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Cognitive Functioning, Physical Fitness, and Game Performance in a Sample of Adolescent Soccer Players

Alejandro Sabarit [1], Rafael E. Reigal [1] , Juan P. Morillo-Baro [1] , Rocío Juárez-Ruiz de Mier [1], Auxiliadora Franquelo [1], Antonio Hernández-Mendo [1] , Coral Falcó [2] and Verónica Morales-Sánchez [1],*

[1] Faculty of Psychology, University of Malaga, Campus Teatinos, 29071, Malaga, Spain; ale.sabarit@uma.es (A.S.); rafareigal@uma.es (R.E.R.); juanpablo.morillo@gmail.com (J.P.M.-B.); rjrm@uma.es (R.J.-R.d.M.); auxifranq@gmail.com (A.F.); mendo@uma.es (A.H.-M.)

[2] Department of Sport, Food and Natural Sciences. Western Norway University of Applied Sciences, Campus Kronstad: Inndalsveien 28, 5063, Bergen, Norway; Coral.Falco@hvl.no

* Correspondence: vomorales@uma.es

Abstract: The aim of this study was to analyze the relationships between cognitive functioning, physical fitness, and game performance in a sample of adolescent soccer players. Eighty-five boys from a soccer team in Rincon de la Victoria (Malaga, Spain), aged between 12 and 16 years, participated in the study. The D2 and Global-Local Attention (GLA) tests were used to evaluate selective and divided attention, respectively, and the Coding and Symbol Search tests of the Wechsler Intelligence Scale for Children (WISC-IV) were used for processing speed. To analyze physical fitness, the standing long jump test, speed test, and *Course-Navette* test of the Alpha-Fitness battery were used. Finally, the Game Performance Assessment Instrument (GPAI) was used to analyze sports performance in three vs. three small-sided games. The analyses showed that cognitive functioning was related to game performance. The results obtained suggest the importance of cognitive functions for performance in this sport.

Keywords: cognitive function; attention; physical fitness; soccer; adolescents

1. Introduction

In sports performance research, there is a need to describe the elements that determine the level of performance [1,2]. Specifically, in open sports such as soccer, which takes place in a dynamic context with a multitude of interactions and possibilities, the factors that modulate an athlete's performance are even more complex. Those that have been described include physical, technical, and tactical demands, field positioning, and players' roles, among others [3–5]. Although some authors have focused on individual actions to explain sports performance [6], there are numerous studies that have attempted to analyze the interactions between different variables and how these influence group factors, such as training and the tactical component, among others, to explain performance from a group dimension [7–9]. It is therefore essential to know which variables are the most decisive [10].

In recent years, researchers have focused on analyzing and relating physiological and anthropometric measurements and technical factors; however, other variables that increase the capacity to predict successful performance still need to be explored [11]. For this reason, other research has explored variables of a psychological and cognitive nature, considering that they help to understand why some athletes show greater talent and sports ability [12–15]. In this line, several studies have focused on the role of cognitive functions in sports performance, showing evidence of the importance of cognitive skills and information processing for successful performance in soccer [16]. On the basis of research published in recent years, cognitive functions appear to be particularly relevant in

high-performance sports, and elite athletes have been found to perform better than amateur athletes in tasks demanding attention, processing speed, and executive functions such as inhibitory control, cognitive flexibility, and working memory, among other skills [17–22].

Several studies have highlighted the relationship between cognitive functioning and soccer. Pursuing this line, several authors [23–25] have focused on basic tasks that require attention, perception, and processing speed, comparing a group of elite athletes with a group of amateur athletes and finding statistically significant differences in favor of the former. Vestberg et al. [22] investigated executive functions and their association with success as a function of the number of goals and assists in soccer, observing higher cognitive ability in a group of elite young players compared to the general population. A similar study conducted by Verburgh et al. [21] showed that improved performance in memory tasks, inhibition, attention, and processing speed are associated with increased sports participation, differentiating a group of elite young soccer players, a group of non-elite players, and a third group of non-athletes.

Other work indicates the importance of performance in executive functions for soccer players, showing that better performance in inhibitory control tasks and cognitive flexibility was achieved by high-performance players compared to low-performance players [26,27]. It has been suggested that the difference in performance between elite athletes and amateur athletes or non-athletes in tasks requiring these skills may be due to practicing physical activity, the number of hours of training being significant [28]. This idea supports the *selective improvement hypothesis*, according to which cardiorespiratory improvement has a positive impact on the development of cognitive skills [29]. A complementary idea along the same lines is the theory known as *component cognitive skills* [16,30,31], which suggests that sports training leads to more efficient neuronal connections and an improvement in neuronal plasticity.

