rosado, 2018), as well as in sport performance being of great interest to researchers and coaches (Liştea et al., 2017).

## Resilience in Sport

Resilience has become increasingly important in recent years in the field of sport (Zurita-Ortega et al., 2018). According to the theory of Fletcher and Sarkar (2012), based on psychological

resilience in Olympic champions, it would be the positive evaluation of the stressful situation shaped by a positive personality, motivation, confidence, concentration and social support, which provide effective decisions and reflections aimed at commitment to the task and increased effort. Therefore, a high level of resilience allows for greater and better adaptation to the euphoria of victory or the disappointment of defeat, using more adaptive coping strategies (García et al., 2014). Being resilient can improve sport performance and vice versa (Chacón-Cuberos et al., 2016). Providing resilience and perseverance leads to greater emotional calm and better planning (Laborde et al., 2017). The capacity to be resilient is twofold, one of which is resilience in the face of conflict, and the other is a positive behavior or attitude toward conflict (Vanistendael and Lecomte, 2002). Together with the optimistic person who has a more adaptive approach to reality than the pessimist (Flórez-Lozano, 2006), we can feel the contribution that optimism makes to resilience (Scheier and Carver, 2003), feeding into it to achieve greater resilience.

## Optimism and Sport

Based on the trait theory formulated by Scheier and Carver (1985), optimists are people who have positive expectations and perceptions about their life, while pessimists tend to represent their life negatively and the future as undesirable. Based on Scheier and Carver (2003) guidelines on dispositional optimism, having positive expectations in the face of difficulties increases efforts, and vice versa. Optimism, as a personality construct, is present in athletes and women in pressure situations (Seligman, 2004). When the athlete or woman shows more optimism, she or he presents better sports results and a higher performance (García-Naveira and Díaz, 2010; Londoño et al., 2011). Several studies have pointed out the relationship between resilience and optimism (Yu and Zhang, 2007; Parkes and Mallet, 2011; Sourri and Hasanirad, 2011; González-Arratia et al., 2012; Freche, 2013). For Ortín et al. (2013) adolescent handball players with an optimistic profile present less anxiety-state, as well as older players are more optimistic than younger players (García-Naveira, 2008).

## Sport Engagement

The above elements or variables, together with engagement, can help or harm athletes if they are not taken into account. Engagement would be a persistent motivational state experienced by athletes in relation to their sport practice and would involve three dimensions: vigor, dedication and absorption. The vigor dimension refers to high levels of energy, high persistence and a strong desire to put effort into training/competition. Dedication is identified with high levels of meaning associated with training/competition, as well as pride and identification with the sport they are playing. Finally, absorption implies high levels of concentration along with the feeling that time is flying by and one is carried away (Schaufeli et al., 2001). Engagement is an optimal state in sport and a type of well-being, which can influence performance as it is one of the components of mental toughness (Crust, 2007). Very little work has applied the study of engagement in the sport domain (Lonsdale et al., 2007b; Hodge et al., 2009; De Freese and Smith, 2013) and it needs to be studied

to learn more about how it relates to other aspects (Lonsdale et al., 2007a).

## Rationale for the Research

The basis for this research is that some studies have focused on individual sports (Cano et al., 2019), such as swimming, or group sports (Ruiz et al., 2012) such as football. Recently two studies have compared individual and team sports (Reche et al., 2019; Reche-García et al., 2020) but not lifesaving and futsal, which are addressed in this study. It is clear from the scientific literature that individual sports athletes have different characteristics from team sports athletes, in relation to personality (Nia and Besharat, 2010; Raharjo et al., 2018), in terms of the use of mental skills (Kajbafnezhad et al., 2011) in mental toughness (Kumar, 2017) in relation to manifesting anxiety and depression are athletes in individual sports are more likely to present them than those in team sports (Pluhar et al., 2019), in addition in team sports passion profiles are higher than those of individual sports (Kovacsik et al., 2020).

Lifeguarding is based on individual performances with which the participants achieve an individual result and at the same time award points in a ranking to their team, but unlike futsal, there is no collaboration, no joint strategy, no zone defense or collective attack, not even a possibility of verbal communication that takes place in an aquatic environment. Some of the events that take place in the swimming pool are: 200 m hurdles, 100 m combined, 100 m fins, 4 × 50 rescue tube, 4 × 50 hurdles, etc.

Therefore, the working hypotheses will be:

H1, men have less anxiety, commitment and resilience than girls.

H2, youth athletes are more optimistic than cadet athletes.

H3, futsal athletes (collective sport) show lower levels of commitment and resilience than lifeguards (individual sport).

H4, futsal players have less anxiety than lifeguards.

All of the above leads us to the objective of the study, which focuses on finding out the existing differences between lifesaving (individual sport) and futsal (team sport) from a psychological perspective, as well as determining differences in relation to the sporting categories, sex and age of the participants, providing answers to the different hypotheses put forward.

## MATERIALS AND METHODS

### Design and Participants

A cross-sectional, observational and quantitative design was carried out, selecting the sample in a non-probabilistic or intentional way. The study, **Table 1**, consisted of a total of 189 young lifeguards and futsal players, corresponding to the youth categories, under 18 years of age (16–17) and cadets, under 16 years of age (14–15). Of which 103 participants were lifeguards and 86 futsal players, 50 girls and the remaining 139 men.

### Procedure

All the athletes were asked, through their coaches, to collaborate in the research. All the minors, in the lifeguard modality, in the course of the processing of the sports license for the year included a section in which they accepted to participate as

sample subjects in possible non-invasive studies that could be carried out. Once informed consent had been obtained from the parents/guardians/legal guardians of the futsal players, all those who wished to participate in the study filled in the questionnaires prior to the celebration of a Spanish championship for the lifeguards and before a league match for the futsal players. Data were collected before the covid-19 pandemic, from the lifesaving athletes, on the day of the competition, in an after-breakfast meeting, all were concentrated in a hotel, and from the futsal players, before the pre-match talk, about 2 h before the lifesaving competition and matches. Their preparation and level of physical work was part of the peak performance phase, taking into account that all participants trained 3–4 h per week. The study was conducted under the guidelines of the Declaration of Helsinki, the design, observational, did not contain any ethical aspects that required prior authorization from the Bioethics Committee of the University of Murcia, Spain.

## Instruments

The questionnaire consisted of a total of 54 items comprised of four separate and established questionnaires measuring resilience, competitive anxiety, optimism and engagement, as well as socio-demographic data. Resilience (RS) was measured using the Connor-Davidson Resilience Scale (CD-RISC-10) (Serrano-Parra et al., 2012). The scale has an internal consistency Cronbach's alpha of 0.89 and with a single dimension consisted of 10 statements (e.g., "I know how to adapt to change") with participants responding on a five-point Likert scale, ranging from 0 ("Strongly disagree") to 4 ("Strongly agree").

The Competitive Anxiety Scale (SAS-2) (Ramis et al., 2010) was used to measure anxiety, with an internal consistency using Cronbach's alpha coefficient of 0.83 for the somatic (AS) subscale, 0.78 for the worry subscale (A-C) and 0.73 for the deconcentration (A-D) subscale. It consists of 15 statements preceded by the phrase "Before the competition..." (e.g., "... I find it difficult to concentrate on the match or competition"). Responses were again given on a four-point Likert scale, ranging from 1 ("Nothing") to 4 ("Much"). Somatic anxiety is understood as anxiety that is perceived by the athlete for no apparent reason, worry anxiety as anxiety that can be justified by a specific situation, deconcentration anxiety as anxiety that due to its importance reduces the involvement in the task at hand and total anxiety as the final result of linking all of them together.

Optimism was assessed with the Life Orientation Test-Revised (LOT-R) (Scheier et al., 1994) in its Spanish version (Ferrando et al., 2002), to measure dispositional optimism or generalized predisposition toward expectations of positive outcomes. The LOT-R has good psychometric properties, Cronbach's reliability of 0.70 and 0.69 for optimism and pessimism respectively. The LOT-R questionnaire consists of 10 items (e.g., "In difficult times, I usually hope for the best"), of which four are control items and of the remaining six, three are written in a positive direction (optimistic direction) and three in a negative direction (pessimistic direction) with responses given on a five-point Likert scale, ranging from 0 ("Strongly disagree") to 4 ("Strongly agree"). Likewise, LOT-R Optimism (LOT-O) is understood as the ability of the athlete or woman to have a positive view of situations,

**TABLE 1** | Descriptive statistics of the sample.

	<i>n</i>	%
<b>Sex</b>		
Female	50	26.5
Male	139	73.5
<b>Sport</b>		
Futsal	86	45.5
Lifeguard	103	54.5
<b>Category</b>		
Youth	86	45.5
Cadets	103	54.5

LOT-R Pessimism (LOT-P) as the ability to see the negative side of situations and LOT-R Total (LOT-T) as a combination of both. For the sample analyzed, optimism obtained a Cronbach's alpha of 0.79 and for pessimism 0.84.

The engagement questionnaire was the Utrecht Work Engagement Scale (UWES) (Guillén and Martínez-Alvarado, 2014), with a Cronbach's alpha reliability of 0.93 and consisting of 9 items. This questionnaire measures the three dimensions of engagement, which are vigor (UWES-V) (e.g., "I feel energized at work"), dedication (UWES-D) (e.g., "My work inspires me") and absorption (UWES-A) (e.g., "I feel disengaged when I am working"). Each item is answered on a Likert-type scale, ranging from 0 ("Never") to 6 ("Always").

## Statistical Analysis

For the descriptive statistical analysis of the sample, the number of cases present in each category and the corresponding percentages of the qualitative variables were obtained. For the quantitative variables, the following descriptive statistics were used: minimum, maximum, mean and standard deviation (SD). Cronbach's alpha was calculated in order to check the reliability of the different scales within this particular sample, and correlations between variables were calculated using Pearson's linear correlation coefficient (*r*). In addition, for quantitative variables, the t-Student test was performed for the comparisons of means between two groups. Assumptions of normality and uniformity of the variances required for mean comparisons were tested using the Kolmogorov-Smirnov test and the Levene test, respectively. Finally, a multivariate linear regression model was developed to determine the possible effects of sex (male or female), sport modality (lifeguards or futsal) and category (cadet or youth) on the resilience, anxiety and engagement scales. Statistical analyses were performed using SPSS 25.0 for Windows (IBM, New York, NY, USA). Statistical significance was defined as  $p < 0.05$ .

## RESULTS

The mean (typical deviations), Cronbach's alpha reliability indexes, and the correlations between the different subscales of the questionnaires used that address each variable chosen.

Internal consistency rates were all higher than 0.79, indicating high reliability.

In **Table 2**, we can see that A-T correlated statistically significantly and positively with A-S, A-C, total engagement (UWES-T), UWES-D and UWES-A dimensions. But negatively and statistically significantly with LOT-O and LOT-P. A-S correlated positively and statistically significantly with A-C, UWES-T, UWES-D and UWES-A and significantly but negatively with A-D, LOT-O and LOT-P. A-C had a positive and statistically significant relationship with UWES-T, UWES-D and UWES-A and was negatively correlated with A-D, LOT-O and LOT-P. The A-D dimension showed a positive and significant correlation with the LOT-O and LOT-P and had a negative correlation with LOT-T, UWES-T, UWES-D, UWES-A and RS.

As for the LOT-R scale, the LOT-T correlated positively and statistically significantly with the LOT-O, UWES-T, UWES-V, UWES-D, UWES-A and RS, however, it correlated negatively and statistically significantly with the LOT-P. The LOT-O dimension was positively and statistically significantly correlated with LOT-P and SR and negatively and statistically significantly correlated with UWES-A. The LOT-P dimension had a negative and statistically significant relationship with the UWES-T, UWES-D, UWES-A and resilience.

The UWES-T showed positive and statistically significant differences with the UWES-V, UWES-D, UWES-A and SR. The UWES-V dimension showed positive and statistically significant differences with UWES-D, UWES-A and RS, and the UWES-D dimension showed positive and statistically significant differences with UWES-A and RS.

Focusing on the differences between males and females in the sample, **Table 3** presents the results of the SAS-2, LOT-R, UWES and RS scales based on gender. There were statistically significant and positive differences in terms of A-T, A-S and A-C, with males reaching higher values, while there were statistically significant and negative differences in favor of females in terms of A-D. LOT-O and LOT-P also showed positive and statistically significant differences in favor of girls. Finally, there were also statistically significant differences in relation to UWES-T, where boys scored higher, as well as in relation to UWES-A, where girls scored higher.

Regarding the sport category variable, higher A-S was found in the juvenile group (<18 years) and higher A-D in the cadets (<16 years), as shown in **Table 4**. The juvenile group scored higher on LOT-T, while the cadets scored higher on LOT-P. There were no differences in any of the engagement dimensions, but the juvenile group had a higher RS ability than the cadets.

When the sample was divided according to sport modality (lifeguard/futsal), there were statistically significant differences between the groups in A-T, and its dimensions, A-S, A-C and A-D, **Table 5**. A-T, A-S and A-C were higher in the lifeguard group, while A-D was higher in the futsal group. There were statistically significant differences in LOT-T, LOT-O and LOT-P, with the lifeguard group scoring higher in terms of LOT-T, but in LOT-O and the LOT-P, the highest scores were found in the futsal group. In the UWES-T scale, as well as in its dimensions UWES-D and UWES-A, statistically significant differences were found, where the lifeguard group had higher

**TABLE 2 |** Means, standard deviations, reliability and Pearson's correlation of the scales.

	Mean (SD)	Cronbach's Alpha	A-T	A-S	A-C	A-D	LOT-T	LOT-O	LOT-P	UWES-T	UWES-V	UWES-D	UWES-A
A-T	34.8 (5.66)	0.855	1										
A-S	10.99 (3.1)	0.801	0.892**	1									
A-C	16.66 (3.6)	0.794	0.852**	0.762**	1								
A-D	7.15 (2.36)	0.866	-0.076	-0.338**	-0.483**	1							
LOT-T	15.47 (2.8)	0.835	-0.021	0.092	0.102	-0.327**	1						
LOT-O	6.7 (2.31)	0.791	-0.474**	-0.558**	-0.506**	0.370**	0.484**	1					
LOT-P	3.23 (2.63)	0.845	-0.394**	-0.588**	-0.553**	0.672**	-0.639**	0.364**	1				
UWES-T	4.39 (0.98)	0.811	0.199**	0.266**	0.235**	-0.232**	0.300**	-0.033	-0.348**	1			
UWES-V	4.05 (1.21)	0.859	-0.027	-0.019	0.005	-0.048	0.188**	0.12	-0.095	0.856**	1		
UWES-D	4.48 (1.03)	0.881	0.157*	0.234**	0.205**	-0.243**	0.317**	-0.014	-0.350**	0.935**	0.751**	1	
UWES-A	4.63 (1.14)	0.832	0.401**	0.497**	0.417**	-0.328**	0.289**	-0.200**	-0.483**	0.831**	0.472**	0.716**	1
Resilience	27.51 (4.26)	0.794	-0.121	0.001	-0.026	-0.264**	0.460**	0.254**	-0.266**	0.170*	0.265**	0.162*	0.011

A-T, Anxiety Total; A-S, Anxiety Somatic; A-C, Anxiety Concentration; A-D, Anxiety Deconcentration; LOT-T, Lot Total; LOT-O, Lot Optimism; LOT-P, Lot Pessimism; UWES-T, UWES Total; UWES-V, UWES Vigor; UWES-D, UWES Dedication; UWES-A, UWES Absorption. \* $p < 0.05$ , \*\* $p < 0.01$ .

**TABLE 3 |** Correlations of anxiety, LOT, UWES and resilience in relation to sex.

	Sex		Mean difference	Test <i>t</i> -student		<i>d</i>
	Men ( <i>n</i> = 139)	Women ( <i>n</i> = 50)		<i>t</i> <sub>(379)</sub>	<i>p</i> -value	
<b>Anxiety</b>						
Total	38.36 (0.48)	33.53 (6.11)	4.83	5.581	<b>&lt;0.001</b>	0.63
Somatic	13.36 (0.48)	10.14 (3.21)	3.22	7.051	<b>&lt;0.001</b>	0.80
Concern	18.96 (1.80)	15.83 (3.73)	3.13	5.702	<b>&lt;0.001</b>	0.64
Deconcentration	6.04 (1.80)	7.55 (2.41)	−1.51	−4.047	<b>&lt;0.001</b>	−0.46
<b>LOT</b>						
Total	15.96 (0.73)	15.29 (3.22)	0.67	1.461	0.146	0.17
Optimism	5.44 (1.15)	7.15 (2.46)	−1.71	−4.74	<b>&lt;0.001</b>	−0.54
Pessimism	1.48 (1.31)	3.86 (2.70)	−2.38	−5.984	<b>&lt;0.001</b>	−0.68
<b>UWES</b>						
Total	4.62 (0.86)	4.31 (1.01)	0.32	1.965	<b>0.051</b>	0.22
Vigor	3.96 (1.21)	4.08 (1.22)	−0.12	−0.618	0.537	−0.07
Dedication	4.71 (0.82)	4.40 (1.09)	0.30	1.8	0.073	0.20
Absorption	5.20 (0.82)	4.43 (1.17)	0.77	4.271	<b>&lt;0.001</b>	0.48
<b>Resilience</b>	27.72 (2.96)	27.43 (4.64)	0.29	0.41	0.682	0.05

$p < 0.001$ . The bold values indicates statistically significant differences.

scores than the futsal group in these three dimensions. There were no significant differences in the remaining dimensions of the scales.

To determine in LOT-R the effects of the variables sex, type of sport (lifeguard-futsal) and sport category (<18 and <16 years) and anxiety, UWES and RS, a linear regression was performed. The results are shown in **Table 6**, the model was statistically significant  $F_{(6;182)} = 14.1$ ;  $p < 0.001$ , explaining 31.7% of the explanatory variance. The variables of commitment and resilience had a significant positive effect, and the category of <16 years had a significant negative effect, so the lower the category, the higher the optimism.

## DISCUSSION

In sport competition, it is essential to know and control the factors (physical, technical and psychological) that influence performance (Morillo et al., 2016). Going deeper into what Cerin (2003) indicates that the pre-competitive state of the athlete must be analyzed from an interconductual approach to human behavior, which includes other related emotions in addition to anxiety, taking the field model as a reference, looking for relationships with other variables.

The aim of the study focuses on finding out the existing differences between the lifesaving (individual sport) and futsal (team sport) modalities; from a psychological perspective, as well



**TABLE 4 |** Correlations of anxiety, LOT, UWES and resilience in relation to category.

	Category		Average difference	Test t-student		d
	Youth (n = 86)	Cadets (n = 103)		t <sub>(379)</sub>	p-value	
<b>Anxiety</b>						
Total	35.36 (5.07)	34.34 (6.09)	1.02	1.237	0.218	0.14
Somatic	11.51 (2.92)	10.56 (3.20)	0.95	2.111	<b>0.036</b>	0.24
Concern	17.09 (3.47)	16.29 (3.68)	0.80	1.53	0.128	0.17
Deconcentration	6.76 (2.05)	7.49 (2.55)	−0.73	−2.137	<b>0.034</b>	−0.24
<b>LOT</b>						
Total	16.36 (2.20)	14.72 (3.03)	1.64	4.189	<b>&lt;0.001</b>	0.47
Optimism	6.79 (2.45)	6.62 (2.20)	0.17	0.501	0.617	0.06
Pessimism	2.43 (2.09)	3.90 (2.85)	−1.47	−3.983	<b>&lt;0.001</b>	−0.45
<b>UWES</b>						
Total	4.46 (0.89)	4.33 (1.05)	0.13	0.913	0.362	0.10
Vigor	4.04 (1.17)	4.06 (1.25)	−0.02	−0.088	0.93	−0.01
Dedication	4.55 (0.92)	4.43 (1.11)	0.12	0.771	0.442	0.09
Absorption	4.79 (1.01)	4.50 (1.23)	0.29	1.769	0.078	0.20
<b>Resilience</b>	28.31 (3.89)	26.84 (4.45)	1.48	2.408	<b>0.017</b>	0.27

$p < 0.001$ . The bold values indicates statistically significant differences.

**TABLE 5 |** Correlation anxiety, LOT, UWES, and resilience depending on the sport modality.

	Sport		Average difference	Test <i>t</i> -student		<i>d</i>
	Futsal ( <i>n</i> = 86)	Lifeguard ( <i>n</i> = 103)		<i>t</i> <sub>(379)</sub>	<i>p</i> -value	
<b>Anxiety</b>						
Total	30.51 (6.03)	38.39 (0.49)	−7.88	−13.219	<b>&lt;0.001</b>	−1.49
Somatic	8.13 (2.40)	13.39 (0.49)	−5.26	−21.721	<b>&lt;0.001</b>	−2.46
Concern	13.93 (3.31)	18.93 (1.81)	−5.00	−13.17	<b>&lt;0.001</b>	−1.49
Deconcentration	8.45 (2.29)	6.07 (1.81)	2.39	7.997	<b>&lt; 0.001</b>	0.90
<b>LOT</b>						
Total	14.97 (4.03)	15.88 (0.72)	−0.92	−2.271	<b>0.024</b>	−0.26
Optimism	8.27 (2.37)	5.39 (1.17)	2.88	10.866	<b>&lt;0.001</b>	1.23
Pessimism	5.30 (2.30)	1.50 (1.31)	3.80	14.233	<b>&lt;0.001</b>	1.61
<b>UWES</b>						
Total	4.17 (1.07)	4.58 (0.87)	0.41	−2.89	<b>0.004</b>	−0.33
Vigor	4.18 (1.24)	3.95 (1.19)	0.23	1.319	0.189	0.15
Dedication	4.27 (1.20)	4.66 (0.83)	−0.39	−2.627	<b>0.009</b>	−0.30
Absorption	4.05 (1.19)	5.12 (0.83)	−1.07	−7.217	<b>&lt;0.001</b>	−0.82
<b>Resilience</b>	27.00 (5.49)	27.93 (2.81)	−0.93	−1.503	0.134	−0.17

$p < 0.001$ . The bold values indicates statistically significant differences.

as determining differences in relation to the sport categories, sex and age of the participants, responding to the different hypotheses put forward.

On analyzing the correlations of the different scales used in the study, we found a relationship between the level of LOT-T and SR, as well as between the UWES-T and SR. Likewise, we found a negative correlation between the level of A-D and SR, data that support previous studies Trigueros et al. (2020) and Reche et al. (2018). In addition, the study has provided other interesting data such as a correlation between LOT-O level

and UWES-D level with SR, supporting previous studies such as Vallarino and Reche-García (2016) with hockey players and Ruiz et al. (2012) with football players; Trigueros et al. (2020) with volleyball players and Reche et al. (2018) with fencers. Similarly, we found a negative correlation between the level of A-D and RS, which was again consistent with the findings of previous studies Reche et al. (2019).