Sports training itself allows athletes to improve their cognitive functioning [32,33], although the natural development of the nervous system would give each athlete a greater capacity to meet sporting demands. For example, various authors have highlighted the importance of myelination processes during childhood, which would influence their attentional capacity or the speed of their cognitive processing [34–37]. Likewise, there are studies that have highlighted how a training program can influence the cognitive abilities of soccer players [38], which would deliberately contribute to the processes of neuronal plasticity that would help to modify the structure and functioning of their brain [39–41]. Other research highlighted that the interaction between cognitive functions and motor skills influences the development of brain networks at a functional and structural level [42]. From a behavioral perspective, a recent study with young elite football players has highlighted the involvement of basic cognitive functions in motor skills, so that this relationship may provide a possible explanation for the possible differences in sporting performance between elite football players at these ages [43].

Thus, the purpose of this study was to analyze the relationships between cognitive functioning, physical fitness, and game performance in adolescent soccer players, specifically in competitive contexts of three vs. three small-sided games.

2. Materials and Methods

2.1. Design

A comparative and predictive design was used for this study [44]. It is a cross-sectional design, through which it will try to determine the relationships between the variables, the differences between groups, and the predictive capacity of some variables over others.

2.2. Participants

The sample was composed of 85 boys belonging to the *infantil* (under-14; n = 51) and *cadete* (under-16; n = 34) categories, aged between 12 and 16 years (mean (*M*) = 13.87; standard deviation (*SD*) = 1.33), belonging to a soccer club in the province of Malaga (Spain). The study began with

97 participants, but 12 were eliminated because they did not properly complete some tests, did not complete all the assessment tests, or withdrew during the process. In addition, those who did not provide informed consent signed by their parents were excluded.

2.3. Instruments and Measures

(a) Physical fitness. To determine the physical fitness of the participants, several exercises from the Alpha-Fitness battery were used [45]. These were the standing long jump test, to determine musculoskeletal capacity, the 4×10 m speed and agility (shuttle run) test, to determine motor capacity, and the 20 m round trip (shuttle run) test, to determine aerobic capacity or maximum oxygen consumption (VO_2max). The following formula was used to estimate the VO_2max measurement: $VO_2max = 31.025 + 3.238S - 3.248A + 0.1536SA$, where S is the maximum speed achieved and A is the age of the participant [46]. The body fat percentage was also analyzed using a bioimpedance meter (Tanita® BC-601 Body Composition Monitor).

(b) D2 Attention Test [47]. This test was used to analyze selective attention and concentration. It consists of 658 items distributed in 14 rows, which contain the letter d or p and may be accompanied by one or two dashes at the top, bottom, or both. The task is to select the letter d when it has two dashes in any position. The participant has a maximum of 20 s to complete each row, working from left to right and from top to bottom. The scores we extracted were total number of elements processed (TE), total number of hits (TH), errors of omission or misses (O), errors of commission or false positives (C), total effectiveness in the test (TET = TE − (O + C)), concentration index (CON = TH − C), row with the most elements attempted (TE+), row with the fewest elements attempted (TE-), and variation index (VAR = (TE+) − (TE−)).

(c) Global-Local Attention (GLA) test [48]. This test evaluates divided attention, specifically analyzing precision in distributing visual attention between global and local features of a stimulus. It facilitates the detection of difficulties in attending to the details of a stimulus or in processing different information at the same time. It is made up of 260 figures, and the task consists of detecting those stimuli that contain the figure "⊐", either in its "small" or individual form (local attention) or in its "large" or compound form (global attention), with an approximate duration of 10 min.

(d) Coding and Symbol Search Tests [49]. These are used, essentially, to evaluate cognitive processing speed, although indirectly they are also thought to evaluate attention and cognitive flexibility. In the Coding test, a series of symbols associated with a previously determined number must be copied. In the Symbol Search test, the participant has to decide whether one of two figures initially shown is represented in a group of symbols shown in parallel. The Processing Speed Index is derived from the scores obtained in these tasks. For both tests, the maximum time allowed is 120 s.

(e) Game Performance Assessment Instrument (GPAI) [50]. This tool was used to evaluate the performance of players during 3 vs. 3 small-sided games. Specifically, it analyzes the ability to resolve tactical situations using a precise technique. For this study, we obtained the Decision-Making Index (DMI), which evaluates the decisions made during play, the Skill Execution Index (SEI), which evaluates whether appropriate techniques were used, the Support Index (SI), referring to moves made to help teammates resolve a situation, the Participation Index (PI), a global index of involvement during play, and the Game Performance Index (GPI), a global index of effectiveness during play. Previous studies have evaluated the reliability and validity of the GPAI, obtaining satisfactory data [50–52].

2.4. Procedure

Firstly, the sports club was contacted to agree on a meeting with the coordinators, at which a work schedule was established, specifying the days on which the evaluation would be carried out and the type of activity that would be performed in each session. In addition, informed parental consent was obtained, respecting at all times the ethical principles established in the Declaration of Helsinki by the World Medical Association (WMA) [53]. The study was also previously approved by an ethics committee of the University of Malaga.

Secondly, all the participants were evaluated. There was one session per week for each team, always involving the same activity, and the same order of participation per group was followed each week. The duration of each session ranged from 30 to 60 min. The evaluation was conducted over a period of 4 weeks, during which several collaborators were involved.

In the first week, cognitive skills were assessed in the club's press room, a space free of noise and distractions. In the second week, physical fitness was evaluated. In the third week, small-sided games were played, and these were recorded for later observation. The field was divided into 3 sections, in which 3 games were played simultaneously. A warm-up and tune-up were carried out before the games. In the last session, the players were summoned 30 min before the start of training to take their body composition measurements.

The format of the small-sided games used for this study was 3 vs. 3 in a 20×20 m playing area (total: 400 m^2, 66.66 m^2 per player), and 3 periods of 4 min each were played. The objective of the game was to keep possession of the ball, without limitation on the number of touches. A SONY$^{®}$ DCR-DVD 505E camera was used to record the games. Subsequently, the GPAI was used to obtain the players' indices: DMI, SEI, SI, PI, and GPI.

2.5. Statistical Analyses

First of all, we analyzed the observations data to obtain the reliability and quality of the data, with the small-sided game as the unit of analysis. The observational records were obtained by means of the GPAI and we used the Pearson, Spearman, Kendall's tau-b (frequencies and intensities), Cohen's kappa, and Phi correlation coefficients, obtaining the averages of each score grouped by categories. For this purpose, we analyzed three observations by two observers, after a previous training session. Two observations were made by the same observer in two points in time and a third observation was made by a second observer. Subsequently, the descriptive analyses and the Kolmogorov–Smirnov normality test were performed to know if parametric or non-parametric tests could be used. Thus, Pearson correlations were estimated to measure the degree of relationship between cognitive functioning and physical fitness with game performance. Linear regression analysis was also used to show the predictive capacity of cognitive functioning on game performance. In these models it has been calculated the coefficient of determination (R), the coefficient of determination adjusted (R^2), the Durbin–Watson index, the Tolerance index, and the Variance Inflation Factor index. Finally, cluster analyses were performed to generate two groups based on the selective attention and cognitive processing speed variables, comparing the differences in GPAI measures in these clusters using the Student's t-test and Mann–Whitney U test. The Shapiro–Wilk normality test was performed. The effect size of the differences between groups was evaluated by Cohen's *d*. The SPSS v.23 and HOISAN programs [54] were used to perform these analyses.

3. Results

3.1. Intra-Observer and Inter-Observer Reliability

First, intra- and inter-observer reliability analyses were performed to ensure that the data obtained with the GPAI was adequate. For this, correlation analysis was used, as shown in Tables 1 and 2. The analyses were performed by age category, with each small-sided game as the unit of analysis. The results showed correlation indices of well over 0.80, while the scores of the measures of agreement between observations were over 0.70 for a permitted deviation of ±1 frame, and close to 0.90 for a permitted range of ±7 frames. According to Landis and Koch [55], the measures of agreement between observations are considered "substantial" from 0.80, thus, these values are sufficient for both intra-observer and inter-observer reliability to be considered good, with agreement between observations at different time points and with adequate agreement between different observers.

Table 1. Intra-observer reliability analysis by age category.