The present data reflected a higher level of A-T and UWES-T in boys, as well as lower levels of A-D and higher levels of LOT-O in girls. Thus, partly corroborating H1, boys have lower A-T,

**TABLE 6 |** Linear regression.

	<i>B</i> (ET)	Beta	<i>t</i>	<i>p</i> -value
Sex (Male, Female)	−0.37 (0.47)	−0.059	−0.8	0.425
Sport (Lifeguard, Futsal)	0.53 (0.56)	0.095	0.958	0.339
Category (Cadets, Youth)	−1.17 (0.36)	−0.209	−3.276	<b>0.001</b>
UWES	0.63 (0.18)	0.222	3.48	<b>0.001</b>
Anxiety	−0.06 (0.04)	−0.129	−1.441	0.151
Resilience	0.24 (0.04)	0.358	5.433	<b>&lt;0.001</b>

$F_{(6,182)} = 14.1$ ;  $p < 0.001$ ;  $R^2 = 0.317$ . The bold values indicates statistically significant differences.

UWES-T and RS than girls. This finding is in line with some previous studies (Martens et al., 1990; Clifton and Gill, 1994) and at the same time does not agree with Reche et al. (2018) and Aranzana et al. (2016) who found no differences between sexes. As for the second part of the hypothesis, it is not corroborated, as girls have higher LOT-O scores, a fact explained by Stach (2006) in sociobiological terms: women, as the mother of the species, must find support mainly in themselves and in their own activities. These data are in opposition to other studies, albeit conducted in the academic field, where Extremera et al. (2007) found that male students showed a stronger optimistic tendency than female students. However, some studies have found that there were no gender differences, for example: Tan and Tan (2014), Aranzana et al. (2016), Hinz et al. (2017), Reche et al. (2018), and Cnen et al. (2020). Furthermore, other authors indicate differences in the interpretation of symptoms in relation to the type of sport and competition experience (Mellalieu et al., 2004). Thus, this variability of data could be marked by the cross-sectional nature and sport modalities of the study, and further longitudinal studies are needed to clarify the nature of these differences.

When analyzing the data according to sport categories: youth (<18 years) and cadets (<16 years), the data show a similar result to previous studies, such as those of Vallarino and Reche-García (2016), who found a higher level of optimism in the under-18 age groups compared to the under-16s. However, other studies, such as Bohórquez and Checa (2017), Sánchez et al. (2012), and Reche et al. (2018), have shown different patterns to the present research, which found higher levels of somatic anxiety and resilience in young people and greater deconcentration and pessimism in under-16s. Kristjánsdóttir et al. (2019) found no significant differences in futsal players related to competitive anxiety or resilience. These results coincide with those presented by Reche-García et al. (2020) where they do not find differences related to the age variables of the participants. In relation to H2, youth category athletes are more optimistic than cadet category athletes, H4 is corroborated. Endorsing previous studies, Vallarino and Reche-García (2016), who found a higher level of LOT-T in groups <18 years compared to <16 years. This difference may be influenced by the fact that cadet athletes, because of their age, have an enthusiastic commitment that represents an individual's feelings of attraction and dedication toward an entity (in this case sport modality) and youth athletes may have a limited commitment that reflects

an individual's feelings of obligation and passive responsibility toward an entity (or sport team) (Scanlan et al., 2016). However, other studies, such as Bohórquez and Checa (2017), Sánchez et al. (2012), and Reche et al. (2018), have shown different patterns than the present research, finding higher levels of A-S and RS in younger athletes and higher A-D and LOT-P in <16 years old. Kristjánsdóttir et al. (2019) find no significant differences in futsal players in relation to competitive A-T or RS. These discrepancies between the different studies could be conditioned by the competitive level of the athletes (local-autonomous-national-international), as these levels of competition can enhance and/or generate different responses in the variables analyzed.

When correlating the different scales in terms of sport modality, in A-T, LOT-T, UWES-T and RS, it is the lifeguard athletes who show higher scores than the futsal athletes. Which determines that H3, futsal athletes (collective sport) show a lower level of commitment and resilience than lifeguards (individual sport), H1 is confirmed. Regarding the sport modality and the relationship between collective sport (futsal) and individual sport (lifeguard), we found similar results to previous studies, such as Bohórquez and Checa (2017) and Reche et al. (2018), regarding UWES-T, A-T and LOT-T in individual sports. Likewise, the results of this study reflected a higher level of A-D and LOT-P in futsal participants (collective sport). This is in contrast to previous studies such as those of Sánchez et al. (2012) and Chacón-Cuberos et al. (2016), which found no differences in these variables according to sport modality. This is supported by the main psychological distinction between individual and team sports, which is based on the concept of responsibility (Mroczkowska, 1997), supported by the fact that personal responsibility for the result (positive or negative) is lower in team sports compared to individual sports (Laborde et al., 2016).

We believe that the results presented are due to the specific characteristics of the sports studied. On the one hand, lifeguarding is a sport in which the work is carried out individually but within a team discipline, which we believe reduces the possibility of differences between its practitioners. Whereas, in Indoor Football, the possibility of distributing responsibility among the team, we understand, is the reason for these differences between modalities. As determined by Vallarino and Reche-García (2016) who highlighted the importance of optimism and resilience in hockey players or the study by Ruiz et al. (2012) on football players.

In relation to H4, Futsal players have lower A-T than lifeguards, H3 is endorsed. Since the lifeguard athletes achieved higher scores than the futsal players. Possibly the cause could be as a consequence of the sport modality practiced (individual) as when one realizes that one is unable to achieve a goal it is probably very stressful, as stress occurs when goals become unattainable (Lazarus, 1999). Considering that lifeguarding is performed individually, but, within a team discipline, the athlete is solely responsible for the outcome. Whereas, in futsal, there is the possibility of distributing the responsibility among the different players of the team, we understand that this could be the reason for these differences between the reviewed sports modalities.

The results of the linear regression revealed the importance of the category, the level of UWES-T and the level of SR of the participants. Unlike previous studies, Sánchez-Oliva et al. (2010) or Chacón-Cuberos et al. (2016) that did not emphasize these variables and similar to the studies of Bohórquez and Checa (2017) as well as Reche et al. (2018), in individual sports such as triathlon or team sports such as hockey, which are in line with this study.

## CONCLUSIONS

The results of this study provided very valuable information about optimism, anxiety, resilience and the level of commitment of athletes <18 years old and <16 years old, both in lifeguarding and futsal. From the data of this study, it will be possible to establish a better working environment in training and provide psychological work situations so that athletes can obtain greater positive feelings, both in individual and collective sport. Providing coaches and athletes with information on the dimensions analyzed, in order to be able firstly to detect if there are risks in athletes and secondly to prevent them from appearing, with the inclusion in training and/or training of athletes of efficient tools and methodologies in the detection, prevention and reinforcement of concepts such as LOT-T and RS that help athletes and coaches to face them with solvency. Using the present research as a reference, additional future research is needed in other sports, both individual and team, before stronger conclusions can be drawn. Larger sample sizes, longitudinal studies, including pre- and post-competition observation may provide more information on the more concrete effects of these variables on athletes. Such research may also reveal whether the results of the questionnaires are different depending on the athlete's performance in an event.

It is worth noting that higher anxiety and UWES ability was observed in the lifeguarding modality, and higher levels of deconcentration and LOT-R-P were observed in futsal participants.

The study provides insight into the athletes of these two sport modalities on which to deepen future research, generate personalized lines of work and improve performance. We are also aware of the need to continue increasing the sample for future replications, and even generate sport-specific studies and comparing different competitive levels.

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## Limitations of the Study

With regard to the limitations of the study, firstly, we can point out that the data have been collected through self-reporting. This is a common practice in studies, although it may lead to a bias in the participants' response, exacerbate common variance and artificially increase correlations between variables (Spector, 2006). Secondly, the sample is composed of Spanish athletes, who have their own cultural characteristics; therefore, the results obtained cannot be extrapolated to other samples. It would be interesting to carry out cross-cultural or cross-national studies to verify whether the results of our work are similar to those of other countries.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical approval was not provided for this study on human participants because as it was an observational study and the information was obtained through a questionnaire, in which there was no sensitive information. The ethics committee determined that there was no need for such a report. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

FC-N and AM-M: conceptualization, writing—review and editing, and supervision. FC-N: methodology, writing—original draft preparation, and project administration. FC-G and RI-P: software and visualization. AM-M, RI-P, and FC-N: validation. AM-M: formal analysis. FC-N and RI-P: investigation. FC-G and AM-M: resources. RI-P: data curation. AM-M, RI-P, FC-G, and FC-N: funding acquisition. All authors have read and agreed to the published version of the manuscript.

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# The Impact of an Authentic Sports Leadership Program for Coach

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**Purpose:** This paper studies the effects of authentic sports leadership training on coaches' self-perception of their own authentic leadership, perceived justice, competence, overall self-efficacy, and collective efficacy. Additionally, players' perceptions of their coaches with respect to their authentic leadership, perceived justice, competence, collective efficacy, satisfaction with the coach, and support for basic psychological needs were analyzed.

**Design:** Twenty-five football and handball coaches were randomly assigned to two groups. Fifteen coaches made up the experimental group that carried out the training leadership program, while 10 coaches made up the control group, carrying out no training whatsoever. A total of 248 football and handball players participated in this study; 136 were led by coaches who participated in the training program, and 112 by coaches who did not participate in the program.

**Results:** The results of this study indicate that coaches' self-perception is positively influenced after having received training in the variables of authentic leadership, perceived justice, competence, overall self-efficacy, and collective efficacy. Players whose coaches were part of the program perceive them as being more competent as coaches.

**Conclusions:** The effects of an authentic sports leadership training program are effective for coaches and players alike.

**Keywords:** sport coaching, identity, influence, self-awareness, football, handball

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## INTRODUCTION

"He was born to be a leader" or "she is a natural leader" are frequent expressions in different contexts where the figure of a leader is present. In the realm of sports, numerous studies attribute a fundamental aspect of sportsman to the coach (Adie et al., 2012; Balaguer et al., 2012), making him or her one of the most significant actors in terms of team sports performance (Myers et al., 2011). But can good leadership be learned, and is it possible to train coaches in these skills? Northouse (2018), maintains that there is a whole series of beliefs surrounding leadership, which opens the door to the ongoing debate of whether leadership is innate, or conversely, a skill that can be developed by coaches and leaders. As in other social activities, in sports it is assumed that leadership skills can be acquired through training programs (Duda, 2013). Hence, in recent decades there has been a growing interest in the study of leadership models and how to apply them. In many cases, these models have been oriented toward interactions and context (Epitropaki et al., 2017), thus, the coach's influence and how it is perceived by athletes has become increasingly central to various conceptualizations and analyses (Steffens et al., 2016; Epitropaki et al., 2017).

In recent years, there has been a growing interest in studying the relationship between effective leadership and the ethical behavior of the leader (Kaptein, 2019; Gamarra and Giroto, 2021). For this reason, models oriented toward the ethical dimension of team leadership have recently emerged, such as what has been termed “authentic leadership,” (Avolio and Gardner, 2005; Gardner et al., 2005a; Moriano et al., 2011). Walumbwa et al. (2008) which posit that authentic leadership comprises four related dimensions: self-awareness, internalized moral perspective, relational transparency, and balanced processing.

Self-awareness refers to the extent which a leader possesses accurate self-knowledge and uses that knowledge to demonstrate he or she is cognizant of their impact on others. Internalized moral perspective pertains to the degree in which a leader's behavior is directed by and is congruent with their personal values and moral standards. It represents a form of self-regulation which allows leaders to engage in ethical conduct even against external pressures. Relational transparency is a leader's presentation of their true thoughts and emotions in an open and transparent manner (vs. being fake or manipulative), while balanced processing is evident when a leader objectively considers and analyzes all relevant information before making decisions (Walumbwa et al., 2008).

Various contextually different studies have shown that authentic leadership is related to the well-being of the leader (Baron, 2012; Gatling and Harrah, 2014; Weiss et al., 2018), additionally improving followers' behavior, satisfaction, and performance (Walumbwa et al., 2008; Caza et al., 2010). In the realm of sports, it has been associated with higher levels of competence and perceived justice on the part of the coach (González-Ponce, 2018), as well as increased satisfaction, enjoyment and cohesion among the team (Bandura and Kavussanu, 2018), as well as greater team cohesion; a relationship mediated by trust and sacrifice (Bandura et al., 2019). A study by McDowell et al. (2018) involving basketball players, the positive team climate presented a mediating effect between authentic leadership and psychological capital and player commitment.

Two of the most influential approaches to sports leadership have been: Leadership Behaviors Model of Sport Leadership (Smoll et al., 1978; Smoll and Smith, 1989) and Multidimensional Model of Sport Leadership (Chelladurai, 1978, 1990, 2007). There have been several programs aimed at training coaches in sports leadership skills which predominantly follow these approaches. One of the pioneers and most widely used is Coach Effectiveness Training (CET), by Smith et al. (1979), which aims to facilitate positive behavior on the part of coaches; likewise, to improve interactions with their athletes. Several studies have supported the usefulness of CET, resulting in more effective coach behaviors and better interactions (Sousa et al., 2008). Based on CET, the Mastery Approach to Coaching (MAC) (Smith et al., 2007; Smoll and Smith, 2009) emphasizes the importance of a task-oriented climate as generated by the coach rather than results-oriented. In this line, the MAC also recommends that coaches avoid post-error punishment and punitive technical instruction (Smoll and Smith, 2010; Vella and Perlman, 2014)

in order to facilitate positive athletic behavior and promote a task-oriented climate.

The Transformational Leadership Approach to Coaching (TLAC) is another proposed approach to developing leadership skills. In essence, transformational leaders promote autonomous actions, pursuing the personal growth of athletes, as well as task cohesion, the satisfaction of needs, and intrinsic motivation (Vella and Perlman, 2014). In youth sport contexts, the TLAC has been implemented with the aim of facilitating positive developmental outcomes among athletes (Vella et al., 2012, 2013) and has been employed to facilitate high performance among Olympic athletes as well (Din and Paskevich, 2013).

The convenience of this study is due to the influence that the coach has on the athletes, and also, putting in value the positive effects that authentic leadership has on athletes (Bandura and Kavussanu, 2018), it could be considered transcendent to seek ways to develop this style of leadership and observe the effects on different variables associated with the abilities to lead by the coach and how it affects the athletes.

The objective of this study was to investigate the effect of an authentic sports leadership training program on several variables affecting both the coaches participating in the program and their players. The efficacy of this intervention was tested by both coaches and their players using a before and after study design. Authentic coach leadership, perceived justice, coach competence, and collective efficacy was evaluated by the coaches. The same variables (excluding coach self-efficacy) along with the satisfaction with the coach and perceived need satisfaction was evaluated by the players. As a result, two main hypotheses were developed:

1. From the perspective of the coaches, it is expected that those coaches who received the training program (experimental group) will show a significant increase in the evaluation of their levels of authentic coach leadership, perceived justice, coach competence (total competence, motivation, decision-making, teaching and instruction of skills, and character influence), coach self-efficacy, and collective efficacy after the intervention in comparison with before, whereas no changes will be found in those coaches who did not receive the intervention (control group).
2. From the evaluation of the players, it is expected that those players whose coaches have received the training program (experimental group) will show an increase in their perception of their coach's authentic leadership, perceived justice, coach competence (total competence, motivating, decision-making, teaching and instruction of skills, and character influence), collective efficacy, satisfaction with the coach, and coach support of their basic psychological needs (competence, autonomy, and relatedness).

## METHOD

### Participants

The training course was offered to all students of the National Degree of Higher Sports Technicians from Spain. A total of 25 coaches agreed to participate, all male, they were randomized;

15 coaches made up the experimental group and 10 coaches made up the control group. The average age of the participants in the experimental group was 36.31 ( $SD = 8.07$ ), whereas the average age among the control group was 31.72 ( $SD = 5.45$ ). The experimental group had an average of 10.53 years of experience as head coach ( $SD = 6.54$ ), with the control group having had 8.50 average years of experience ( $SD = 2.99$ ).

A total of 248 football and handball players participated in this study, 178 being male, and 70 female; 136 were led by coaches from the experimental group who had received leadership training, and 112 were led by coaches from the control group. The average age of the participants was 17.84 years ( $SD = 4.44$ ). The athletes had an average of 10.45 years of experience ( $SD = 4.83$ ) participating in the sport being played. Finally, all the coaches and the players trained more than 8 h per week and compete in a regional category.

## Variables and Instruments

### Authentic Coach Leadership

This variable was evaluated according to the Spanish adaptation validated by Moriano et al. (2011) of the Authentic Leadership Questionnaire (ALQ) (Walumbwa et al., 2008). This instrument consists of 12 items. The answer format is a Likert scale from 1 (never) to 7 (always). Following Gadermann et al. (2012) recommendations, internal consistency reliability was calculated using Omega coefficients. Good levels were found for the coaches (before the intervention:  $\omega = 0.91$ ; after the intervention:  $\omega = 0.91$ ) and the players (before:  $\omega = 0.93$ ; after:  $\omega = 0.92$ ).

### Perceived Justice

This variable was evaluated using an adaptation of Colquitt's Organizational Justice scale (2001) by García-Calvo et al. (2014a) of which a modification was made in order to measure perceived justice within a sport-specific framework. The instrument consists of 12 items and the response format is a Likert scale from 1 (never) to 7 (always). Internal consistency reliability showed good levels for the coaches (before:  $\omega = 0.88$ ; after:  $\omega = 0.85$ ) and the players (before:  $\omega = 0.91$ ; after:  $\omega = 0.91$ ).

### Coach Competence

This variable was evaluated by means of Athletes Perceptions of Coaching Competency Scale II-High School Teams (APCCS II-HST; Myers et al., 2010) validated in Spanish (González-Ponce et al., 2017). There are 15 items in this instrument and four subscales: competence to motivate, decision-making, teaching and instruction of skills, and influence on the player. The response format is a Likert scale from 1 (incompetence) to 7 (full competence). Good levels of internal consistency reliability were found for both coaches (motivate: before:  $\omega = 0.63$ , after:  $\omega = 0.85$ ; decision-making:  $\omega = 0.76$ , after:  $\omega = 0.77$ ; teach and instruct:  $\omega = 0.89$ , after:  $\omega = 0.88$ ; influence:  $\omega = 0.77$ , after:  $\omega = 0.80$ ), and players (motivate: before:  $\omega = 0.78$ , after:  $\omega = 0.78$ ; decision-making:  $\omega = 0.79$ , after:  $\omega = 0.84$ ; teach and instruct:  $\omega = 0.79$ , after:  $\omega = 0.79$ ; influence:  $\omega = 0.70$ , after:  $\omega = 0.72$ ).

### Coach Self-Efficacy

This variable was evaluated using the Scale of Self Efficacy of Baessler and Schwarzer (1996) based on the Spanish version developed by Sanjuán et al. (2000). This instrument consists of 10 items. The response format is a Likert scale from 1 (strongly disagree) to 4 (strongly agree). Only the coaches gave their responses on this scale. Internal consistency reliability also showed good levels in this case (before:  $\omega = 0.84$ ; after:  $\omega = 0.92$ ).

### Collective Efficacy

This variable was evaluated using a scale developed by Leo et al. (2010). This instrument consists of 6 items. The response format is a Likert scale from 1 (poor) to 5 (excellent). Good levels of internal consistency reliability were found for both coaches (before:  $\omega = 0.83$ ; after:  $\omega = 0.63$ ) and players (before:  $\omega = 0.71$ ; after:  $\omega = 0.75$ ).

### Satisfaction With the Coach

This variable was evaluated using an adaptation of the Myers et al. (2011) in its Spanish version. This instrument consists of 3 items and represents a reduced version adapted to the Spanish context (González-Ponce et al., 2015). The response format is a Likert scale from 1 (very little) to 5 (a lot). This scale was only responded to by the players. Internal consistency reliability also showed good levels in this case (before:  $\omega = 0.80$ ; after:  $\omega = 0.83$ ).

### Perception of Support for Basic Psychological Needs

This variable was evaluated using the Psychological Needs Support Questionnaire (CANPB; Sánchez-Oliva et al., 2013) adapted to the sports context. This instrument consists of 12 items distributed across three dimensions: autonomy, competence, and need for relatedness. The response format is a Likert scale from 1 (totally disagree) to 5 (totally agree). Only players responded to this scale. Again, good levels of internal consistency were observed in the three subscales (autonomy: before:  $\omega = 0.81$ , after:  $\omega = 0.76$ ; competence: before:  $\omega = 0.80$ , after:  $\omega = 0.77$ ; relatedness: before:  $\omega = 0.87$ , after:  $\omega = 0.76$ ).

### Procedure

This study was conducted applying a before/after design with an experimental group and a control group. Prior to the intervention, initial questionnaires were administered to all coaches and teams. For the coaches, the questionnaires were administrated outside the sporting context in which they regularly perform their duties as coaches. Conversely, the athletes were taken to the facility where they habitually train and explained the guidelines for completing the questionnaires by the researcher. Any related questions were also addressed at this time. The questionnaires were administered to the athletes collectively, with all members of the team present. The researcher remained on-site and available to the participants at all times should any questions arise. In both cases, the time used by both coaches and athletes was ~25–30 min. For coaches and players in both groups, there was a 7-week period between the first and second administration of the questionnaires.



This study respected the norms of the Declaration of Helsinki. Additionally, the parents of the minors were informed and all participants signed consent forms.

## Description of the Program

Authentic leadership seeks to move away from unethical actions, respecting and displaying values that inspire others to join in that direction. According to George (2015, p. 1), “authentic leaders are people committed to meeting the needs of the interest groups they serve, displaying values and self-discipline that inspire others.” Our training program was oriented toward this behavior, considering the four dimensions proposed in the Authentic Leadership Questionnaire (ALQ) by Walumbwa et al. (2008): transparency in relationships, internalized morality, balanced processing and self-awareness. The duration of the training program was 15 h divided into four sessions developed within three consecutive days. The structure and contents of the training program took into account the “model for the development of the moral component of authentic leadership” proposed by May et al. (2003). This model consists of three key elements: authenticity in decision-making, authentic behavior, and development of authentic leadership, each of which was present in the training program, especially in sessions 2, 3, and 4. Similarly, in the implementation of the program, “the integral model for the development of the authentic leader and his followers” proposed by Gardner et al. (2005b) was considered. The approach of this model is oriented toward the leader’s self-awareness (identity, values and motivations) and self-regulation (balanced processing and transparency in relationships); in particular the contributions of this model were used in sessions 1, 2, and 3 as detailed below. The following table describes the contents and timing of the program.

## Program Sessions

Session 1 (4 h). Transparency in relationships. In this session, the program was presented and the relationships that exist in sports groups were developed through inquiry tasks. Tasks were carried out in small groups where the meaning and purpose of relationships and the role of the coach among them were discussed. Communication skills and active listening were developed with the coaches, linking these components to sports environments. Through group dynamics these skills were put into practice, seeking that the coaches could show themselves as they are, without fear of judgments or external evaluations.

Session 2 (4 h). Internalized morality. This session was divided into two main blocks, the first dedicated to the work of the coach’s self-awareness (content that was also developed in session 4). Through role play and reflective tasks, the coaches identified their personal values that made sense in leadership with their teams. How to approach ethical behavior and how to maintain authenticity in their conduct from a moral point of view was shared with the coaches through reflective tasks. The second block of this session was aimed at connecting the identity of the coach with the identity and values of his teams. Through role-playing games, everyday situations were put into practice among the teams, the coach being required to recognize frequently

recurring moral dilemmas. The worked out was in a way that respected personal values and the identity of the team.

Session 3 (4 h). Balanced processing. Ethical decision-making seeks to objectively examine the variables involved in accepting personal responsibility for actions, results, and mistakes. In this session, the coaches focused on the ethics of decisions made in the teams, seeking to align performance with the value system seen in the previous session. In the same way, information channels and sources of feedback available to the coach were identified (even if they were contrary to his positions). Group dynamics, self-reflective tasks and role-playing games were used where coaches were proposed to commonly experience ethical conflicts with sports teams. Decisions related to authentic leadership were identified as those which respected the relationship between the personal values of the coach and team groups.

Session 4 (3 h). Self-awareness. This session was directly linked to session 2, establishing the identity of the coaches, thus strengthening their values and principles. Similarly, through research tasks, coaches identified the professional areas in which they were most and least effective. In small groups they worked to expose resources and procedures that would allow them to pinpoint the least effective areas. Finally, through group dynamics, coaches shared program highlights and learning reported (see Table 1).

## Statistical Analysis

In order to study the program’s effectiveness, an ANOVA of repeated measurements was conducted with an intra-subject factor (time of measure: before and after the intervention) and an inter-subject factor (experimental and control groups). *Post-hoc* tests of multiple comparisons with the Bonferroni adjustment were also performed in order to analyze significant interactions. In this way, differences between pre- and post-intervention dependent variables within the experimental and control groups, and differences among the same dependent variables between the experimental and control groups at the time of pre- and post-intervention evaluation could be studied. For all analyses, a significance of 0.05 was established for  $\alpha$ .

Finally, it should be mentioned that Omega’s alpha was used to evaluate the reliability of the scales used. All analyses were carried out with the SPSS 24.0 statistical package (IBM, Armonk, NY, USA).

## RESULTS

### Coaches

Below are the most relevant results obtained in relation to each of the variables investigated. To evaluate the effectiveness of the program, a series of repeated measurement ANOVAs were performed with an inter-subject factor (experimental vs. control groups) and an intra-subject factor (period of evaluation).

The interaction period of measurement\*group was statistically significant (see Table 3) for the variables authentic leadership [Wilks’  $\lambda = 0.643$ ,  $F_{(1,22)} = 12.21$ ,  $p = 0.002$ ,  $\eta_p^2 = 0.357$ ], perceived justice [Wilks’  $\lambda = 0.724$ ,  $F_{(1,22)} = 8.39$ ,  $p = 0.008$ ,  $\eta_p^2 = 0.276$ ], ability to teach and instruct skills to players [Wilks’  $\lambda = 0.796$ ,  $F_{(1,23)} = 5.89$ ,  $p = 0.023$ ,

**TABLE 1** | Programming, themes, and contents of the authentic leadership program.

Session/duration	Theme	Content
1/4 h	Relational transparency	Team relationships Communication and listening skills
2/4 h	Internalized morality	Identification of personal and group values Relationship of team identity with group values Awareness and shared responsibility
3/ 4 h	Balanced processing	Ethics of decision-making Relationship between personal and group decisions and values Respect for the values and identity of the team in decision-making
4/3 h	Self-awareness	Personal effectiveness analysis Resources for managing effectivity and learning reported

$\eta_p^2 = 0.204$ ], general self-efficacy [Wilks'  $\lambda = 0.747$ ,  $F_{(1,22)} = 7.45$ ,  $p = 0.012$ ,  $\eta_p^2 = 0.253$ ] and collective efficacy [Wilks'  $\lambda = 0.773$ ,  $F_{(1,23)} = 6.74$ ,  $p = 0.016$ ,  $\eta_p^2 = 0.227$ ].

To interpret these interactions, a series of *post-hoc* tests of multiple comparisons with the Bonferroni adjustment was performed, revealing a significant increase in the levels of authentic leadership ( $p = 0.008$ ), perceived justice ( $p = 0.004$ ), general self-efficacy ( $p = 0.005$ ) and collective efficacy ( $p = 0.002$ ) after the intervention in the experimental group, while no change was found in the control group in these variables. In fact, a significant decrease in this group was observed in the case of authentic leadership ( $p = 0.048$ ). A statistical trend was also found of a marked increase in the ability to teach and instruct skills to players in the post-intervention evaluation in the experimental group ( $p = 0.061$ ), while no variation was observed in the control group.

The interaction period of measurement\*group was not statistically significant for the coach's overall competence variable although a clear statistical trend was observed [ $F_{(1,23)} = 4.00$ ,  $p = 0.057$ ,  $\eta_p^2 = 0.148$ ]. When a series of *post-hoc* tests was carried out in accordance with Bonferroni's adjustment, a significant increase in the coaches' competence levels was observed within the experimental group ( $p = 0.007$ ), with no change observed in respect to the control group (see **Table 2**, and **Figure 1**).

In addition, no major effect was identified for the period of measurement, however, there was a significant effect for the cluster related to competence to motivate [ $F_{(1,23)} = 5.03$ ,  $p = 0.035$ ,  $\eta_p^2 = 0.180$ ] and that of perceived justice [ $F_{(1,22)} = 6.07$ ,  $p = 0.022$ ,  $\eta_p^2 = 0.216$ ]. In both cases, the control group (motivational competence:  $M = 3.87$ ; perceived justice:  $M = 5.75$ ) scored higher than the experimental group (motivational competence:  $M = 3.32$ ; perceived justice:  $M = 5.28$ ).

## Players

The most relevant results obtained in relation to each of the variables investigated appear below. To evaluate the effectiveness of the program, a series of repeated measurement ANOVAs was performed with an inter-subject factor (experimental

vs. control group) and an intra-subject factor (period of evaluation).

The interaction period of measurement\* group was statistically significant (see **Table 3**) for the variables: coach's overall competence [Wilks'  $\lambda = 0.949$ ,  $F_{(1,80)} = 9.58$ ,  $p = 0.002$ ,  $\eta_p^2 = 0.051$ ], coach's ability to motivate [Wilks'  $\lambda = 0.960$ ,  $F_{(1,80)} = 7.43$ ,  $p = 0.007$ ,  $\eta_p^2 = 0.040$ ], decision-making ability [Wilks'  $\lambda = 0.975$ ,  $F_{(1,80)} = 4.55$ ,  $p = 0.034$ ,  $\eta_p^2 = 0.025$ ] and ability to positively influence the player's attitude [Wilks'  $\lambda = 0.965$ ,  $F_{(1,80)} = 6.48$ ,  $p = 0.012$ ,  $\eta_p^2 = 0.035$ ].

To interpret these significant interactions, a series of *post-hoc* tests of multiple comparisons was carried out in accordance with the Bonferroni adjustment. First, a significant increase in the coach's decision-making ability ( $p = 0.027$ ) was found in the experimental group, while no change was observed in the control group. A significant decrease in the coach's overall competence ( $p = 0.007$ ), the coach's ability to motivate ( $p = 0.012$ ) and to positively influence the player's attitude ( $p = 0.023$ ) was observed in the control group after the intervention, while the experimental group maintained the same levels as prior to the intervention.

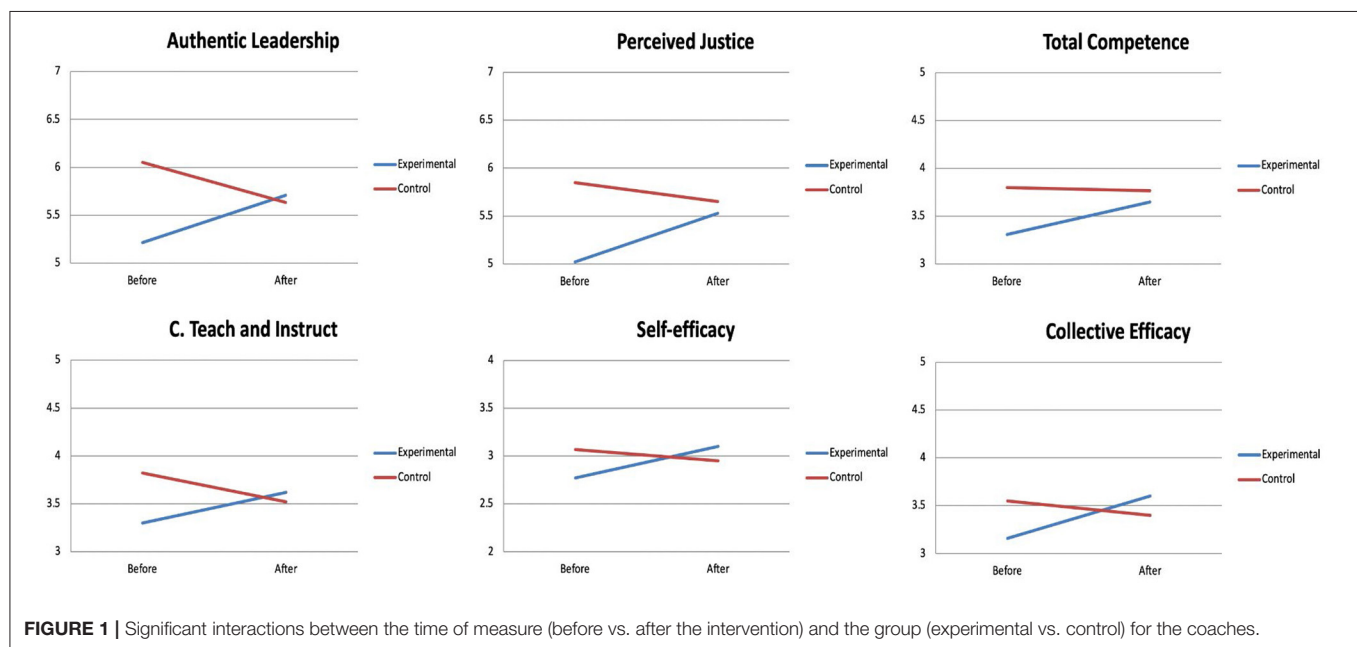
The interaction period of measurement\* group was not statistically significant for authentic leadership, although a clear statistical trend was observed [ $F_{(1,180)} = 3.68$ ,  $p = 0.057$ ,  $\eta_p^2 = 0.020$ ]. The multiple comparison tests post Bonferroni adjustment only detected a statistical trend indicating a decrease in the control group between before and after the intervention ( $p = 0.079$ ), while the experimental group remained the same.

Finally, it is noteworthy that no major effect was identified for the group except in the case of the period of measurement relating to the need for autonomy [ $F_{(1,180)} = 5.78$ ,  $p = 0.017$ ,  $\eta_p^2 = 0.031$ ] and competence [ $F_{(1,180)} = 4.07$ ,  $p = 0.045$ ,  $\eta_p^2 = 0.022$ ]. In both cases, higher levels were obtained after the intervention (autonomy:  $M = 3.51$ ; competence:  $M = 4.17$ ) compared to before (autonomy:  $M = 3.36$ ; competence:  $M = 4.09$ ) (see **Table 3**, and **Figure 2**).

**TABLE 2 |** Means and standard deviations of the coaches in the experimental and control groups before and after the intervention, and interaction time of measure\*group.

	Before		After		Interactions		Significant interactions	
	Exp. group	Control group	Exp. group	Control group	Time of measure*group		Exp. group	Control group
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>p</i>	$\eta_p^2$		
Authentic leadership	5.21 (0.66)	6.05 (0.34)	5.71 (0.71)	5.63 (0.60)	0.002	0.357	B < A	B > A
Perceived justice	5.02 (0.61)	5.85 (0.31)	5.53 (0.59)	5.65 (0.57)	0.008	0.276	B < A	B = A
Total competence	3.31 (0.48)	3.80 (0.82)	3.65 (0.44)	3.77 (0.51)	0.057	0.148	B < A	B = A
C. Motivation	3.13 (0.65)	3.80 (0.59)	3.51 (0.71)	3.93 (0.70)	0.340	0.040		
C. Decision-making	3.20 (0.54)	3.50 (0.59)	3.42 (0.53)	3.57 (0.58)	0.413	0.029		
C. Teach and instruct	3.30 (0.64)	3.82 (0.31)	3.62 (0.64)	3.52 (0.45)	0.023	0.204	B < A	B = A
C. Character influence	3.53 (0.74)	4.10 (0.38)	4.08 (0.71)	4.16 (0.65)	0.230	0.062		
Self-efficacy	2.77 (0.34)	3.07 (0.39)	3.10 (0.39)	2.95 (0.50)	0.012	0.253	B < A	B = A
Collective efficacy	3.16 (0.42)	3.55 (0.55)	3.60 (0.52)	3.40 (0.44)	0.016	0.227	B < A	B = A

B, Before; A, After.

**FIGURE 1 |** Significant interactions between the time of measure (before vs. after the intervention) and the group (experimental vs. control) for the coaches.

## DISCUSSION

### Coaches

As results obtained show, the coaches' perception of their own authentic leadership increased significantly for the experimental group, taking into account the before and after measurement period. In the control group, however, self-perception of their own authentic leadership showed a significant decrease. According to the results found in the two groups of coach, the training program had a positive effect on the perception of their leadership style in the experimental group. Results similar to other training programs related to authentic leadership developed in non-sports contexts (Baron, 2012; Fusco et al., 2016; Frasier, 2019).

Paying attention to the relational transparency dimension and the contents developed within the program, it could

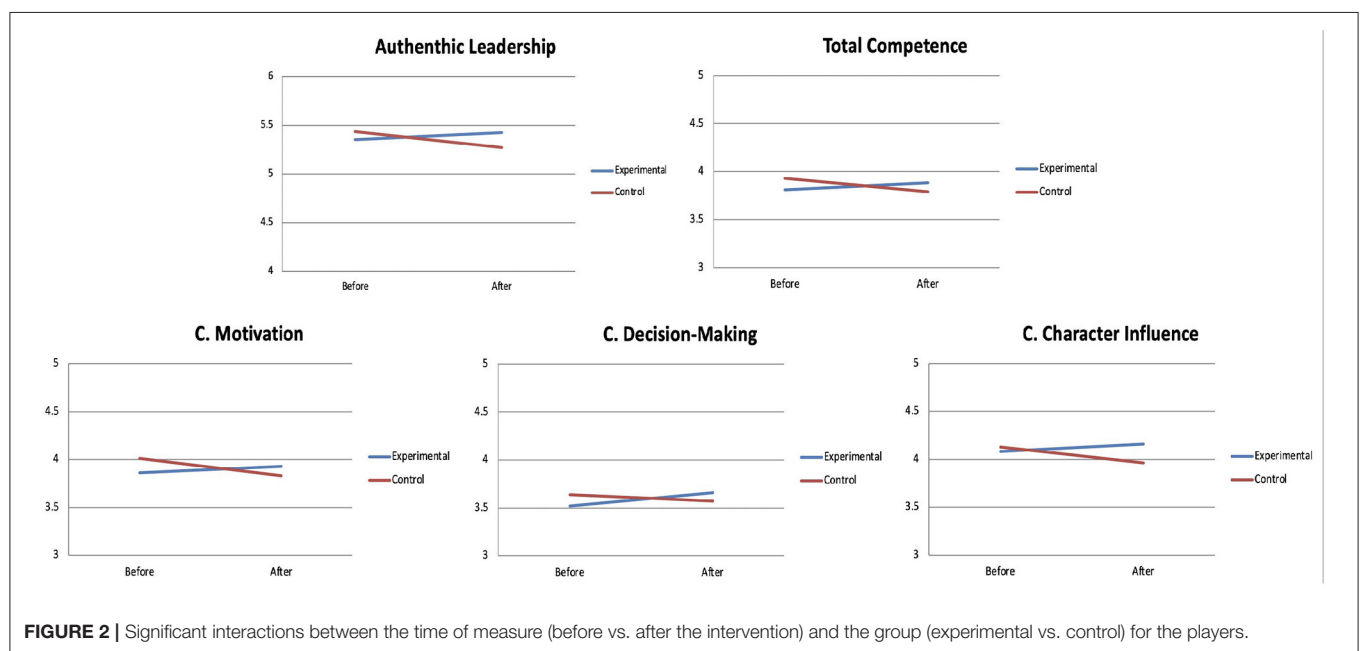
be considered that communication has an influence on the development of this dimension. Cranmer et al. (2020) relates the coach's communication skills to team cohesion and in turn, various studies (Houchin, 2011; González-Ponce, 2018) have revealed positive and significant relationships between authentic leadership and cohesion.

Regarding the development of the internalized moral dimension, role-playing games and reflective tasks that included ethical questioning were used in order to achieve a shared identity that is reflecting the ability of sports leaders to mobilize the efforts of athletes (Slater et al., 2019). The coach's self-perception following the analysis of information related to decision-making and balanced processing could be affected by the contents developed in the authentic leadership program. Since the coach's competence is one of the most determining variables in the performance of sports teams (Myers et al., 2011), it seems

**TABLE 3 |** Means and standard deviations of the players in the experimental and control groups before and after the intervention and interactions between time of measure\*group.

	Before		After		Interactions		Significant interactions	
	Exp. group	Control group	Exp. group	Control group	Time of measure*group		Exp. group	Control group
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>p</i>	$\eta_p^2$		
Authentic leadership	5.35 (0.95)	5.43 (1.02)	5.42 (0.83)	5.27 (0.90)	0.057	0	B = A	B > A
Perceived justice	5.50 (0.83)	5.31 (1.04)	5.42 (0.84)	5.22 (0.94)	0.909	0		
Total competence	3.81 (0.59)	3.93 (0.55)	3.88 (0.56)	3.79 (0.60)	0.002	0.051	B = A	B > A
C. Motivation	3.86 (0.74)	4.02 (0.60)	3.94 (0.66)	3.83 (0.65)	0.007	0	B = A	B > A
C. Decision-making	3.52 (0.54)	3.64 (0.59)	3.66 (0.53)	3.57 (0.58)	0.034	0.025	B < A	B = A
C. Teach and instruct	3.87 (0.69)	3.99 (0.66)	3.85 (0.65)	3.83 (0.68)	0.130	0.013		
C. Character Influence	4.08 (0.68)	4.13 (0.70)	4.16 (0.60)	3.96 (0.70)	0.012	0.035	B = A	B > A
Collective efficacy	3.80 (0.66)	3.69 (0.61)	3.81 (0.69)	3.82 (0.50)	0.179	0.010		
Satisfaction with the coach	4.25 (0.61)	4.16 (0.77)	4.32 (0.65)	4.12 (0.89)	0.286	0.006		
PNS autonomy	3.38 (0.73)	3.33 (0.89)	3.53 (0.79)	3.48 (0.77)	0.995	0		
PNS Competence	4.18 (0.55)	4.15 (0.73)	4.12 (0.64)	4.06 (0.64)	0.786	0		
PNS relatedness	4.25 (0.60)	4.21 (0.69)	4.25 (0.59)	4.19 (0.67)	0.891	0		

B, Before; A, After.



essential to acquire and develop the coach's self-reflection on their abilities, thus allowing them to evaluate their impact on others.

The significant increase in the perception of authentic leadership of the coach could have effects on the well-being of the coach. A study by Weiss et al. (2018) concluded that that mediated by a reduction in mental exhaustion, authentic leadership lessens the stress of leaders and increases work commitment. In addition, the timing of the training program's administration coincided with the final phase of the season where coaches are subjected to greater pressure in relation to

the achievement of objectives, it could be considered that the program could positively affect well-being from the coach. From the perspective of the positive effects that authentic leadership to athletes, Bandura and Kavussanu (2018) conclude in the need to find ways encouraging coaches to adopt authentic leadership. Therefore, it could be considered that a program like the one developed in this study it could be one of those paths.

Other studies in which a leadership skills training program was carried out have evidenced coaches' greater perception of their leadership style and the variables that make it up



(Newin et al., 2008; Vella and Perlman, 2014). With regard to the results obtained concerning the coach's perception of the justice that he/she promotes within the team, the results were significant for the experimental group when taking before and after measurements into account; post-training values being statistically significant. In the control group, no change was observed in terms of the perception of justice being promoted by the coaches. As with other research, coaches felt more confident in their ability to convey the decisions they made (Newin et al., 2008). In different contexts a connection has been made with organizational justice promoted as an important factor in determining leadership style (Gillet et al., 2013). Specifically, authentic leadership has been associated with organizational justice within the business environment (García-Guio et al., 2015). In the realm of sports, Jowett (2005, 2009) relates a style of leadership and justice promoted by coaches to foster closeness, which includes emotional ties between the coach and his athletes, could facilitate a greater degree of commitment by both parties.

The results obtained after the training program oriented toward authentic leadership meant that the coaches' self-perception of competence, were significant for the experimental group, considering whether the measurement was taken before or after, with higher values obtained after having participated in the training program. No variation, meanwhile, was found for the control group and these results coincide with previous research (Conde et al., 2010; Soriano et al., 2014). When analyzing the subscales into which the questionnaire was divided, it was discovered that the interaction period of measurement\*group was significant for the subscale "teaching and instructing skills." For the remaining subscales: "competence to motivate," "competence to make decisions," and "capacity to influence attitude," the interaction period of measurement/group was not significant. The post-training increase occurring solely in the aforementioned subscale ("teaching and instructing skills") may be due to the implementation of the training program on the part of the coaches, and the orientation of these acquisitions toward more procedural aspects that are related to their background (Mesquita et al., 2011b). In this sense, it seems that their assessment of the program has resulted in a stronger appreciation of their own competence in relation to procedural and technical issues. In line with other studies that administered a program with comparable objectives (Smith et al., 2007; Newin et al., 2008), the coaches gained greater confidence with respect to their own competence.