					Cohen's Kappa				Phi Coefficient			
	r	ρ	tb (F)	tb (I)	±1	±3	±5	±7	±1	±3	±5	±7
Under 14	0.99	0.95	0.92	0.91	0.79	0.89	0.92	0.92	0.80	0.88	0.91	0.92
Under 16	0.99	0.97	0.94	0.94	0.78	0.90	0.92	0.93	0.79	0.90	0.92	0.92

Note: *r* = Pearson correlation coefficient; ρ = Spearman correlation coefficient; tb (F) = Kendall's tau-b (frequencies); tb (I) = Kendall's tau-b (intensities).

Table 2. Inter-observer reliability analysis by age category.

					Cohen's Kappa				Phi Coefficient			
	r	ρ	tb (F)	tb (I)	±1	±3	±5	±7	±1	±3	±5	±7
Under 14	0.99	0.88	0.88	0.86	0.65	0.79	0.82	0.84	0.66	0.79	0.81	0.83
Under 16	0.99	0.91	0.85	0.84	0.70	0.80	0.83	0.84	0.70	0.79	0.82	0.83

Note: *r* = Pearson correlation coefficient; ρ = Spearman correlation coefficient; tb (F) = Kendall's tau-b (frequencies); tb (I) = Kendall's tau-b (intensities).

3.2. Descriptive and Normality Analyses

Second, descriptive and normal statistics are shown for physical fitness, cognitive functioning, and GPAI variables, as shown in Table 3. These analyses will decide the use of subsequent parametric or non-parametric tests. The results show normality problems in some variables (GLA-Global Execution, GLA-Total Execution, and GPAI-SI), which have been adjusted in all cases using the 1/x (GLA-Total Execution) and x^2 (GLA-Global Execution, GPAI-SI) algorithms. These algorithms allow for obtaining equivalent data distributions but adjust for normality problems.

Table 3. Descriptive measures and Kolmogorov–Smirnov test for the physical fitness variables analyzed.

	M	*SD*	*S*	*K*	*K–S*
Age	13.87	1.33	0.15	−1.19	0.21
Physical fitness test					
Body fat %	17.65	4.69	1.45	2.78	1.28
Standing long jump	197.42	24.93	0.12	−0.65	0.80
VO$_2$ max	48.27	7.05	0.62	0.60	0.83
Speed test	10.46	1.18	−0.23	−0.09	1.32
Attention test					
D2-TE	62.00	20.03	−0.21	−0.38	0.71
D2-TH	58.41	20.28	−0.05	0.03	0.77
D2-O	42.61	20.83	−0.04	−0.02	0.74
D2-C	44.92	17.73	−0.60	−0.08	1.31
D2-TET	59.99	19.74	−0.09	−0.16	0.65
D2-CON	56.22	21.26	−0.15	0.02	0.64
D2-TE(+)	65.35	19.65	−0.51	0.45	0.84
D2-TE(−)	59.87	24.66	−0.08	−0.61	0.89
D2-VAR	58.25	21.54	−0.43	0.01	0.97
GLA-Local Execution	54.52	37.27	−0.29	−1.49	1.27
GLA-Global Execution	49.02	36.21	−0.06	−1.53	1.34 *
GLA-Total Execution	51.49	36.71	−0.14	−1.60	1.42 *
GLA-Relative Execution	58.99	33.75	−0.32	−1.35	
Processing speed test					
WISC IV-Coding	10.09	2.71	−0.17	−0.33	1.00
WISC IV-Symbol Search	10.48	4.25	−0.27	−0.23	1.08
WISC IV-Processing Speed Index	102.66	15.67	−0.20	−0.53	0.71

Table 3. *Cont.*

	M	*SD*	*S*	*K*	*K–S*
Playing behavior					
GPAI-DMI	0.76	0.10	−0.91	2.19	0.88
GPAI-SEI	0.72	0.10	−0.25	0.21	0.65
GPAI-SI	0.93	0.07	−1.09	0.56	1.76 **
GPAI-PI	25.76	5.84	−0.12	−0.44	0.47
GPAI-GPI	0.81	0.07	−0.82	2.52	1.03

Note: *M* = mean; *SD* = standard deviation; *S* = skewness; *K* = kurtosis; *K–S* = Kolmogorov–Smirnov test; % = percentage; VO_2max = maximum oxygen consumption rate (ml/kg/min); D2 = D2 test; TE = total number of elements processed; TH = total number of hits; O = errors of omission (misses); C = errors of commission (false positives); TET = total effectiveness in the test; CON = concentration index; TE+ = row with the most elements attempted; TR− = row with the fewest elements attempted; VAR = variation index; GLA = Global-Local Attention test; WISC-IV = Wechsler Intelligence Scale for Children IV; GPAI = Game Performance Assessment Instrument; DMI = Decision-Making Index; SEI = Skill Execution Index; SI = Support Index; PI = Participation Index; GPI = Game Performance Index. * p < 0.05; ** p < 0.01.