The results obtained for the coaches' self-efficacy were statistically significant for the experimental group when taking into account whether the data was coming from the first or second measurement period. In the control group, no significant modifications were detected regarding perceived self-efficacy between the two sets of data. We believe that the authentic leadership training program modulated the results obtained by the coaches with respect to the perception of their overall self-efficacy. On the other hand, it stands to reason that coaches' perception of self-efficacy may be influenced by their level of training, academic education, or coaching experience (Mesquita et al., 2011a). In this regard, we believe that the program may have generated an increase in coaches' perceived ability to solve

problems within their domain. Bandura (2001) emphasizes that the convictions people use to achieve success better predict the perception of their self-efficacy beliefs. In this line, it stands to reason that coaches with higher levels of overall self-efficacy develop more favorable beliefs about their ability to solve problems. In view of the findings, we believe that the contents developed in the authentic training program could have positively influenced the enhanced self-efficacy of the coach. In our work, and also in other studies with similar characteristics (Lee et al., 2002), the training program increased perceived level of general self-efficacy.

The training program oriented toward authentic leadership in terms of the collective efficacy that coaches perceived within their teams indicated a significant increase among coaches who received the authentic leadership program. Collective efficacy is one of the greatest predictors of performance (Feltz and Lirgg, 1998), and in this sense, other studies have linked task-centered and less ego-driven behaviors to higher collective efficacy environments (Damato et al., 2011). In other words, the substantial shift in the values obtained with regard to collective efficacy leads us to believe that the authentic training program implemented alters the coaches' priorities by concentrating their efforts more closely on the task rather than the result. The perception of high collective efficacy is positively related to other relevant variables in team sports performance.

## Players

The results obtained with respect to the players' perception of their coach's authentic leadership were not significant for the experimental group. In the control group, a statistical trend was observed which marked a significant decrease in the players' perception of their coach's authentic leadership. It is striking to find the same result among the players in the control group as among their coaches. Both perceived a decrease in the authentic leadership that was developed. It is possible that the incidents that took place within the teams between the two data collection sessions, specifically in this final stretch of the season where relationships tend to deteriorate (García-Calvo et al., 2014b; González-Ponce, 2018), may have generated these results.

Regarding the level of competence that players perceived in their coaches, the results show a significant decrease in the perception of competence in the control group, both in the overall competence, and in two of the subscales of the questionnaire (competence to motivate and competence to influence attitude). For the experimental group, on the other hand, it was found that after the authentic leadership program the players felt that their coaches were more competent in making decisions. It was observed that the authentic training program not only generated an increase in the coaches' perception of self-competence, but that the players under their charge also identified an increase in the coaches' competence (in the subscale decision-making competence). Other studies that administered a leadership program have also found that players reported an improvement in their perception of their coach's competence after he or she had undergone training (Smith et al., 2007; Newin et al., 2008; Urra, 2018). The results in the two groups are therefore noteworthy, given that while the players in the

experimental group perceived an increase in the decision-making competence of their coaches, the players in the control group showed a significant decrease in the perception of their coach's competence when he or she had not undergone training.

In terms of perceived justice as reported by the players, the results obtained show no difference between the two periods of measurement in either group. While the coaches in the experimental group perceive themselves to exhibit higher levels of justice, their players do not report the same perception. Regarding collective efficacy perceived by players, the results obtained did not show differences in either group, although other studies in which coaches were trained (Voight and Callaghan, 2001) did in fact reveal an increase in the efficacy perceived by athletes on collective performance.

To conclude, both hypotheses were partially confirmed. In addition, the authentic sports leadership training program had a remarkable effect not only on the coaches, but, for the different variables studied, that effect extended to their players as well.

These findings may have important practical implications. First, this study could be used to guide the organisms in charge of coach training to include leadership as a key aspect. Second, the results of this research should be taken into account by the head coaches of team sports. Likewise, sports clubs and associations could invest more in training programs aimed at developing authentic leadership among coaches as the positive effects involve not only the coaches but also their players. At last, authentic leadership training programs could help coaches and their assistant teams identify possible areas for improvement in their training and development as sports technicians.

## Limitations of the Study and Future Research

The sample size regarding coaches was small due to its having been selected from the National Degree of Higher Sports Technicians Schools with the highest level of training in both sports modalities. This helped to make a good selection of reputable coaches. A low power analysis sensitivity was found, but it did not impede that all the interactions time of measure\*group showed significant, except for three subdimensions of the competence scale but not for the total score. Also, there was not a follow-up evaluation of the intervention.

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Future studies should address whether these results hold 6 months, or a year, after the conclusion of the intervention. Finally, the evaluation of the program was carried out exclusively through the application of questionnaires. Future studies of a qualitative nature could study the reasons why this program has been effective. It will also be relevant to test the contents and number of sessions necessary for an effective intervention.

## CONCLUSIONS

The coach's self-perception of authentic leadership, perceived justice, competence, self-efficacy, and collective efficacy is favorably influenced by the training program. The players also perceive their coach as more competent after the training course. A 15-h intervention program was quite effective with such a short duration. This study highlights the benefit of authentic leadership training in sports coaches.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

Ethical approval was not provided for this study on human participants because it fulfilled all the precepts of the Declaration of Helsinki. The participants and their tutors were informed. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

DS: conceptualization, methodology, investigation, resources, data curation, writing—original draft, supervision, and project administration. JG: conceptualization, methodology, software, investigation, resources, writing—original draft, and project administration. RC: methodology, software, formal analysis, writing—original draft, and visualization. MS: investigation, writing—review and editing, and visualization. All authors contributed to the article and approved the submitted version.

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# Aggression Dimensions Among Athletes Practising Martial Arts and Combat Sports

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**Purpose:** The main aim of the research was to analyse aggression dimensions among athletes practising martial arts and combat sports.

**Material and Methods:** There were 219 respondents. The Buss and Perry Aggression Questionnaire (BPAQ) in the Polish adaptation by Siekierka was applied.

**Results:** Martial arts apprentices turned out to present a statistically significantly lower level of hostility ( $p < 0.001$ ) and of the general aggression index ( $p = 0.04$ ) than combat sports athletes. It turned out that lower level of aggression was noted in female participants (physical aggression ( $p < 0.001$ ), verbal aggression ( $p = 0.004$ ), hostility ( $p < 0.001$ ), and the general aggression index ( $p < 0.001$ ). Analysis revealed that the training experience and the training rank did not differentiated the level of the respondents' particular aggression dimensions.

**Conclusions:** It would be advisable to perform parallel analyses in other areas of Poland and take into account the respondents' education and place of residence.

**Keywords:** judo, karate, aikido, wrestling, fencing, aggression

## INTRODUCTION

Statistics nowadays indicate an increasing number of crimes involving aggression, such as causing damage to health, engaging in a fight or beating, destroying or damaging property, or robbery crimes, i.e., mugging, extortion, or robbery with violence<sup>1</sup>. Aggression escalation also applies to sport, becoming a subject of growing concern among sports philosophers, pedagogues, and psychologists. It results in progressive dehumanisation and devaluation of sport, manifested in violence on sports pitches and stands (Cynarski and Litwiniuk, 2007; Vertonghen and Theeboom, 2010; Chahal and Chaudhary, 2012). It is worrying that aggression, even under the demands of rules and regulations, sometimes becomes the predominant source of players' excitement, pleasure, and satisfaction, or even the key motive for participating in sports (Krishnaveni and Shahin, 2014). Moreover, aggression combined with the desire to win often pushes athletes into breaching the principles of noble competition and makes fair play forgotten (Graczyk et al., 2010; Vertonghen and Theeboom, 2010; Krishnaveni and Shahin, 2014). Transferring the views of Bandura (2001) to the sports context, one could suppose that if athletes' aggressive behaviours are not punished or, worse, become rewarded (resulting in scoring a point, scoring a goal, winning a medal, or preventing the

<sup>1</sup> Available online at: <https://statystyka.policja.pl/st/informacje/57720,Przestepczoscmlodych-ludzi-zwiazana-z-agresja.html>

rival from doing so), they will be frequently observed during competitions (Bukowska et al., 2012; Chahal and Chaudhary, 2012). Bukowska et al. (2012) indicate that taking up physical activity can become a way to “clear oneself” of aggression in a socially accepted way. On the other hand, it can reinforce the tendency to react with more aggression in everyday life and strengthen the character traits that are useful in sports competition, but not necessarily in social life, such as bravery or obstinacy (Szmajke and Doliński, 1991; Vertonghen and Theeboom, 2010; Tomczak, 2013). The research conducted so far to investigate this problem has not yielded clear results. In view of the above, it is important to carry out further detailed studies.

It should be emphasised that in its majority, aggression observed in athletes' actions is instrumental in nature: the aim is to achieve non-aggressive benefits by means of aggressive behaviours (Mroczkowska et al., 2008; Klimczak et al., 2014; Martinkova and Parry, 2016). In sport, manifestations of uncontrolled aggression are undesirable for two reasons. They provide young people with negative behavioural patterns, at the same time distorting the image of sport (Mroczkowska et al., 2008), as well as increase the risk of a career-ending injury (Pedersen, 2007). In the case of combat sports, considering the propensity for violent behaviours is not only of cognitive significance because of the dangers associated with the athletes' extensive skills and strength, which can be employed outside the sports arena to use violence, engage in fights, and commit various crimes (Reynes and Lorant, 2001, 2002a,b, 2004; Graczyk et al., 2010; Klimczak et al., 2014; Martinkova and Parry, 2016; Harwood et al., 2017).

The awareness of the factors mentioned above, the inconsistencies in the results of previous studies, were inspirations to conduct our own investigations. There is no doubt that the goals, tasks, and other aspects related to sports competition and recreational practise of traditional martial arts are divergent (Figueiredo, 2009; Martinkova and Parry, 2016), so it was deemed reasonable to analyse aggression dimensions among people practising martial arts and combat sports.

## THE PURPOSE OF THE STUDY

The objective of the study was to determine whether there exists a difference with regard to aggression dimensions between respondents and the normative value (Tucholska, 1998), as well as between combat sports fighters and athletes practising martial arts and with the consideration of the training period and degree, and the respondents' gender.

The following research questions were submitted:

1. Is there a statistically significant difference in aggression dimensions between respondents and the normative value developed by Tucholska (1998)?
2. Is there a statistically significant difference in aggression dimensions between athletes practising martial arts and combat sports?
3. Do the factors of gender, training experience, and training rank determine the results of the studied variables, i.e.,

physical aggression, verbal aggression, angry, hostility and the general aggression index?

Due to the exploratory nature of the research, it was decided to abandon the research hypotheses.

It was expected that the analyses would significantly broaden the scope of the existing knowledge on the subject, thus allowing to obtain important results, especially in the field of humanities, i.e., psychology, sociology, pedagogy, and ethics. Besides, many authors (Tiric-Campara et al., 2012; Kuśnierz and Bartik, 2014; Martinkova and Parry, 2016; Harwood et al., 2017; Basiaga-Pasternak et al., 2020) indicate the scarcity of publications on martial arts and combat sports. It should also be added that the issue of aggression has been extremely rarely raised, especially in the last decade. Undoubtedly, all the above aspects also became an inspiration to perform own analysis.

## MATERIALS AND METHODS

### Participants and Procedure

The research was performed between March 2017 and November 2017 in sports clubs and sections of martial arts (Pszczynska Martial Art, capoeira, and aikido) and combat sports (judo, wrestling, fencing, taekwondo, and Kyokushin karate) in the Silesia Province in Poland. Nonprobability consecutive sampling was applied in the analyses. After obtaining permissions and support from the club or organisation representatives, researcher approached athletes. Researcher invited potential participants and presented the study aims and conditions. Informed consents were obtained. Those who agreed to participate in the study got the questionnaire with a request to fill it. The respondents were of both genders, at least 15 years old; they had been training martial arts or combat sports for at least 1 year. All individuals submitted a written consent to voluntarily participate in the research. In the case of minors, the consent was obtained from the parents or legal guardians. Over 550 questionnaires were distributed, 243 were collected back. However, some questionnaires were not filled in completely, and these were excluded from consideration. Owing to the above mentioned inclusion criteria and conditions, and lack of complete documentation, results obtained from 219 respondents underwent final analysis. Out of the participants, 113 (51.60%) practised martial arts and 106 (48.40%) were combat sports athletes. Women ( $n = 101$ ) constituted 46.12% of the study group. Their mean age equalled 23.61 years ( $SD = 4.83$ ). Men ( $n = 118$ ) constituted 53.88% of the study group, with the mean age of 24.31 years ( $SD = 5.91$ ). In the analyses, the respondents were divided into two groups depending on training experience: those who had been training for less (107 people) and for more than 5 years (112 athletes). The study also involved analyses depending on the participants' training rank. It was assumed that a high rank meant having at least 3 kyu (3 kup for taekwondo practitioners), and a white and orange colour for capoeira practitioners. In the case of martial arts styles whose representatives took part in the research, this rank is achieved, on average, by individuals after 2.5–3.5 years of regular training. The trainees have high technical skills; they are involved by instructors in conducting parts of the classes, e.g., warm-ups,

stretching, etc., and also act as assistants. For combat sports such as fencing and wrestling, the rank of a player was determined by the coach prior to the respondent's completing the questionnaire. The coaches were acquainted with the criteria applied in sporting level assessment, i.e., scores of the official ranking list and the sporting classes awarded for strictly defined achievements. In the statistical analyses, "high rank" referred to respondents who obtained very good (medal zone) or good (places 4–15) sports results in their age categories and achieved a regular increase in their sporting level. These competitors are already included in a specialised training phase. With these criteria, eventually, 94 subjects, including 43 combat sports athletes, had a low rank, and 125 individuals, including 62 martial arts practitioners, had a high rank.

The consent for conducting the research was obtained from the Bioethical Committee of the Academy of Physical Education in Katowice.

## Instruments

The diagnostic poll method with the questionnaire technique served to fulfil the assumed aims. A standardised research tool was applied. Aggression was assessed with the Buss-Perry Aggression Questionnaire (BPAQ) (Buss and Perry, 1992) in the version developed by the Amity Institute in Warsaw, Poland (Siekierka, 2005). The tool contains 29 statements designed to evaluate four dispositional components of aggression: physical aggression (e.g., I have threatened people I know.), verbal aggression (e.g., My friends say that I'm somewhat argumentative.), anger (e.g., Some of my friends think I am a hothead.), and hostility (e.g., Other people always seem to get the breaks.). The results for these subscales total the general aggression index of an individual. The task of the respondent was to rank the particular statements using a five-point Likert scale, where 1 meant "does not match my personality at all" and five stood for "fully matches my personality." The questionnaire is characterised by a clear theoretical model and satisfactory psychometric properties (Archer, 2004; Siekierka, 2005; Aranowska and Rytel, 2012). In the study conducted in Poland by Aranowska and Rytel (2012) exploratory and confirmatory models were evaluated among a sample of 3,990 Polish participants (aged from 10 to 79 years). A five-factor structure resulted in the exploratory analysis and five-factor structure showed acceptable fits in confirmatory analyses (with the Cronbach's  $\alpha$  ranging from 0.60 for angry to 0.87 for general aggression index.) Measures used to assess the fit of the model

to the data took acceptable values, i.e., Root Mean Square Error of Approximation—RMSEA = 0.06; Comparative Fit Index—CFI = 0.86, Normed Fit Index—NFI = 0.85 (Aranowska and Rytel, 2012). Aranowska and Rytel (2012) showed appropriate to high reliabilities for all scales, i.e., Cronbach's  $\alpha$  was 0.85 for physical aggression, 0.72 for verbal aggression, 0.83 for angry, 0.77 for hostility, and 0.89 for whole items. In own research, it was obtained indicators of the questionnaire reliability with the Cronbach's  $\alpha$  ranging from 0.75 for physical aggression to 0.81 for verbal aggression (Table 1). So, it turned out that all scales had satisfactory reliability (John and Benet-Martines, 2000).

The tool also included information for the participants describing the aim and subject of the research, as well as a list of demographic questions, which allowed to obtain data on the respondents' age, gender, training experience, and rank.

## Statistical Analysis

The basic analysis of the data employed descriptive statistics for the whole sample, for the groups of martial arts practitioners and combat sports athletes, as well as for the population stratified by gender, training experience, and training rank. The mean ( $M$ ), standard deviation ( $SD$ ), median ( $Me$ ), mode ( $Mo$ ), coefficient of variation ( $V$ ), and skewness ( $As$ ) were calculated. Kurtosis ( $Ku$ ) was used to measure concentration in the study. The distribution was tested for normality with the Shapiro-Wilk  $W$  test. Levene's test served to assess the equality of variances. The nature of the variable distributions, Levene's test results, and the sample size ( $n = 219$ ) allowed the use of parametric tests to verify the significance of differences between the tested variables (significance tests for differences in independent samples). The significance level was assumed at  $p < 0.05$ . In order to compare the levels of the aggression dimensions among the practitioners of martial arts and combat sports with the normative value developed by Tucholska (1998), a significance test called 'Difference between Two Means' was applied, available in the Statistica software. The effect size ( $ES$ ) was calculated (Cohen's  $d$ ) not only whenever statistically significant differences between the examined variables were revealed. It was assumed to be small for values ranging 0.2–0.49, moderate for values ranging 0.5–0.79, and large for  $ES > 0.79$  (Rodriguez, 2007).

Based on the data available on the website of the Central Statistical Office in 2018<sup>2</sup>, it was assumed that about 101,774 people practise martial arts or combat sports in Poland.

<sup>2</sup> Available online at: [https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5495/13/2/1/kultura\\_fizyczna\\_w\\_polsce\\_w\\_2018.pdf](https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5495/13/2/1/kultura_fizyczna_w_polsce_w_2018.pdf)

**TABLE 1 |** Skewness, kurtosis and Cronbach's alpha values.

Studied variable	<i>As</i>	<i>Me</i>	<i>Mo</i>	<i>V</i>	<i>Ku</i>	Cronbach's alpha
Anger	0.17	19.00	19.00	4.71	0.67	0.77
Physical aggression	−0.08	21.00	21.00	9.58	−1.11	0.75
Hostility	−0.60	22.00	23.00	7.65	0.57	0.76
Verbal aggression	0.42	15.00	15.00	5.58	1.04	0.81
General aggression index	−0.22	77.00	78.00	4.88	−1.16	0.79

Source: the authors' own research.

Therefore, it has been calculated<sup>3</sup> that 383 is the minimum recommended size for the own study. At the same time, it turned out that for the sample of 219 respondents, the margin of error was 6.62%. It should be added that in the case of 219 people participating in the own research, the confidence level above 86% was obtained.

The analyses were performed with Microsoft Office Excel 2010 and StatSoft Statistica v. 12.

## RESULTS

The study revealed cases of asymmetric (skewed) distributions. However, all variables fell within the range of  $<-1, 1>$ , both for the whole sample and irrespective of the type of physical activity undertaken by the respondent, their gender, training experience, and training rank. Thus, it was assumed that the distribution of the studied variable was moderately asymmetric. The kurtosis ( $Ku$ ) for all variables in each group fell within the  $<-2, 2>$  range, indicating that the concentration around the mean value was satisfactory (Table 1).

In the second step of the analysis, the results of the respondents were compared with the normative value developed by Tucholska (1998) (Table 2).

<sup>3</sup> Available online at: <http://www.raosoft.com/samplesize.html>

A statistically significantly lower level of hostility, and, in the case of the female gender, also of the general aggression index ( $p = 0.05$  in one-tailed test;  $ES = 0.23$ ), was observed among women ( $p = 0.002$  in one-tailed test;  $p = 0.004$  in two-tailed test;  $ES = 0.52$  and among men ( $p = 0.02$  in one-tailed test;  $p = 0.04$  in two-tailed test;  $ES = 0.30$ ) training martial arts and combat sports.

The following analyses considered the type of the undertaken physical activity (Table 3).

Martial arts apprentices turned out to present a statistically significantly lower level of hostility ( $p < 0.001$ ;  $ES = 0.49$ ) and of the general aggression index ( $p = 0.04$ ;  $ES = 0.28$ ) than combat sports athletes.

It was very important to implement analyses with the consideration of the respondents' gender (Table 4).

It turned out that only the level of anger ( $p = 0.75$ ) did not differentiate women and men. In the remaining cases, a lower level of aggression was noted in female participants. What draws attention is the effect size, which was large with regard to physical aggression ( $ES = 0.91$ ;  $p < 0.001$ ), small in the case of verbal aggression ( $ES = 0.40$ ;  $p = 0.004$ ), and moderate for hostility ( $ES = 0.66$ ;  $p < 0.001$ ) and the general aggression index ( $ES = 0.66$ ;  $p < 0.001$ ).

To answer the question whether the level of aggression dimensions depended on the respondents' training experience or

**TABLE 2 |** Comparison of the level of aggression dimensions between the respondents' results and the normative value.

Gender	Studied variable	Martial arts and combat sports practitioners		Normative value		p-value		Effect size
		M	SD	M	SD	One-tailed test	Two-tailed test	
Women	Anger	19.07	4.05	19.2	4.9	0.42	0.84	0.03
	Physical aggression	18.72	4.26	18.9	5.7	0.40	0.80	0.04
	Hostility	19.52	4.15	21.8	4.7	0.002	0.004	0.52
	Verbal aggression	14.06	2.90	14.5	2.9	0.14	0.29	0.15
	General aggression index	71.38	11.66	74.3	13.4	0.05	0.10	0.23
Men	Anger	19.24	3.78	19.1	4.6	0.41	0.81	0.03
	Physical aggression	22.62	4.29	22.9	6.4	0.35	0.71	0.05
	Hostility	22.25	4.15	23.6	5.1	0.02	0.04	0.30
	Verbal aggression	15.10	2.38	15.7	3.0	0.06	0.11	0.23
	General aggression index	79.20	11.86	81.4	14.8	0.12	0.24	0.17

Source: the authors' own research, with reference to Tucholska (1998).

**TABLE 3 |** Comparison of the level of aggression dimensions between martial arts and combat sports athletes.

Studied variable	Martial arts		Combat sports		t	df	p-value	Effect size
	M	SD	M	SD				
Anger	19.09	3.87	19.24	3.95	0.28	217	0.78	0.04
Physical aggression	20.38	4.71	21.29	4.65	1.44	217	0.15	0.20
Hostility	19.99	4.28	22.06	4.22	3.60	217	< 0.001	0.49
Verbal aggression	14.45	2.67	14.80	2.69	0.97	217	0.33	0.13
General aggression index	73.91	12.63	77.39	11.95	2.09	217	0.04	0.28

Source: the authors' own research.



training rank, a significance test for differences in independent samples was applied (Tables 5, 6).

The presented data imply that neither the training experience nor the training rank differentiated the level of the respondents' particular aggression dimensions.

## DISCUSSION

It turned out that in comparison with the normative value developed by Tucholska (1998), a statistically significantly lower level of hostility, and, in the case of the female gender, also of the general aggression index, was observed among women and among men training martial arts and combat sports. The obtained results of own analyses are in line with other authors' outcomes (Wojdat et al., 2017a), who also noticed that regardless of the respondents' gender, the hostility in athletes was lower as compared with the average for the Polish population. Furthermore, a lower level of hostility to the environment was

observed in karate, aikido, and taekwondo practitioners (Graczyk et al., 2010). In the same research, only boxers did not reveal a favourable effect of sport on this aggression dimension. These findings corroborate the earlier views of Graczyk (1994). It is worth emphasising that a lower level of hostility is beneficial for health, as confirmed by the research conducted in Finland by Sawicki et al. (2015). It turned out that the sense of hostility was associated with an increased risk of myocardial infarction and stroke, as well as the development of atherosclerotic diseases and diabetes. Additionally, people with high levels of this aggression dimension receive much less social support and face more negative attitudes in their working environment, which contributes to experiencing even more grief, uncertainty, injustice, and suspiciousness. The lower values of this aggression dimension determined both in the presented research and in reports by other authors (Wojdat et al., 2017a) indicate that practising combat sports, mainly traditional martial arts, can satisfy the need for belonging to a social group and contribute to

**TABLE 4 |** Comparison of the level of aggression dimensions between women and men.

Studied variable	Women		Men		<i>t</i>	<i>df</i>	<i>p</i> -value	Effect size
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Anger	19.07	4.05	19.24	3.78	−0.32	217	0.75	0.04
Physical aggression	18.72	4.26	22.62	4.29	−6.72	217	< 0.001	0.91
Hostility	19.52	4.15	22.25	4.15	−4.83	217	< 0.001	0.66
Verbal aggression	14.06	2.90	15.10	2.38	−2.92	217	0.004	0.40
General aggression index	71.38	11.66	79.20	11.86	−4.91	217	< 0.001	0.66

Source: the authors' own research.

**TABLE 5 |** The level of aggression dimensions depending on the training experience.

Studied variable	> 5 years of experience		<5 years of experience		<i>t</i>	<i>df</i>	<i>p</i> -value	Effect size
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Anger	19.10	3.92	19.22	3.90	−0.24	217	0.81	0.03
Physical aggression	21.38	4.74	20.24	4.58	1.79	217	0.07	0.25
Hostility	21.44	4.29	20.52	4.40	1.56	217	0.12	0.21
Verbal aggression	14.92	2.73	14.31	2.60	1.70	217	0.09	0.23
General aggression index	76.83	12.55	74.30	12.12	1.52	217	0.13	0.21

Source: the authors' own research.

**TABLE 6 |** The level of aggression dimensions depending on the training rank.

Studied variable	High rank		Low rank		<i>t</i>	<i>df</i>	<i>p</i> -value	Effect size
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Anger	19.47	3.82	18.74	3.95	−1.37	217	0.17	0.19
Physical aggression	21.27	4.48	20.22	4.81	−1.64	217	0.10	0.23
Hostility	21.45	4.45	20.38	4.25	−1.80	217	0.07	0.25
Verbal aggression	14.61	2.75	14.64	2.64	0.08	217	0.93	0.01
General aggression index	76.80	11.53	73.99	12.89	−1.67	217	0.10	0.23

Source: the authors' own research.

the feeling of confidence about the environment and to showing a friendly attitude to others, mutual cordiality, and kindness. Supinski (1991), after: Tomczak (2013) observed that karate and judo athletes, as well as boxers presented a statistically significantly lower level of aggression than female students of one of the secondary schools in Wrocław. Furthermore, Daniluk et al. (2004) found that national team judo athletes demonstrated low and moderate degrees of aggression as compared with the general population. Budnik (2004) revealed that karate practitioners were characterised by lower aggression intensity than students. In addition, Kuśnierz and Bartik (2014) proved that the practise of combat sports has a favourable impact on fighters; even though ju-jitsu fighters achieved the highest level of physical and verbal aggressions in groups under research, the general level of their aggression was lower than in the case of non-training persons. Mroczkowska et al. (2008) also noticed that in the case of wrestlers, judo athletes, and traditional karate practitioners, the general aggression index was far below the maximum outcome. It should be mentioned, too, that Wojdat et al. (2017a) observed a statistically significant relationship between education and a decrease in general aggression among judo athletes, regardless of gender, with a high determination indicator value. In the control group, this correlation was not implied (Wojdat et al., 2017b).

On the other hand, Szmajke and Doliński (1991) mention the results of studies showing that young people who train 'high contact' sports present a larger tendency toward aggressive behaviours, both in sport and in everyday life, than individuals with no such experience. Jasiński et al. (2002) also noticed that the level of anxiety and aggression was statistically significantly higher in training youth than among young people who had never practised hand-to-hand combat. Other authors also observed that contact sports fighters are more aggressive than contestants in non-contact sports (Chahal and Chaudhary, 2012; Kumar, 2015; Rui and Cruz, 2017). The results of own analyses are also not in line with research conducted by Tomczak (2013). He observed that women and men who practised wrestling or fencing, as well as female judo competitors achieved lower levels of aggression compared with the normative value. In the same study, karate competitors and foil fencers obtained results similar to those of the standardisation group respondents. Tomczak (2013) proved that on exceeding certain values, aggression may even interfere with effective functioning. The author noted negative correlations between physical aggression and the frequency of manifesting the style of planned actions both in judo competitors and in female foil fencers, the style of various actions in female foil fencers, and the effectiveness of sports action in male foil fencers. Tomczak (2013) also indicated that respondents with a higher level of hostility manifested a less diverse style than athletes with a lower average score in this variable. According to Tomczak (2013), a lower level of aggression has more significance in very precise disciplines, such as foil fencing, where special control is required. Furthermore, Wrześniewski (2015) revealed that taekwondo practitioners obtained higher levels of all aggression dimensions than the control group, consisting of physical education and physiotherapy students.

Own research showed that martial arts apprentices presented a lower level of hostility and of the general aggression index than combat sports athletes. Moreover, considering gender and type of the undertaken physical activity, it also turned out that both women and men practising combat sports obtained higher levels of hostility than martial arts respondents. Szmajke and Urbanowicz (2012) indicate that the tendency toward competition is not an inherent trait of human nature but a very strong instinct and that the necessity to engage in competition leads to negative social consequences. According to Aronson (1995), rivalry is not only among the main causes of inter-group prejudices and hostility, of a decline in openness and trust in relationships, but also constitutes a factor strengthening these phenomena. It is pointed out that the very expectation of competition usually leads to attributing negative features, reprehensible motives for action, and biased judgments to the opponent (Doliński and Szmajke, 1991; Szmajke and Urbanowicz, 2012). What is more, undertaking physical activity, as mentioned in the introduction, can reinforce the tendency to react with more aggression and fury in everyday life (Szmajke and Doliński, 1991). Thus, exercise can strengthen the character traits that are useful in sports fight, but not necessarily in social life. One might suppose that socialisation of anxiety and aggression behaviours based on rigid rules and principles of martial arts statistically significantly decreases their incidence in athletes. These views have been confirmed in publications by many authors (Jasiński et al., 2000; Lu, 2008; Mroczkowska et al., 2008; Krishnaveni and Shahin, 2014; Harwood et al., 2017). Kubacka-Jasiecka and Wrześniewski (2012) claim that although athletes practising martial arts for recreational purposes or participating in combat sports competitions have to self-induce a certain degree of aggression, they do not differ in this respect from individuals engaged in other sports disciplines or physical activities. These authors found average levels of aggression among aikido, karate, judo, taekwondo, and Krav Maga practitioners. Basiaga-Pasternak et al. (2020) proved that competitive and non-competitive combat sports athletes had similar level of all types of aggression. The obtained own results are in line with a study carried out by Budnik (2005), who observed a larger tendency to manifest aggression in sports karate competitors than in respondents practising the traditional form of this discipline. Mroczkowska et al. (2008) also indicated that the general aggression index was statistically significantly lower in people practising traditional karate than in judo athletes and wrestlers. It is worth adding that higher sociability, impulsiveness, and hostile aggression were observed among female basketball players than in female taekwondo practitioners (Litwiniuk and Daniluk, 2009). One should also refer to a study by Graczyk et al. (2010), who found a higher average level of emotional self-aggression in boxers and aikido competitors than in karate and taekwondo athletes. They noted the biggest mean indices of physical self-aggression, hostility to the environment, unconscious aggressive inclinations, as well as displaced and indirect aggression among boxers. These results are very close to those obtained in a prior research performed by Graczyk (1994). Besides, Mazur and Organista (2015) showed that women practising kickboxing

and wrestling achieved statistically significantly higher levels of physical aggressiveness than female respondents practising artistic gymnastics and synchronised swimming. The same research revealed that the difference in the total aggression index remained at the trend level, although it should be mentioned that women practising kickboxing and wrestling were slightly more aggressive again. The authors also noted that female wrestling competitors were characterised by a statistically significantly higher average level of suspiciousness and the feeling of guilt than women practising kickboxing. In addition, Vertonghen et al. (2014) found higher levels of physical aggression among kickboxing and Thai boxing athletes as compared with people practising judo, aikido, and karate. In turn, Kuśnierz et al. (2014) did not observe statistically significant differences in physical aggression among capoeira practitioners, boxers, and ju-jitsu competitors. It is worth emphasising that the lowest score was shown in respondents training capoeira, and the biggest average referred to both boxers and the control group, which consisted of high school and physical education students. The authors indicate that contemporary boxers are more prone to aggressive behaviours than previous generations undertaking this type of physical activity. Kuśnierz et al. (2014) proved that the highest mean value for verbal aggression was obtained by non-training respondents, and the lowest by capoeira practitioners. The highest level of anger was noted in the control group, and the lowest in ju-jitsu athletes. In turn, the highest level of hostility was found in the control group and boxers, and the lowest in ju-jitsu competitors. The biggest mean general aggression index was reported for the control group, and the smallest in ju-jitsu athletes. A study carried out by Piepiora et al. (2016) is also worth mentioning. The authors observed that practising different styles of karate, with different rules of kumite, did not differentiate competing athletes in terms of aggressiveness. They noticed that karate practitioners fighting in the semi-contact system (Shotokan karate) presented substantially lower levels of the general aggression index, physical and verbal aggression, and suspiciousness than other competitors in kumite systems. Karate athletes competing in mixed fighting (Shidokan karate) were characterised by significantly higher levels of physical aggression and irritability than those engaged in less violent forms of kumite. Knockdown karate (Kyokushin karate) practitioners tended to have significantly higher overall levels of aggression, both physical and verbal, and suspiciousness than representatives of the semi-contact system (Shotokan karate). Mixed fighting (Shidokan karate) athletes turned out significantly less physically aggressive and irritable than full contact (Oyama karate) fighters and relatively more negative and resentful than those competing in knockdown (Kyokushin karate). It should be emphasised that all the results for competitors and students are presented as average indicators of aggression.

As expected, the own analyses revealed that only the level of anger did not differentiate women and men. In the remaining cases, a lower level of aggression was noted in female participants. What draws attention is the effect size, which was large with regard to physical aggression, small in the case of verbal aggression, and moderate for hostility and the general aggression index. In turn, Wojdat et al. (2017a) noted that

among judo athletes, women obtained a statistically significantly lower average only with reference to physical aggression as compared with men. There is no doubt that aggression, especially physical aggression, is one of the functional dimensions for which differences between women and men are indisputable and have been regularly reported in the literature since the 1820s (Hyde, 2005; Rytel, 2011). The observed differences can be explained by biological, social, and evolutionary factors. They can result from the processes of learning aggression; according to the social role theory, gender differences are insignificant in early childhood but they become gradually intensified during childhood as a consequence of the gender role learning process (Rytel, 2011). In addition, as implied by the sexual selection theory, rooted in sociobiology and evolutionary psychology (Rytel, 2011), differences in the level of aggression should emerge early in ontogenesis and reach their highest values in young adults (aged 20–30 years), i.e., at the peak of the reproductive capacity (Archer, 2004, 2009). With reference to the former theory, the higher level of physical aggression in men than in women is associated with the requirements of the social role, while in the case of the latter, it results from the competition in the access to female partners, entailing the need to apply more risky strategies to guarantee a reproductive success. Both theories additionally assume that there are larger differences between males and females in physical than in verbal aggression (Rytel, 2011). The results of our own analyses related to verbal aggression can also be explained by referring to study by Rytel (2011). These authors indicate that for women, the language of conversation is primarily a means to communicate, build relationships, and create bonds. For men, in turn, talking is a way to remain independent and to gain and maintain position in the hierarchical social order. Our results are in line with research performed by Buss and Perry (1992), as well as with the meta-analysis conducted by Archer (2004), which revealed that most studies did not report statistically significant inter-gender differences in the anger variable. Exceptions included a study carried out in England in which a higher average value was observed in women, and an Australian one that revealed an escalation in the aggression dimension among men. It should be noted that Archer (2004) did not provide results concerning the level of hostility. The results of own research do not corroborate the studies in which no statistically significant differences were found between women and men for the aggression dimension (Nakano, 2001; Gerevich et al., 2007). The results of own research are partly in line with a study conducted by Rytel (2011).

Taking into account training experience, own results do not coincide with the outcomes obtained by other authors. Kurpel et al. (2005) observed that in wrestlers, aggression decreased with an increase of competition experience. According to Wrześniewski (2015), practising taekwondo reduces aggressive tendencies, but only after several years of training. Drumińska et al. (2016) revealed a trend toward lower general aggression with increasing training experience in children aged 12–15 years practising judo, taekwondo, and karate. However, in taekwondo athletes, positive correlations were observed between training experience and all aggressive tendencies except physical

aggression (Zalech, 2002), and the strongest relationship was demonstrated in the case of verbal aggression. Budnik (2004) noted that karate practitioners with longer training experience were characterised by a higher level of indirect aggression and suspiciousness than athletes with a shorter sporting career. Basiaga-Pasternak et al. (2020) noticed that despite the lack of statistical significance it was noted that the level of almost all types of aggression was higher in the amateurs than in the professionals. It is worth referring to a study performed by Wojdat et al. (2017a), who found a statistically significant relationship between the general aggression index and training experience among judo practitioners. However, it turned out that this correlation was negative in women and positive in men. It is suggested that an increase in the aggression level among athletes with longer training experience can result from frustration caused by lack of sports successes.

Regardless of gender, the own analyses revealed that neither the training period nor the training rank differentiated the level of the respondents' particular aggression dimensions. The obtained results are not in line with studies by other authors, who noted, for example, that practising judo decreased or did not influence the level of aggression (Lamarre and Nosanchuk, 1999; Nosanchuk and Lamarre, 2002). In turn, Reynes and Lorant (2001, 2002a,b); Reynes and Lorant (2004) observed an increase in aggression during judo training and its decrease as a result of karate training. According to these authors, practising combat sports can have a beneficial effect on aggression dimensions, but this can be demonstrated only after a longer period of training; in 10–12-year-old boys, 1 year's training did not yield the desired results (Reynes and Lorant, 2002a,b). Ziaee et al. (2012) implied that karate training had a positive impact on controlling aggression among adolescents, but no such influence was found in respondents practising judo. Attention should also be paid to the worrying results of a study by Rotter et al. (2015), in which a statistically significantly higher mean value for physical aggression was obtained among young people practising sports 3–4 times a week than in their less physically active peers. Among judo and wrestling competitors, a higher level of aggression was observed in athletes from the national team as compared with individuals at a lower training level (Zyto-Sitkiewicz, 1986), which is not in line with research carried out by Skelton et al. (1991), or Daniels and Thornton (1992). It has been indicated that sport engages people with a higher tendency toward physical aggression, and this aggression can only be alleviated with a strong sporting commitment (Reynes and Lorant, 2002a,b; Wojdat et al., 2017b).

On the basis of the results obtained in our own analyses and the research of other authors, it can be stated that aggressive behaviour can be changed, modified, and relieved, but also accumulated through physical activity (Mroczkowska et al., 2008; Vertonghen and Theeboom, 2010; Tiric-Campara et al., 2012; Kuśnierz et al., 2014; Martinkova and Parry, 2016; Harwood et al., 2017). So, these findings provide an important basis to understand

personality differences in aggressive-related variables, e.g., assess competitive state anxiety, the level of emotional intelligence, temperamental characteristics.

## CONCLUSIONS

Our research allows us to formulate the following conclusions:

1. As compared with the normative value (Tucholska, 1998), both women and men training martial arts and combat sports presented lower levels of hostility; in the case of females, this also applied to the general aggression index.
2. Lower values for hostility and the general aggression index were noted among those practising martial arts than in combat sports athletes.
3. Women demonstrated lower levels of all aggression dimensions, with the exception of anger, for which the difference turned out statistically insignificant.
4. The duration and level of training did not determine the degree of aggression in the respondents.

On the basis of the results obtained in our own analyses it can be stated that regular and with full commitment training combat sports and especially martial arts supervised by a trainer who pays attention to educational aspects and compliance with the rules can become a method of reducing the level of hostility. Martial arts with a centuries-long tradition are regarded in social opinions as a carrier of many desired, moral values and function as an education system for children and young people, not only in Eastern societies. On the basis of the own study, it should be noticed that it is worth introducing elements of martial arts into school physical education and as part of organised physical activity in free time.

It should also be noted that the levels of particular aggression dimensions are not constant, but characterised by a certain dynamics and changeability in a lifetime. The consciousness of these phenomena makes one thus approach any results obtained in a given moment with considerable caution. The results cannot be perceived as final conclusions. Also, because of the sample size, the research presented here should constitute, among others, a starting point for further considerations.

Among the possible areas of expanding this research project, performing longitudinal studies with the application of a cross-sectional and sequential analysis design seems justified. They would aim at determining the changes occurring in the motivational processes, the accepted hierarchy of values, as well as aggressive tendencies, e.g., during a 2-years training cycle. Moreover, as the presented research involved only sports clubs and sections of martial arts and combat sports located in the Silesia Province, it would be advisable to perform parallel analyses in other areas of Poland. It seems that taking into account the respondents' education and place of residence (as divided into the city and the country) would contribute to a more expanded analysis. In this way, the exploration of the subject and the study conclusions could become more comprehensive and more valuable.



## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Bioethics Committee of the Academy of Physical Education in Katowice (KB/04/2017 as of 13 February 2017). Written informed consent to participate

in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Effects of Attentional Control on Gait and Inter-Joint Coordination During Dual-Task Walking

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In the process of walking, attentional resources are flexibly allocated to deal with varying environmental constraints correlated with attentional control (AC). A dual-task paradigm was used to investigate the effects of AC on gait and inter-joint coordination. Fifty students volunteered to participate in this study. Based on the reaction time (RT) in the Stroop task, the top 15 participants were assigned to the High Attentional Control (HAC) group, while the last 15 participants were assigned to the Low Attentional Control (LAC) group. The participants in the two groups were randomly asked to perform three tasks: (i) single 2-back working memory task (ST 2-back); (ii) single walking task (ST walking); and (iii) dual task (DT). Cognitive outcomes and gait spatiotemporal parameters were measured. Continuous relative phase (CRP), derived from phase angles of two adjacent joints, was used to assess inter-joint coordination. The LAC group exhibited significant task effects regarding RT, correct rate (CR), step width, gait cycle, step time, forefoot contact times, heel-forefoot times, hip-knee mean absolute relative phase (MARF), and deviation phase (DP) in the stance and swing phases ( $p < 0.05$ ). In the HAC group, significant task effects were only detected in RT and foot progression angle of the left foot ( $p < 0.05$ ). Under the three task conditions, the LAC group exhibited a higher CR in ST, longer heel contact times, and longer heel-forefoot times when compared with the LAC group ( $p < 0.05$ ). Compared with the LAC group, the HAC group exhibited significantly smaller (closer to zero) MARF and weaker hip-knee DP values in the swing phase across all gait conditions ( $p < 0.05$ ). In the stance phase, the HAC group had smaller MARF (closer to zero) values when compared with the LAC group ( $p < 0.05$ ). In conclusion, the ability to maintain gait control and modulate inter-joint coordination patterns in young adults is affected by the level of attentional control in accommodating gait disturbances. AC is correlated with the performance of motor control, which theoretically supports the competitive selection of athletes and fall prevention strategies for a specific population.

**Keywords:** attentional control, gait, inter-joint coordination, dual-task walking, performance

## INTRODUCTION

In human daily life, many activities involve multitasking, which challenges both motor and cognitive functions. Attention plays an essential role in controlling human position and movement; for example, it regulates walking and balance (Woollacott and Shumwaycook, 2002; Möhring et al., 2018). It has been reported that safe walking is a highly attention-demanding task, which requires a

high level of mobility skills and cognitive flexibility to attend to a range of environmental demands in order to control movement direction, identify and track visual targets, and be able to read or talk (Lajoie et al., 1993; Buchman et al., 2011). We define attention as the information processing capacity of an individual, which is regarded as limited cognitive resources, for performing tasks affecting the central nervous system (CNS). Therefore, the number of activities that people can perform simultaneously is limited.

Most laboratory studies use the dual-task paradigm to reproduce such daily situations, which is the primary approach to studying the interactions between cognitive processing and motor behavior (Kerr et al., 1985; Abbud et al., 2009; Nordin et al., 2010; Hallal et al., 2013; Patel et al., 2014; Leone et al., 2017). In these studies, walking was performed in tandem with another attention-demanding task, and performance of one or both tasks may be deteriorated (Neumann, 1984; Wickens, 1989; Mcsp, 1996; Shumway-cook and Woollacott, 2000; Leone et al., 2017), which is believed to result from competition for attentional resources (Bynicksersonr, 1980) or competition for information processing neural pathways (Pashler, 1994). Gait is a complex process that requires integrating various sensory inputs from visual-vestibular and proprioceptive systems. These sensory inputs combine with the appropriate neuromuscular response and flexibilities of joint movements to achieve walking (Smith et al., 2017). However, in daily life, walking is often required to complete other behaviors or perform other thinking activities that are unrelated to walking itself. This ability to simultaneously perform multiple tasks and its impact on attention distribution to each task are the focus of current studies. Dual-task walking is a strong predictor of fall risk, disability, and mortality (Beurskens and Bock, 2012; Holtzer et al., 2017). The extent of the effects of dual tasks on walking depends on factors, such as age, type, and complexity of tasks. Regulation of dual-task walking can improve balancing abilities as well as the ability to selective apply attention (Verghese et al., 2012).

In most sports, higher requirements for coordination and stability between limbs, good limb coordination, and stability are closely associated with the excellent performance of athletes. Therefore, attentional control (AC) seems to be crucial. For instance, professional athletes need a wide breadth of attention, including the position and movement of teammates and opponents in order to perceive unexpected stimuli, thereby generating tactical response patterns and seeking original solutions in the game plan (Memmert and Furley, 2007). In skiing, in addition to skills, diverse external factors, such as temperature, wind, and snow conditions, affect the performance of athletes. Therefore, outcomes depend on how athletes manage their attentional resources, either by concentrating or distributing them (Florina et al., 2014). It has been defined that AC is the ability of an individual to transfer attention from a particular dominant environment to another subordinated information (Derryberry et al., 2003), which reflects the ability of an individual to allocate attention to environmental information (Rothbart et al., 1994) and is also part of cognitive control. Therefore, the cognitive control mechanism in the brain is an executive system that determines how to allocate limited

attentional resources, which is crucial for an individual to flexibly and dynamically adjust their performance in response to changing environmental demands and internal goals (Shenhav et al., 2013). Posner et al. reported that AC is associated with functions of the anterior attentional system that is located within the frontal region (anterior cingulate cortex) (Posner and Petersen, 1990; Posner and Rothbart, 1998) and plays a critical role in complex cognitive/attentional processing (Badgaiyan and Posner, 1998; Casey et al., 2015). Since the anterior cingulate cortex is influenced by emotions (Derryberry and Reed, 2002), tasks, and characteristics of individuals (Bush et al., 1999), AC varies with each individual. Enhancement of anterior system functions is associated with stronger voluntary control over orientation, conceptual processing, and behaviors, which allows for greater flexibility and control over dominant tendencies (Derryberry et al., 2003). Individuals with better AC and with a high level of precision and flexibility in controlling behaviors (Derryberry et al., 2003) are better at attenuating their fears, making effective plans and their implementation to be more likely (Compas and Boyer, 2001). Individual differences are associated with diverse ways through which people deal with negative or threatening information, as well as the coping efficiency associated with daily failures (Derryberry and Reed, 2002; Unsworth et al., 2012). Various studies have evaluated the role of AC in sports psychology (Corbetta and Shulman, 2002; Derryberry and Reed, 2002; Derryberry et al., 2003; Eysenck and Derakshan, 2011): however, the impact of AC on motor performance under dual task conditions have not received much attention.

This study aimed at elucidating the impact of cognitive tasks on gait and inter-joint coordination. We determined whether different AC affects gait and coordination in the completion of dual tasks and investigated the relationship between AC and motor control. We hypothesized that compared with High AC (HAC), the Low AC (LAC) group is more susceptible to cognitive tasks, has a weaker ability to maintain gait control and inter-joint coordination, and has a higher risk of falling.

## METHODS

### Participants

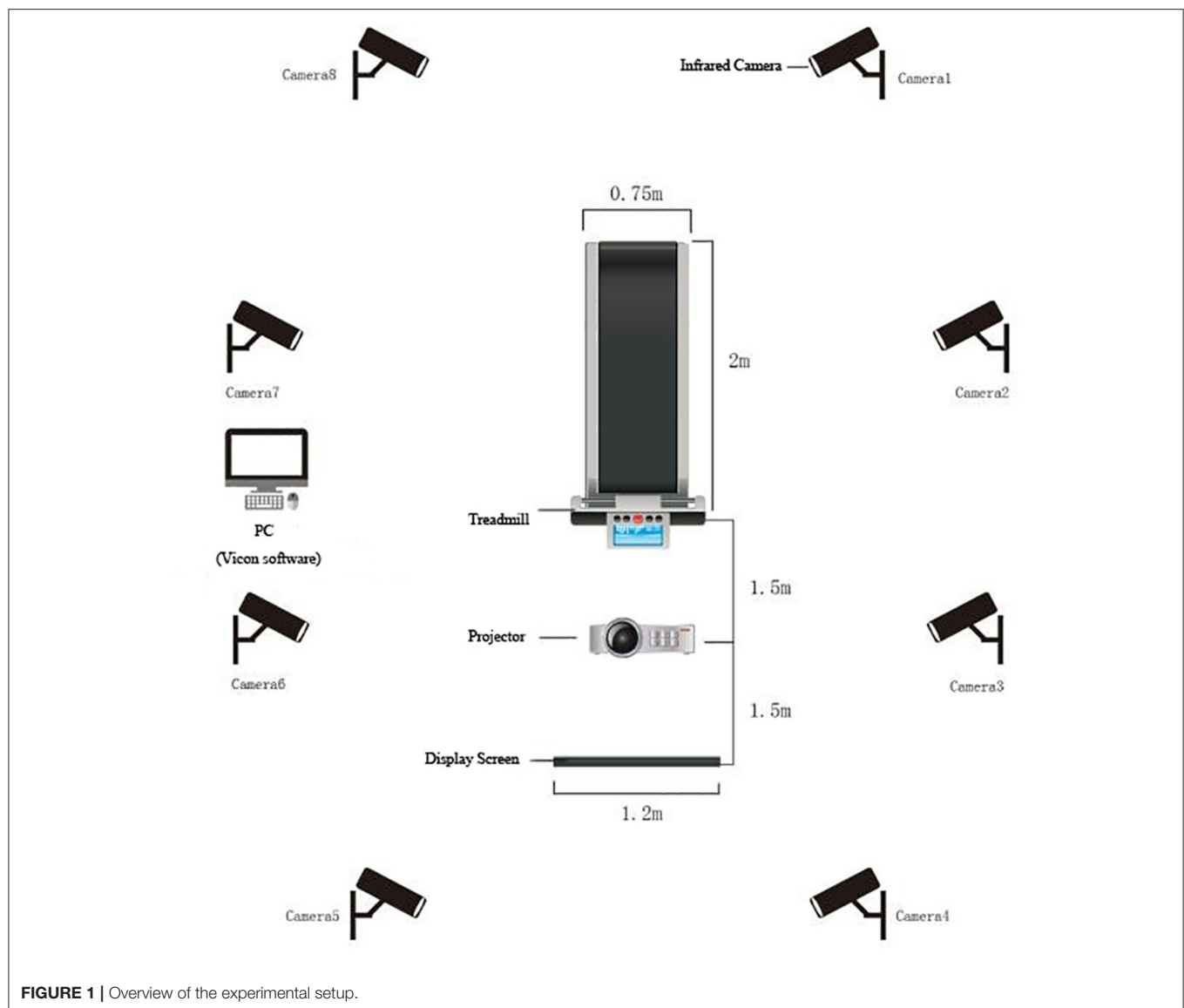
Fifty young male students were recruited from Soochow University and subjected to the Stroop task. Based on the reaction time (RT) of the Stroop task, they were ranked from low to high. The top 15 participants (30%) were assigned to the HAC group, while the last 15 participants (30%) were

**TABLE 1 |** Characteristics of participants per group.

	LAC ( <i>n</i> = 15)	HAC ( <i>n</i> = 15)
Reaction time (ms)	2615.21 (294.11)	1756.31 (127.62)
Age (yr)	21.00 (0.93)	20.67 (1.72)
Height (cm)	178.67 (4.30)	176.53 (7.55)
Weight (kg)	72.16 (8.83)	71.46 (10.36)

Values are presented as mean (*M*) (*SD*) unless stated otherwise.





**FIGURE 1** | Overview of the experimental setup.

assigned to the LAC group (Derryberry and Reed, 2002; Roelofs, 2003) (**Table 1**). Due to our consideration of gender differences, only men were included in the study. Participants were excluded from the study if they exhibited musculoskeletal pain, have had lower extremity injury during the prior 6 months, exhibited neurological impairments, exhibited cardiovascular or cardiopulmonary problems, and had contraindications to treadmill walking. All the participants were right-handed and heel strike, with a normal or corrected-to-normal vision. Ethical approval was obtained from the Ethics Committee of Soochow University (ECSU), and all the participants provided written informed consent.

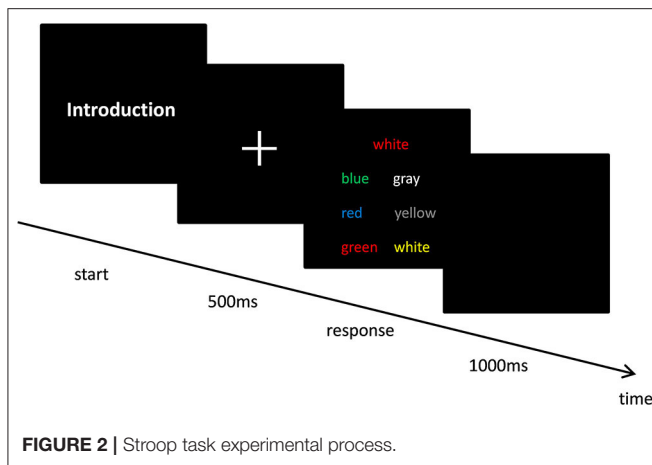
## Material and Apparatus

A projector (Panasonic BX30, Panasonic Inc., Osaka, Japan) and a screen placed directly in front of the participants were used to perform cognitive tasks. Response buttons were held

in both the left and right hands, and the E-prime software 2.0 (Psychology Software Tools, Inc, Sharpsburg, PA, United States) was used to record RT and correct rate (CR). Gait tests were performed on a motorized treadmill with a large pressure sensor embedded at the speed of 1.33 m/s (ZebrisFDM-T, Zebris Medical GmbH, Isny, Germany), which allowed for online detection of gait characteristics (e.g., gait cycle, gait speed, step length, step speed, step width, step time) (**Figure 1**). Eight high resolution IR cameras (Vicon, Inc., Oxford, United Kingdom) at a sampling rate of 100 HZ and a Vicon lower body plug-in gait marker set was used to capture kinematic data on the sagittal plane (Davis et al., 1991).

## Experimental Protocol

To quantitatively measure their ability for AC, 50 young male students were instructed to perform the Stroop task and answer the Attentional Control Scale questionnaire (Derryberry and



Reed, 2002). Given the correction ( $r = -0.352$ ,  $p = 0.001$ ) between two measurements, the groups were unequal in AC abilities (Peers and Lawrence, 2009; Judah et al., 2014). In the Stroop task, the participants were asked to select the correct option among six response options as quickly and as accurately as possible while displaying the target and response options on the screen (choose the color that matches the target itself rather than the color of word description). The experiment was repeated 90 times within 10 min and included 10 familiarizations and 80 formal tests. Only after the participants had selected the correct option was the next trial performed. The specific experimental process is as shown in **Figure 2**.

The experimental protocol consisted of a single task (ST) and a dual task (DT). This study describes gait performance as a motor function and cognitive task performance as a cognitive function. ST contains two conditions: (i) ST cognitive task: 2-back working memory task while sitting; and (ii) ST motor performance: walking. During the ST cognitive task, a series of 25 pseudo-randomized letters (A–J) was consecutively projected on the screen. Each white letter was presented against a black background for 500 ms with an interstimulus interval of 1,900 ms (E-prime2.0). The participants were required to respond after each letter: They pressed a button on the right hand if the letter on the screen matched the letter displayed two stimuli earlier (i.e., two back); otherwise, they pressed a button on the left hand if there was no match. There were 25 letters in the sequence, five of which were correct responses (20% of total stimuli) (Wrightson et al., 2016). Before beginning the ST motor performance test, participants were instructed to perform a familiar trail by walking on the treadmill at a speed of 1.33 m/s. After familiarization, the tests were completed without any cognitive task.

Regarding DT, participants were required to walk at a speed of 1.33 m/s after familiarization while simultaneously performing a 2-back task. They performed three 60-s trials (Potvin-Desrochers et al., 2017) per condition, presented in a randomized order, and counterbalanced across them. They were allowed a 5-min break between each trial (Wollesen et al., 2016) in each condition to prevent fatigue or boredom.

## Data Collection and Analysis

Correct rate and RT as cognitive outcomes were directly acquired by E-prime2.0 during both ST (sitting) and DT (walking). Gait-related parameters were step length, step width, foot progression angle, step time, gait cycle, contact time (forefoot, midfoot, heel), and heel-forefoot time, which were recorded using Zebris during ST (walking) and DT (cognitive-walking). Evaluation of the inter-joint coordination may elucidate essential timing and sequencing of the neuromuscular system control over biomechanical degrees of freedom. Variability of coordination may reflect the adaptability of this control. Moreover, CRP has been used in various studies to identify the pattern and variability of lower limb inter-joint coordination (Burgess-Limerick et al., 1993; Hamill et al., 1999; Lu et al., 2008; Chiu and Chou, 2012; Chiu et al., 2013). In this study, a custom-written MATLAB (Matlab R2013a, MathWorks, Natick, MA, United States) program was used to calculate CRP.

To minimize the influence of different movements in amplitudes and frequencies, normalization was performed to define the values of angular positions ( $\theta$ ) between 1 and  $-1$ , with the midpoint located at zero. Angular velocities ( $\omega$ ) were normalized by maximum absolute velocity (Hamill et al., 1999; Li et al., 1999; Chiu and Chou, 2012; Hein et al., 2012) with the following equations:

$$\theta_i = \frac{2 \times [\theta_i - \min(\theta_i)]}{\max(\theta_i) - \min(\theta_i)} - 1 \quad (1)$$

$$\omega_i = \frac{\omega_i}{\max\{|\omega_i|\}} \quad (2)$$

where  $\theta_i$  and  $\omega_i$  represent angular positions and velocity for each data point during a gait cycle. Phase angle ( $\varphi$ ) was calculated as  $\varphi = \tan^{-1}(\frac{\omega}{\theta})$  along each normalized data point and unwrapped to correct discontinuities occurring during angle computation (Chiu and Chou, 2012). Calculated phase angles were in the range of  $0^\circ$ – $180^\circ$ , with positive values in the first and second quadrants and negative values in the third and fourth quadrants. Then, four quadrant arctangent phase angles were normalized with the following equations (Hamill et al., 1999):

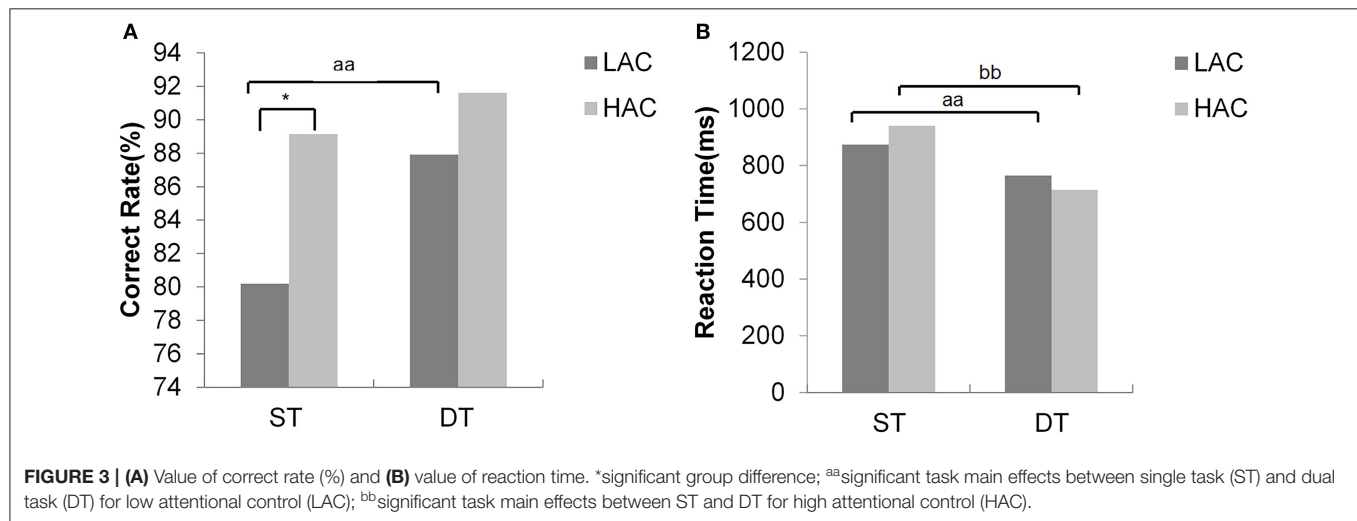
$$\begin{aligned} \varphi &= 180 + \left[ \arctan\left(\frac{\omega}{\theta}\right) \right] \\ \varphi &= \left[ \arctan\left(\frac{\omega}{\theta}\right) \right] \\ \varphi &= 180 - \left[ \arctan\left(\frac{\omega}{\theta}\right) \right] \\ \varphi &= \left[ \left[ \arctan\left(\frac{\omega}{\theta}\right) \right] \right] \end{aligned}$$

By subtracting the phase angle of the distal joint from that of the proximal joint ( $\varphi_{\text{Hip-Knee}} = \varphi_{\text{Hip}} - \varphi_{\text{Knee}}$ ;  $\varphi_{\text{Knee-Ankle}} = \varphi_{\text{Knee}} - \varphi_{\text{Ankle}}$ ), relative phase angles (RPAs) were obtained to identify adjacent joint coordination (hip-knee or knee-ankle) (Burgess-Limerick et al., 1993). If an RPA is close to  $0^\circ$  or  $\pm 360^\circ$ , adjacent joints move in a similar fashion or in-phase. If an

**TABLE 2 |** M (SD) values of cognitive outcomes during ST and DT for LAC and HAC.

	LAC		HAC		Group difference	Task difference
	ST	DT	ST	DT	<i>F</i> and <i>P</i> -value	<i>F</i> and <i>P</i> -value
CR (%)	80.19 (11.22) <sup>aa</sup>	87.92 (7.52) <sup>aa</sup>	89.13 (4.80) <sup>*</sup>	91.61 (4.03)	<b><i>F</i> = 7.00, <i>p</i> = 0.013</b>	<b><i>F</i> = 15.44, <i>p</i> = 0.001</b>
RT (ms)	874.78 (163.11) <sup>aa</sup>	765.40 (194.17) <sup>aa</sup>	940.32 (200.51) <sup>bb</sup>	714.13 (207.16) <sup>bb</sup>	<i>F</i> = 0.01, <i>p</i> = 0.916	<b><i>F</i> = 74.31, <i>p</i> = 0.001</b>

ST, single task; DT, dual task; LAC, low attentional control; HAC, high attentional control; CR, correct rate; RT, reaction time. <sup>\*</sup>Represents a significant effect. <sup>aa</sup>indicates *p* < 0.05; <sup>bb</sup>indicates *p* < 0.01. Bold values: significant *p*-values.



RPA approaches  $\pm 180^\circ$ , the adjacent joints move in an opposite fashion or out-of-phase (Hamill et al., 1999; Stergiou et al., 2001).

Differences in all points of the ensemble CRP curve over the stance and swing phases of a gait cycle were examined with mean absolute relative phase (MARF) and deviation phase (DP) (Stergiou et al., 2001). The MARF over stance and swing phases of a gait cycle was calculated to evaluate phase relations between joints.

A MARF value that is close to 0 indicates synchronous oscillation between the joints (Stergiou et al., 2001). The DP represented trial-to-trial variability and was used to compare systemic inter-joint characteristics within the stance and swing phases of a gait cycle. A high DP value indicated high coordination variability between two joints (Hamill et al., 1999; Stergiou et al., 2001).

## Statistical Analysis

Mean (M) and SD of the parameters were calculated using a two-way repeated measures ANOVA with group as the between-subject factor (HAC, LAC) and task as the within-subject factor (ST, DT). Paired sample *t*-tests were performed to test differences between ST and DT in LAC and HAC, respectively. Significance was set at *p* < 0.05. All statistical analyses were performed using the software SPSS statistics (17.0, IBM Inc., Chicago, IL, United States).

## RESULTS

### Cognitive Task Outcomes

The mean CR of HAC was higher than that of LAC in ST. Moreover, LAC exhibited significant differences in RT and CR ( $t = 4.08$ , *p* = 0.001;  $t = -3.57$ , *p* = 0.003). However, HAC only exhibited significant differences in RT ( $t = 8.02$ , *p* = 0) (Table 2, Figure 3).

### Gait-Related Parameters

There were significant task effects on step width ( $t = 2.69$ , *p* = 0.018), support phase ( $t = 2.67$ , *p* = 0.018;  $t = 4.32$ , *p* = 0.001, respectively), swing phase ( $t = -2.67$ , *p* = 0.018;  $t = -4.32$ , *p* = 0.001, respectively), double-support phase ( $t = 3.6$ , *p* = 0.003), right step time ( $t = -2.48$ , *p* = 0.027), left forefoot and right forefoot contact time ( $t = 4.46$ , *p* = 0.001;  $t = 3.85$ , *p* = 0.002, respectively), and left heel-forefoot time in LAC ( $t = -2.96$ , *p* = 0.01). However, significant task effects were only found on left foot progression angle ( $t = -2.23$ , *p* = 0.043).

Comparisons of gait-related parameters between LAC and HAC revealed that LAC was performed with longer heel contact times of left foot and right foot and longer heel-forefoot times of left foot and right foot in both conditions. None of the other gait-related parameters differed significantly between the groups (*p* > 0.05). Spatiotemporal gait parameters under the two conditions are shown in Table 3.

**TABLE 3 |** M (SD) value of spatiotemporal gait parameters during ST and DT for LAC and HAC.

		LAC		HAC		Group difference	Task difference
		ST	DT	ST	DT	F and P-value	F and P-value
Foot progression angle (°)	L	5.49 (5.12)	5.88 (5.24)	7.52 (4.20) <sup>b</sup>	8.48 (4.89) <sup>b</sup>	$F = 1.74, p = 0.198$	<b><math>F = 5.138, p = 0.031</math></b>
	R	8.84 (4.74)	9.56 (5.10)	9.25 (3.34)	10.10 (4.40)	$F = 0.09, p = 0.768$	$F = 3.83, p = 0.060$
Step length (/height)		0.75 (0.04)	0.76 (0.02)	0.76 (0.03)	0.77 (0.03)	$F = 1.30, p = 0.263$	<b><math>F = 5.11, p = 0.032</math></b>
Step width (cm)		12.93 (3.92) <sup>a</sup>	11.69 (2.95) <sup>a</sup>	10.67 (2.53)	10.20 (2.83)	$F = 2.96, p = 0.096$	<b><math>F = 7.93, p = 0.009</math></b>
Support phase (%)	L	62.29 (1.12) <sup>a</sup>	61.36 (1.93) <sup>a</sup>	62.00 (1.16)	61.71 (1.48)	$F = 0.01, p = 0.944$	<b><math>F = 7.45, p = 0.011</math></b>
	R	62.82 (1.20) <sup>aa</sup>	61.73 (1.71) <sup>aa</sup>	62.49 (1.04)	62.10 (1.02)	$F = 0.00, p = 0.958$	<b><math>F = 14.77, p = 0.001</math></b>
Swing phase (%)	L	37.71 (1.12) <sup>a</sup>	38.64 (1.93) <sup>a</sup>	38.00 (1.16)	38.29 (1.48)	$F = 0.01, p = 0.944$	<b><math>F = 7.45, p = 0.011</math></b>
	R	37.18 (1.20) <sup>aa</sup>	38.2 (1.71) <sup>aa</sup>	37.51 (1.04)	37.90 (1.02)	$F = 0.00, p = 0.958$	<b><math>F = 14.77, p = 0.001</math></b>
Double-support phase (%)		25.10 (2.18) <sup>aa</sup>	23.09 (3.59) <sup>aa</sup>	24.47 (1.83)	23.81 (2.18)	$F = 0.00, p = 0.957$	<b><math>F = 12.81, p = 0.001</math></b>
Step time (s)	L	0.49 (0.02)	0.50 (0.01)	0.50 (0.03)	0.50 (0.03)	$F = 0.09, p = 0.766$	$F = 4.14, p = 0.052$
	R	0.48 (0.02) <sup>aa</sup>	0.51 (0.01) <sup>aa</sup>	0.49 (0.03)	0.50 (0.03)	$F = 0.28, p = 0.599$	<b><math>F = 8.78, p = 0.006</math></b>
Forefoot contact time (%)	L	90.86 (1.80) <sup>aa</sup>	89.32 (1.84) <sup>aa</sup>	90.96 (2.24)	90.66 (2.72)	$F = 0.91, p = 0.348$	<b><math>F = 12.26, p = 0.002</math></b>
	R	90.73 (1.53) <sup>aa</sup>	89.35 (1.93) <sup>aa</sup>	91.15 (2.38)	90.50 (2.87)	$F = 1.03, p = 0.320$	<b><math>F = 15.52, p = 0.001</math></b>
Midfoot contact time (%)	L	71.23 (4.90)	70.68 (5.27)	70.65 (4.61)	71.33 (5.38)	$F = 0.00, p = 0.986$	$F = 0.01, p = 0.918$
	R	70.31 (5.16)	70.16 (5.52)	71.15 (4.07)	69.98 (6.28)	$F = 0.03, p = 0.858$	$F = 0.99, p = 0.33$
Heel contact time (%)	L	50.09 (7.29)*	51.43 (7.73)*	44.75 (6.64)*	44.89 (7.72)*	<b><math>F = 5.34, p = 0.028</math></b>	$F = 0.90, p = 0.351$
	R	49.95 (6.90)*	50.60 (7.28)*	42.88 (7.03)*	44.04 (8.86)*	<b><math>F = 7.33, p = 0.01</math></b>	$F = 0.64, p = 0.429$
Heel-forefoot time (%)	L	31.98 (5.51) <sup>a*</sup>	34.39 (5.19) <sup>a*</sup>	27.77 (7.23)*	29.92 (4.36)*	<b><math>F = 5.44, p = 0.027</math></b>	<b><math>F = 6.31, p = 0.018</math></b>
	R	31.35 (5.76)*	33.59 (5.05)*	26.37 (8.02) <sup>b*</sup>	29.96 (4.83) <sup>b*</sup>	<b><math>F = 5.65, p = 0.025</math></b>	<b><math>F = 5.33, p = 0.029</math></b>

ST, single task; DT, dual task; LAC, low attentional control; HAC, high attentional control; CR, correct rate; RT, reaction time.

\*Represents a significant group effect. <sup>a</sup>indicates a significant effect for LAC group. <sup>b</sup>indicates a significant effect for HAC group. \*indicates  $p < 0.05$ ; <sup>a</sup> and <sup>aa</sup> indicate  $p < 0.05$ ,  $p < 0.01$ , respectively; <sup>b</sup> indicates  $p < 0.05$ . Bold values: significant  $p$ -values.

## Inter-joint Coordination

Figures 4, 5 show phase angles of the hip, knee, and ankle joints of LAC and HAC under the two walking conditions and mean hip-knee and knee-ankle CRP curves of LAC and HAC under the two walking conditions, respectively.

Significant differences between gait conditions were detected in hip-knee MARP and DP in the stance phase for LAC ( $t = -2.89, p = 0.012$ ;  $t = -2.5, p = 0.026$ , respectively), consistent with the swing phase ( $t = 2.82, p = 0.014$ ;  $t = -2.3, p = 0.038$ , respectively). However, there were no statistically significant differences in HAC ( $p > 0.05$ ) (Figures 6, 7).

In the swing phase, HAC demonstrated significantly smaller (closer to zero) MARP and weaker hip-knee DP values in the swing phase across all gait conditions compared with LAC ( $F = 4.9, p = 0.35$ ;  $F = 4.2, p = 0.05$ , respectively, Figure 6). Similarly, during the stance phase, HAC exhibited smaller MARP (closer to 0) values when compared with LAC ( $F = 4.74, p = 0.038$ , respectively, Figure 7).

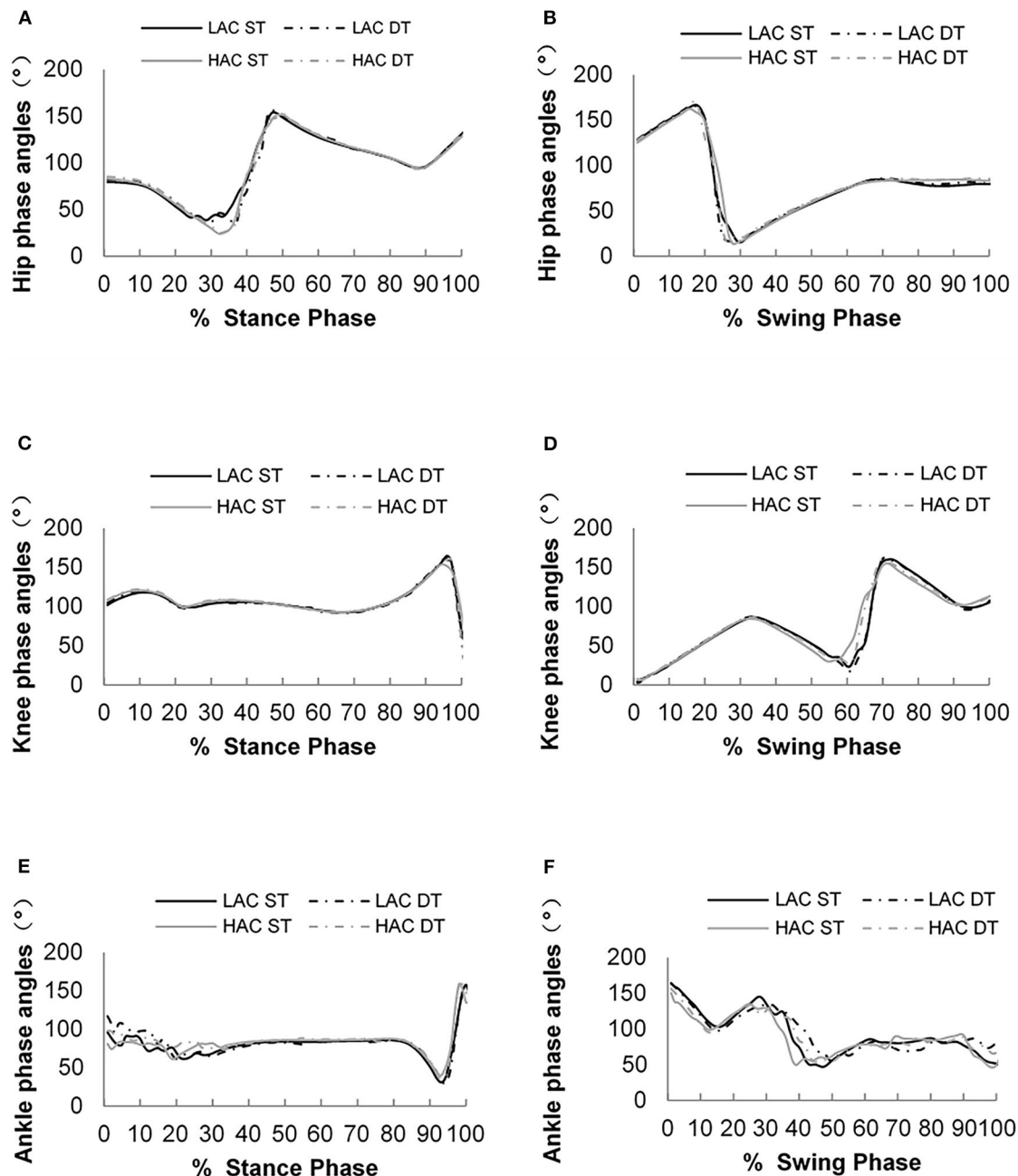
## DISCUSSION

In this study, we evaluated whether cognitive and motor performances under dual task conditions are different with different AC levels. As expected, CR was higher for HAC than for LAC in ST, which shed light on different levels of AC between the two groups (Derryberry and Reed, 2002; Derryberry et al., 2003). There were significant changes in CR, RT, gait cycle, and lower limb coordination for LAC, while there were no changes

in HAC, except for progression angle of the left foot. These outcomes indicate that different ACs are associated with different sensitivities to cognitive interference, consistent with previous findings that the ability to allocate attention resources vary with AC (Derryberry and Reed, 2002; Derryberry et al., 2003; Lonigan and Vasey, 2009). It has been reported that in LAC, with a higher sensitivity to distractions, it might be more difficult to ignore threatening distractors, even if these are known to be task-irrelevant (Paulewicz et al., 2012). However, it might be easier for HAC, with a high level of precision and flexibility in controlling behavior (Derryberry et al., 2003) and attention, to intentionally change the way in which their attention reacts to the presence of certain task-irrelevant stimuli (Derryberry and Reed, 2002). Hence, compared with HAC, it can be inferred that LAC may allocate more attention to cognitive tasks and less attention to walking or other movements.

Previous studies on ST have reported slower gait velocity, longer support time and step time, shorter swing time, narrower step width, shorter step length, and greater inter-joint coordination variability than those of DT (Plummer-D'Amato et al., 2008; Nordin et al., 2010; Peper et al., 2012; Chiu et al., 2013). In this study, LAC exhibited a shorter support time and forefoot contact time but a longer swing time, step time, and heel-forefoot time in DT. These unexpected results should be considered in the type of cognitive task. According to the U-shaped non-linear interaction model, the additional task, with varying cognitive challenges, may either improve or diminish balance performance (Huxhold et al.,

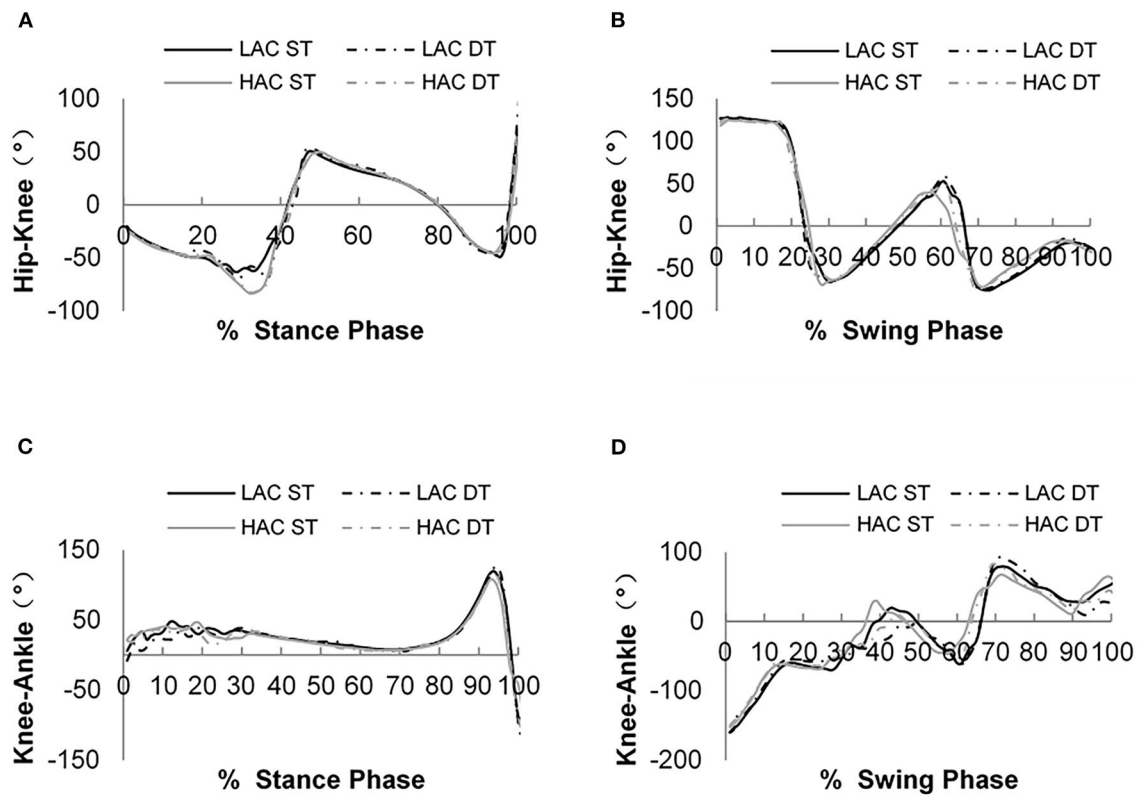




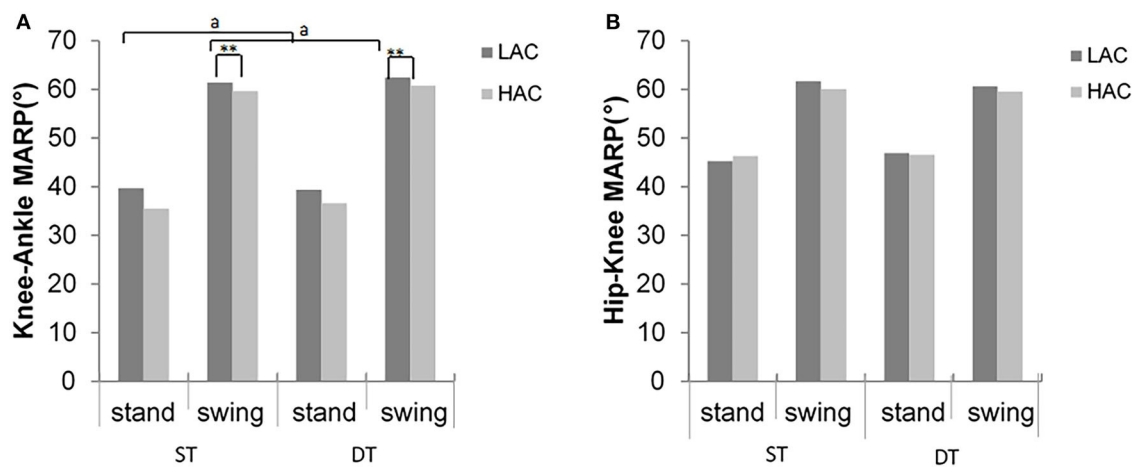
**FIGURE 4 | (A)** Phase angles of the hip joint during the stance phase; **(B)** phase angles of the hip joint during the swing phase; **(C)** phase angles of the knee joint during the stance phase; **(D)** phase angles of the knee joint during the swing phase; **(E)** phase angles of the ankle joint during the stance phase; and **(F)** phase angles of the ankle joint during the swing phase.

2006). Nordin E et al. reported that gait control is attention demanding; however, not all cognitive tasks affect gait in the same manner (Nordin et al., 2010). Moreover, pattern changes in hip-knee inter-joint coordination in the stance phase induced by cognitive task in LAC were greater than those in ST, while the change in the swing phase was weaker than that in ST. Since walking requires adequate integration

of peripheral information and communication between spinal and supraspinal structures (Fukuyama et al., 1997), peripheral information from somatosensory systems plays different roles in gait regulation that can be dependent on different gait phase. Therefore, dynamic postural demands and attentional requirements during walking vary from one phase to another (Regnaud et al., 2008; Abbud et al., 2009; Plummer-D'amato



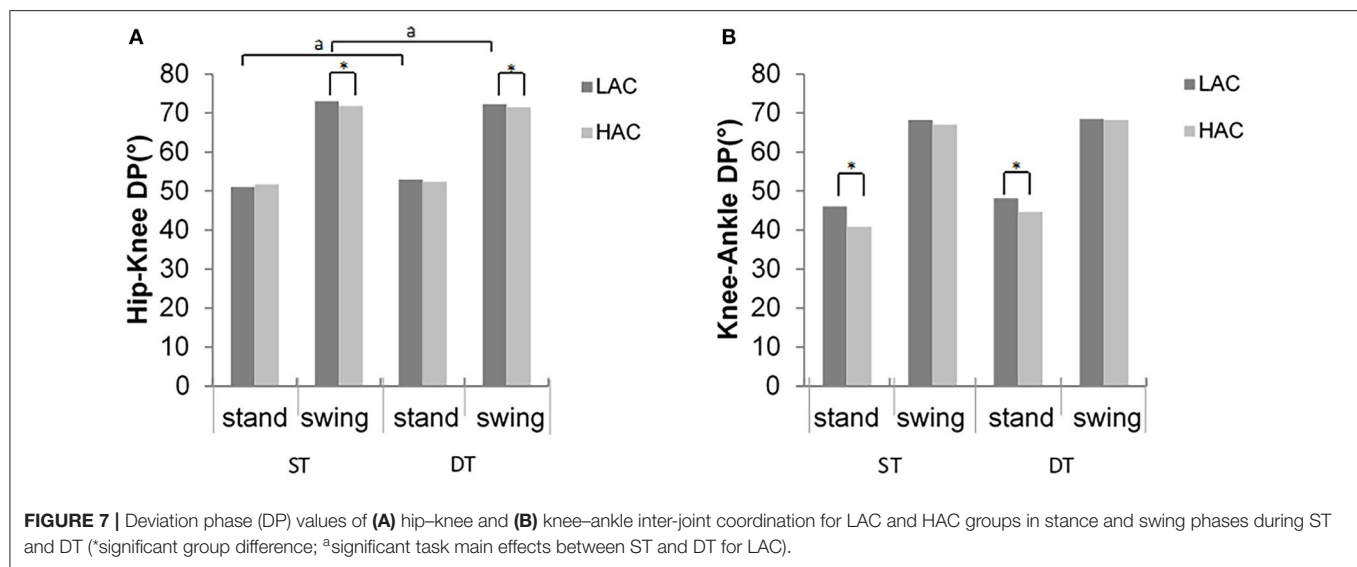
**FIGURE 5 |** (A) Hip-knee continuous relative phase (CRP) curves during the stance phase; (B) hip-knee CRP curves during the swing phase; (C) hip-knee CRP curves during the stance phase; and (D) knee-ankle CRP curves during the swing phase.



**FIGURE 6 |** Mean absolute relative phase (MARP) values of (A) hip-knee and (B) knee-ankle inter-joint coordination for LAC and HAC groups in stance and swing phases during ST and DT (\*\*significant group difference between LAC and HAC at 0.01; <sup>a</sup>significant task main effects between ST and DT for LAC at 0.05).

et al., 2010; Lo et al., 2017), resulting in different inter-joint coordination according to the phase of the gait cycle. Another explanation may be found in longer swing time for adjusting the posture and shorter stance time for adjusting the posture in DT.

Significant differences were found in contact times of heel, heel-forefoot times, and inter-joint coordination between LAC and HAC. First, LAC exhibited longer contact time of heel and heel-forefoot time, which indicated that when walking, LAC moved slower than HAC. Second, we found that changes



in hip-knee inter-joint coordination patterns during the swing phase and knee-ankle inter-joint coordination patterns during the stance phase of LAC were greater than those of HAC. These findings imply that HAC exhibits a more stable gait, with better hip-knee coordination patterns during the swing phase and knee-ankle coordination patterns during the stance phase. Since, coordination is important in maintaining dynamic balance (Winter, 1992; Lacquaniti et al., 1997), more out-of-phase coordination and greater hip-knee and knee-ankle inter-joint coordination variability in LAC compared with HAC could be contributing factors to gait imbalance in LAC (Chiu et al., 2013). Visual information plays a significant role in overcoming obstacles during the swing phase (Mcfadyen et al., 2007), and that visual inputs are vital in determining whether a participant can accurately place the foot on the ground in the terminal swing (Bent et al., 2004). Furthermore, the CNS selects an efficient control strategy that exploits lower limb dynamics to accomplish visual disturbance conditions, especially for controlling proximal joints (hip and knee) (Mcfadyen and Carnahan, 1997; Chiu et al., 2013). The hip, the most proximal joint of the lower limb, offered a more efficient means of elevating the swing toe than the knee and ankle (Lu et al., 2006). In this study, greater hip-knee coordination variability during the swing phase in LAC was associated with elevating the whole limb with increased knee flexion rather than the hip, which may be responsible for greater foot obstacle clearance and higher tripping incidents during the swing phase for LAC. Proximal joints play a greater role in balance control (Winter, 1995; Chiu and Chou, 2012), but the adjustment of distal joints might also be essential for accommodating complex walking tasks (Chiu et al., 2013). For example, in the stance phase, the ankle strategy was used in maintaining balance as a single-segment inverted pendulum by generating torque at the ankle during quiet standing (Karlsson and Lanshammar, 1997; Colobert et al., 2006; Lu et al., 2008; Gatev et al., 2010). To maintain stability during walking,

humans normally do not significantly adjust the sagittal plane position of the foot but rather adjust the center of pressure position and increase the push-off force to reduce the effort associated with maintaining stability during walking, reflecting the use of ankle joint moment (Bruijn and van Dieën, 2018). Therefore, decreased stability of knee-ankle coordination in the stance and swing phases may indicate increased difficulty in ankle joint control when modulating the stability of the body during LAC.

Therefore, differences in attention have a certain impact on movement stability and joint coordination, implying that we may need to select the population with HAC for sports with high requirements on movement coordination and movement stability. However, it has not been established whether it is possible to enhance athletic performance by training AC. This study is associated with some limitations. It has been established that we use visual targets (Rushton et al., 1998) to navigate through our environment and need specific topographic information to secure adequate foot placement. However, this study involved walking on the treadmill while looking ahead, where space was confined and fixed and unlike over-ground. Therefore, in both ST and DT, the participants could have partly distracted their attention resources when walking, which explains the same significant differences between LAC and HAC regardless of ST or DT. Another limitation is that we did not assess how the other types of DT interfered with different cognitive tasks. We only evaluated one type of DT, and further studies are needed to assess and validate gait and inter-joint coordination with different types of DT. In addition to target action performance, sports performance includes various interlaced connections between psychology and physiology. We only evaluated the performance of walking movement, which has some limitations. More studies are needed to evaluate the influence of AC on sports performance from other perspectives.

## CONCLUSION

In conclusion, LAC devotes fewer attention resources to the regulation of walking, resulting in poor gait adjustment ability and greater inter-joint coordination variability to perturbations. This finding implies that AC influences the ability to maintain gait control and modulate inter-joint coordination patterns when accommodating gait perturbations. Such differences may be explained, in part, by LAC limitations in cognitive flexibility, which is correlated with the reallocation of CNS capacity or resources. The findings suggest that there may be a correlation between AC ability and sports performance, which may be used to provide theoretical support for future studies on athlete selection and reduction of fall risk in a specific population.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Soochow University (ECSU).

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The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

CW, GW, and YZ prepared the original manuscript, figures, and tables. CW and GW analyzed the data, interpreted the results, and drafted the document. AL participated in the elaboration of experimental design and data interpretation. All authors approved the submitted version and contributed to the article.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.665175/full#supplementary-material>

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# Differences on Prosaccade Task in Skilled and Less Skilled Female Adolescent Soccer Players

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Although the relationship between cognitive processes and saccadic eye movements has been outlined, the relationship between specific cognitive processes underlying saccadic eye movements and skill level of soccer players remains unclear. Present study used the prosaccade task as a tool to investigate the difference in saccadic eye movements in skilled and less skilled Chinese female adolescent soccer players. Fifty-six healthy female adolescent soccer players (range: 14–18 years, mean age: 16.5 years) from Fujian Youth Football Training Base (Fujian Province, China) took part in the experiment. In the prosaccade task, participants were instructed to fixate at the cross at the center of the screen as long as the target appeared peripherally. They were told to saccade to the target as quickly and accurately as possible once it appeared. The results indicated that skilled soccer players exhibited shorter saccade latency ( $p = 0.031$ ), decreased variability of saccade latency ( $p = 0.013$ ), and higher spatial accuracy of saccade ( $p = 0.032$ ) than their less skilled counterparts. The shorter saccade latency and decreased variability of saccade latency may imply that the attentional system of skilled soccer player is superior which leads to smaller attention fluctuation and less attentional lapse. Additionally, higher spatial accuracy of saccade may imply potential structural differences in brain underlying saccadic eye movement between skilled and less skilled soccer players. More importantly, the results of the present study demonstrated that soccer players' cognitive capacities vary as a function of their skill levels. The limitations of the present study and future directions of research were discussed.

**Keywords:** saccadic eye movement, prosaccade task, cognitive processes, adolescent soccer players, skill level

## INTRODUCTION

Eye-tracking methods are widely used in various research domains such as psychology, psychiatry, or sport (Duchowski, 2003). They are popular because eye movement measures are easy to obtain and participants can understand eye movement tasks easily (Noiret et al., 2017). More importantly, eye-tracking methods provide unique means to measure cognitive processes (Thomas et al., 2021). Therefore, eye movement experiments are carried out in different populations in various research domains (Noiret et al., 2018).

Saccade is a rapid eye movement we typically make three times every second (Rayner, 1998). Saccadic eye movements can be characterized by several eye movement measures such as saccade latency (i.e., the time elapsed from the onset of the target to the onset of the first saccade after target onset), saccade velocity (i.e., the velocity of saccade), and saccade amplitude (i.e., the spatial distance between two successive fixations). The prosaccade task is a well-known experimental paradigm that is used to examine saccadic eye movements. In a typical prosaccade task, participants are instructed to fix on a central dot. Then, they have to direct their gaze toward a target dot appearing at the periphery as quickly and as accurately as possible. Research has shown that saccadic eye movements are associated with multiple cognitive processes including processing speed, attention, and inhibitory control (Hutton, 2008; Noiret et al., 2017).

For instance, some previous studies have revealed that the saccade latency needed to trigger a prosaccade in prosaccade tasks varies as a function of the attentional process (Clark, 1999; Pratt et al., 2006; Noiret et al., 2018). Noiret et al. (2017) found that saccade latency is influenced by information processing speed. Moreover, some research on some special populations has suggested that saccade latency variability is a good indicator of attentional fluctuation in saccadic eye movement tasks (Kaufman et al., 2010, 2012). Kaufman et al. (2010) found that patients with Lewy body had greater saccade latency variability than aged controls. Mostofsky et al. (2001) examined the saccadic eye movements of boys with Tourette syndrome. They found that boys with ADHD (i.e., attention deficit hyperactivity disorder) had greater saccade latency variability than boys without ADHD in the prosaccade task. Studies on Alzheimer's disease have shown that patients with Alzheimer's disease had longer saccade latency as well as greater saccade latency variability than healthy senior adults.

The purpose of the present study was to use the prosaccade task as a tool to investigate the difference in cognitive processing underlying saccadic eye movements in skilled and less skilled female adolescent soccer players. Soccer is a game that requires players to process a great amount of internal and external information under pressure within a limited time and react to complex and rapidly changing contexts (Vestberg et al., 2012). Soccer players have to distribute their attention over multiple objects (e.g., moving ball, teammates, and opponents) during games (Ando et al., 2001). Therefore, saccadic eye movement is a critical index for soccer players' performance. Some research has found that eye movement measures vary as a function of skill level in many sports. Ando et al. (2001) revealed that soccer players had shorter visual reaction time than nonathletes when responding to peripheral stimulus, indicating that soccer players had faster visual processing speed. Similarly, Zwierko (2008) found that handball players had shorter response time to peripheral stimulus compared to nonathletes. A recent study showed that cricketers had faster visual reaction times than nonathletes and cricketers' stability of gaze is associated with faster visual reaction time (Barrett et al., 2020). Moreover, some researchers examined the search behaviors of skilled and less skilled soccer players when viewing

film of defensive scenarios in soccer finding that skilled players exhibited more fixations, shorter duration, and more fixation locations than less skilled players (Ward and Williams, 2003; Williams and Ericsson, 2005; Williams, 2009; Roca et al., 2011).

In summary, previous studies have shown that there are differences in eye movement tasks among populations with various skill levels. However, to our knowledge, little work has used the prosaccade task to investigate the differences in saccadic eye movements between skilled and less skilled players. Some studies using the prosaccade task only focus on examining the cognitive changes of players caused by head impact exposure in contact and collision sports (Kiefer et al., 2018; Gallagher et al., 2020).

Therefore, the goal of the present study was to examine the potential differences in cognitive processes underlying saccadic eye movements between skilled and less skilled female adolescent soccer players by using the prosaccade task. Based on previous studies, we predict that skilled players would have higher cognitive ability and would thus perform better than less skilled players in prosaccade task. More specifically, we hypothesized that skilled players will exhibit shorter saccade latency, decreased variability of saccade latency, and higher spatial accuracy of saccade than their less skilled counterparts.

## MATERIALS AND METHODS

### Ethics Statement

This study was approved by the Ethical Committee of the Fujian Normal University. All participants provided their written informed consent to participate in this study. This study was performed in full compliance with the Declaration of Helsinki.

### Participants

The G\*Power tool (Erdfelder et al., 2009) was used to calculate the sample size in the present study. A statistical power analysis was conducted based on the reported effect size of skill level on saccade latency (mean Cohen's  $d=0.817$ , from Ducrocq et al., 2016). The result indicated with an alpha level of 0.05; at least 46 participants are required to get a power of 0.80 ( $n=23$  in each group). Therefore, we recruited 56 healthy female soccer players from Fujian Youth Football Training Base to participate in our experiment, which met the requirements of statistical power for replicating previous results. Their ages ranged from 14 to 18 years, with an average of 16.5 years. Each player was paid ¥50 for their participation. The experimental design of the present study is a one-way design. Players were assigned into two groups. The skilled player group consisted of 24 skilled players who were determined as Level 1 or Level 2 players. The less skilled player group consisted of 32 less skilled players who were determined as Level 3 or Level 4 players. The levels of players are determined by Fujian Provincial Sports Association according to the latest version of Technical Classification Standards of Soccer Players (2019 edition) developed by Chinese Football Association. **Table 1** reports the age, training years, and the skill level ranking for skilled



and less skilled players. Before participants were enrolled in the study, each of them was informed about the study protocol and gave his written informed consent. All participants had normal or corrected-to-normal vision, with no reported color blindness. None of them have suffered from any neurological or psychiatric disorders.

## Apparatus

The prosaccade task was programmed in Experimental Builder (SR Research Ltd.). The materials were presented on a 17-inch DELL PC laptop (DELL VOSTRO 15; resolution: 1,920×1,080 pixels; refresh rate: 150Hz). Stimulus was displayed in black (RGB: 0, 0, 0) on a grey background (RGB: 153, 153, 153). Participants were seated at a viewing distance of approximately 58cm from the computer monitor. A chin rest was used to stabilize the participants' heads. Participants viewed stimulus binocularly, while only their right eyes were monitored. Their eye movements were recorded using an Eyelink Portable Duo eye-tracking system with a sampling rate of 1,000 Hz.

## Procedure

The prosaccade task comprised 75 trials. Five of them were practice trials. Each trial began with a fixation cross ( $1^\circ \times 1^\circ$ ) at the center of the screen displayed for 1,000 ms. Then, the target circle ( $1.2^\circ \times 1.2^\circ$ ) was displayed with an eccentricity of  $\pm 10^\circ$  of visual angle in the horizontal plane for 1,500 ms (30 trials for each side), followed by an intertrial interval randomly varied between 800 and 1,200 ms. Participants were instructed to fixate at the cross to ensure that they were looking at the center of the screen when the target appeared peripherally. They were also instructed to look at the target circle as quickly and accurately as possible once it appeared.

Participants were tested individually in a quiet room. After reading the experimental instructions and a brief description of the apparatus, the chair was adjusted to make them feel comfortable, and the eye tracker was calibrated using a nine-point calibration and validation procedure. The maximal error of validation was below  $0.5^\circ$  in the visual angle. At the beginning of each trial, a black circle ( $0.5^\circ \times 0.5^\circ$ ) was presented on the center of the computer screen as drift correction. Once the participant successfully fixated on the black circle, following stimuli were displayed. The prosaccade task lasted about 12 min.

## Statistical Analysis

The raw eye movement data were analyzed using Data Viewer (SR Research Ltd.). To ensure the including eye movements

data are qualified, following criteria for inclusion were used in analyses (Jazbec et al., 2006): (1) saccades with a latency between 80 and 800 ms is observed, (2) saccade durations must be larger than 25 ms, and (3) saccade amplitude must be greater than  $3^\circ$ . This resulted in a loss of approximately 11% of the trials.

On the basis of these criteria, the following saccade indexes were derived: (1) saccade latency, which was defined as the time elapsed from the onset of the target to the onset of the first saccade after target onset. (2) Variability of saccade latency, which was defined as the standard deviation of saccade latency. (3) Saccade amplitude, which was defined as the spatial distance between the last fixation on fixation cross and the first fixation on target circle. (4) Spatial accuracy of saccade, which was defined as the distance (in degrees of visual angle) between the landing position of the first saccade toward the target circle and the center of the target circle. (5) Peak velocity, which was defined as peak value of gaze velocity (in visual degrees per second) of the saccade. (6) Average velocity, which was defined as average velocity of the saccade.

## RESULTS

Independent sample *t* tests were conducted to compare the difference in each index between skilled and less skilled players (Table 2). Skilled players had shorter saccade latency (167.33 ms, *SD*=23.32) than less skilled players (184.43 ms, *SD*=32.02),  $t(54) = -2.21$ ,  $p = 0.031$ . Additionally, skilled players had decreased variability of saccade latency (33.89 ms, *SD*=10.46) than less skilled players (45.00 ms, *SD*=24.30),  $t(54) = -2.57$ ,  $p = 0.013$ . Skilled players showed higher spatial accuracy of saccade ( $0.54^\circ$ , *SD*=0.11) than less skilled players ( $0.60^\circ$ , *SD*=0.08),  $t(54) = -2.20$ ,  $p = 0.032$ . The saccade amplitude, peak velocity, and average velocity of two groups of players were comparable ( $|t|s < 0.91$ ; see Figure 1).

## DISCUSSION

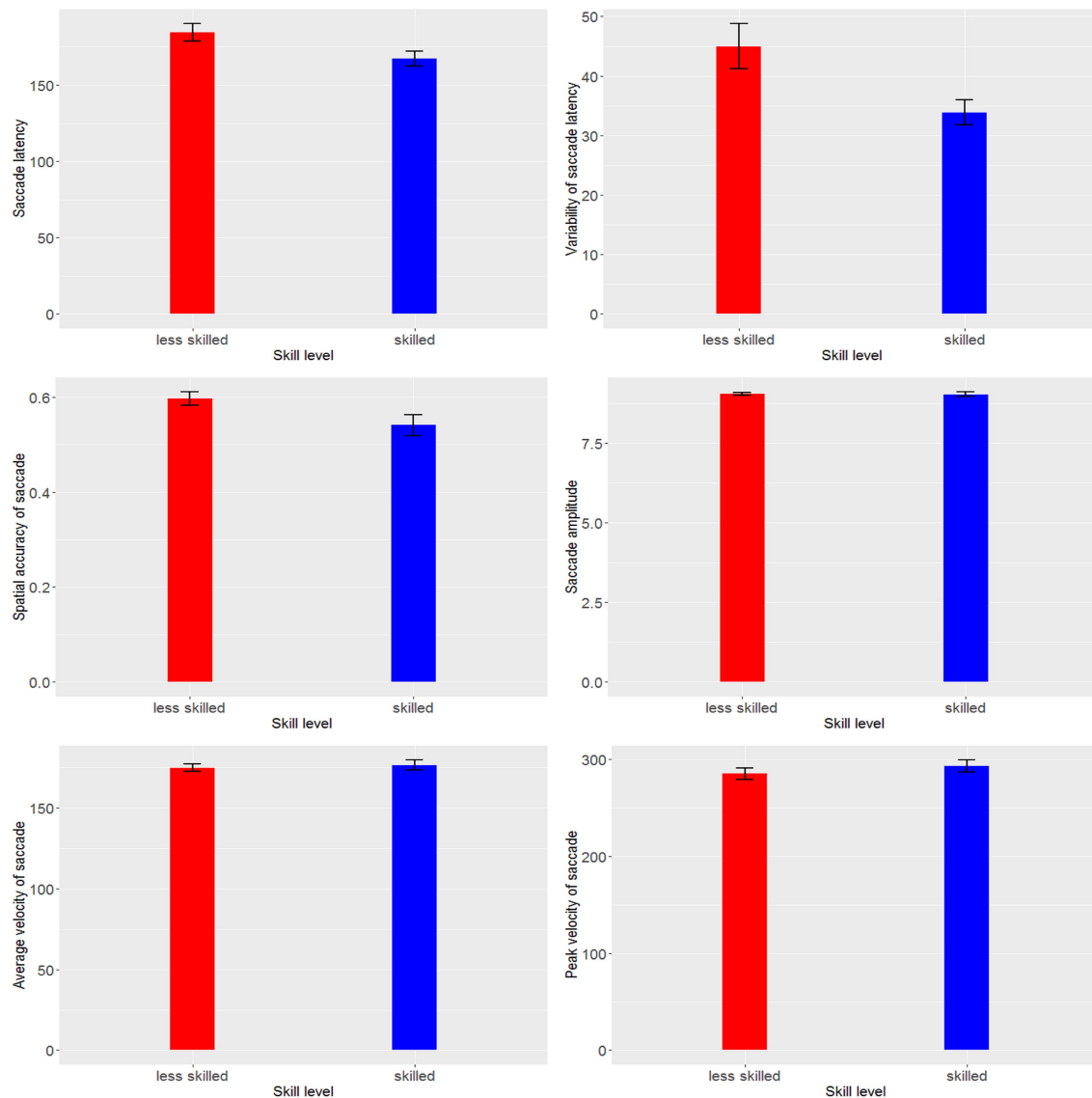
In the current study, we conducted prosaccade task to investigate the difference in saccadic eye movements between skilled and less skilled female adolescent soccer players. As we hypothesized, the results showed that the skilled players, as compared to their less skilled counterparts, were faster to saccade to the target appeared peripherally, exhibited less variability of saccade

**TABLE 1 |** Characteristics of skilled and less skilled adolescent soccer players.

	Skilled players ( <i>n</i> = 24)	Less skilled players ( <i>n</i> = 32)	<i>p</i>
Age (years)	16.6 (0.7)	16.4 (0.7)	0.197
Skill level ranking	1.5 (0.5)	3.5 (0.5)	<0.001
Training years	5.29 (0.62)	5.28 (0.58)	0.949

**TABLE 2 |** Mean (*SD*) of saccadic eye movement indexes in prosaccade task for two groups of players.

Indexes	Skilled players	Less skilled players
Saccade latency (ms)	167.33 (23.32)	184.43 (32.02)
Variability of saccade latency (ms)	33.89 (10.46)	45.00 (24.30)
Saccade amplitude ( $^\circ$ )	9.02 (0.35)	9.04 (0.26)
Spatial accuracy of saccade ( $^\circ$ )	0.54 (0.11)	0.60 (0.08)
Peak velocity ( $^\circ/s$ )	293.32 (29.56)	285.33 (34.21)
Average velocity ( $^\circ/s$ )	176.43 (15.02)	174.80 (12.05)



**FIGURE 1 |** Differences in saccadic eye movement indexes between skill and less skilled players.

latency, and more accurate saccade. Hence, our study supports the view that skilled players have higher cognitive ability and would thus perform better than less skilled players in prosaccade task.

The result that skilled players had shorter saccade latency than less skilled players suggests that skilled players had faster information processing speed than less skilled players. This is consistent with previous studies, demonstrating that saccade latency is influenced by information processing speed (Noiret et al., 2017, 2018) and others showing that saccade latency varies as a function of cognitive function (Coors et al., 2021; Thomas et al., 2021). More importantly, this result is also consistent with studies, demonstrating that players' cognitive capacities vary as a function of their skill levels (Vestberg et al., 2012, 2017; Glavaš, 2020).

Another critical result is that less skilled players exhibited larger variability of saccade latency than skilled players. Kapoula et al. (2010) suggested that variability of saccade latency could be used as a good index of attentional fluctuation in saccadic eye movement tasks. This is due to more attentional lapses caused by more attentional fluctuation in one's attentional system would contribute more longer reaction times in cognitive tasks (Schmiedek et al., 2007; McVay and Kane, 2012; Unsworth and Robison, 2016). This conclusion was supported by several studies, finding that individuals with inferior attentional system had larger variability of saccade latency than their counterparts with superior attention system (Mostofsky et al., 2001; Jazbec et al., 2006; Yang et al., 2013; Kiefer et al., 2018). Taken together, this result may imply that the attentional system of skilled soccer player

is superior which leads to smaller attention fluctuation and less attentional lapse.

The result also suggests that skilled soccer players' saccades are more accurate than less skilled soccer players. Previous studies have found that the spatial accuracy of prosaccade is mainly influenced by cerebellar (Ettinger et al., 2005; Optican, 2005; Coors et al., 2021), and the cerebellum, particularly the vermis, plays an important role in the spatial accuracy of saccade (Robinson and Fuchs, 2001; Leigh and Kennard, 2004). Hence, this result may imply that the function of cerebellum of skilled soccer player is superior to that of less skilled soccer. Moreover, this result also implies potential structural differences in brain underlying saccadic eye movement between skilled and less skilled soccer players.

No significant differences were observed in saccade amplitude, peak velocity, and average velocity. For saccade amplitude, previous study found that the saccade amplitude was mainly influenced by target eccentricity in prosaccade task (Petrella et al., 2019). On the one hand, the distance between the peripheral target and the position of the onset of saccade (fixation cross) is constant in the present experiment. On the other hand, all participants in this study had normal or corrected-to-normal vision. Therefore, the absent of significant difference between two groups in saccade amplitude is understandable. For saccade velocity, previous research has demonstrated that the peak velocity was relatively stable (Coors et al., 2021). Sparks (2002) suggested that, from the perspective of neurophysiology, peak velocity is subject to the number of spikes and firing rate of saccadic burst cells. Some researcher suggested that as people conduct approximately 200,000 saccades per day, the saccadic burst cells are continuously trained (Pratt and Welsh, 2006). Considering that all players in two groups had not suffered any neurological or psychiatric disorders or traumatic brain injury, their nervous system and oculomotor system should be normal and comparable. Therefore, it is also understandable that skilled and less skilled players did not differ in saccade velocity.

The findings of the present study shed some light on understanding of the relationship between saccadic eye movement and skill level in the field of sport and expertise. Besides, these findings supported the results of previous studies, indicating that cognitive ability differed as a function of skill level (Fontani et al., 2006; Brams et al., 2019; Barrett et al., 2020). Furthermore, the present study implies some practical applications for determining or predicting soccer players' skill level and cognitive abilities by analyzing their saccadic eye movements during some eye movement tasks. It would be more economical and convenient for coaches and training instructors to determine a player's skill level using some specific eye movement tasks.

Nevertheless, owing to the restriction of conditions, we should note that the present study has some limitations. For example, the current sample is representative of an adolescent, female, and soccer player sample. It remains unclear whether the results are fully generalizable to adolescent male or adult soccer players' samples. Likewise, it is also unclear whether the results are

fully generalizable to players in other sports. Besides, the relatively small sample was used in the present study as was subject to some objective circumstances. The future studies should include a larger sample to get greater statistical power to detect any differences between groups in cognitive processes on eye movements. Additionally, the current study only explored the differences in saccadic eye movements between skilled and less skilled soccer players using prosaccade task. Yet, growing body of research has shown that antisaccade task is a useful tool to examine the differences in inhibitory control and executive functions among different groups of population (Noiret et al., 2018; Gallagher et al., 2020; Bey et al., 2021; Coors et al., 2021). Therefore, future research should consider combining prosaccade task with antisaccade task when examining the saccadic eye movements of soccer players.

## CONCLUSION

In summary, the results of the current study suggest that skilled soccer players outperform less skilled soccer players on saccadic eye movement in prosaccade task indicating superior cognitive processes underlying saccadic eye movement in skilled soccer players. Overall, the present findings have implications for understanding the relationship between saccadic eye movements and skill level.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Academic and Ethics Committee of the Fujian Normal University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

ZJ contributed to the conception, design of the study, conducted the experiment, performed the statistical analysis, and wrote the first draft of the manuscript.

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The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.711420/full#supplementary-material>



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