3.3. Pearson Correlations

Third, to determine the relationships among the study variables, correlation analyses were performed, as shown in Table 4. These analyses were performed using bivariate Pearson correlations. There were statistically significant relationships between some cognitive functioning variables and GPAI scores. The main D2 measures correlated with all the GPAI measures except PI. The Processing Speed Index showed significant relationships with all the GPAI measures except SI. The GLA tests were not related to the GPAI scores.

Table 4. Analysis of correlations between physical fitness and cognitive functioning variables and GPAI scores.

	GPAI				
	DMI	**SEI**	**SI**	**PI**	**GPI**
Age	0.20	0.19	−0.21	0.05	0.09
Physical fitness test					
Body fat %	−0.11	−0.03	0.01	−0.20	0.02
Standing long jump	0.05	0.03	−0.19	0.11	−0.08
VO_2 max	0.18	0.18	0.06	0.03	0.19
Speed test	−0.16	−0.20	0.02	−0.04	−0.14
Attention test					
D2-TE	0.19	0.28 **	0.23 **	0.20	0.29 **
D2-TH	0.23 *	0.27*	0.15	0.15	0.29 **
D2-O	0.13	0.01	−0.07	0.05	0.08
D2-C	0.09	0.06	0.11	0.10	0.06
D2-TET	0.24 *	0.31 **	0.22 *	0.17	0.33 **
D2-CON	0.23 *	0.24 *	0.17	0.12	0.27 *
D2-TE(+)	−0.03	0.13	0.18	0.16	0.10
D2-TE(−)	0.22 *	0.21	0.15	0.20	0.26 *
D2-VAR	0.25 *	0.11	0.01	0.02	0.20
GLA-Local Execution	0.07	0.13	−0.03	0.16	0.09
GLA-Global Execution	0.16	0.13	0.14	0.12	0.15
GLA-Total Execution	0.16	0.14	0.11	0.17	0.14
GLA-Relative Execution	0.15	0.08	0.09	0.07	0.12
Processing speed test					
WISC IV-Coding	0.16	0.20	0.03	0.17	0.15
WISC IV-Symbol Search	0.30 **	0.23*	−0.02	0.27 *	0.23 *
WISC IV-PS Index	0.29 **	0.26*	−0.03	0.28 **	0.24 *

Note. DMI = Decision-Making Index; SEI = Skill Execution Index; SI = Support Index; PI = Participation Index; GPI = Game Performance Index; % = percentage; VO_2max = maximum oxygen consumption rate (ml/kg/min); D2 = D2 test; TE = total number of elements processed; TH = total number of hits; O = errors of omission (misses); C = errors of commission (false positives); TET = total effectiveness in the test; CON = concentration index; TE+ = row with the most elements attempted; TR− = row with the fewest elements attempted; VAR = variation index; GLA = Global-Local Attention test; WISC-IV = Wechsler Intelligence Scale for Children IV; PS = processing speed. * p < 0.05; ** p < 0.01.

3.4. Linear Regressions

Fourth, the aim was to determine if the variables of physical condition and cognitive functioning could predict the GPAI scores. For this, linear regression models were generated, as shown in Table 5. The coefficient of determination (R) indicates the proportion of the variance explained by the model. R2 adjusted is the value of R corrected and it is interpreted when multiple linear regression analysis is used. ANOVA analysis indicates the validity of the linear regression model (p-value less than 0.05 is statistically significant).

Table 5. Linear regression analysis of the GPAI variables.

Criterion Variable	ANOVA	R	R^2 Adjusted	D–W	Predictor Variable	Beta	t	T	VIF
DMI	5.91 **	0.36	0.11	2.15	WISC IV-PSI	0.23	2.16 *	0.94	1.06
					D2-VAR	0.22	2.09	0.94	1.06
SEI	8.84 *	0.31	0.09	1.95	D2-TET	0.31	2.97 **	1.00	1.00
PI	11.07 **	0.35	0.11	2.26	WISC IV-PSI	0.35	3.32 **	1.00	1.00
GPI	10.25 **	0.33	0.10	2.17	D2-TET	0.33	3.20 **	1.00	1.00

Note: DMI = Decision-Making Index; SEI = Skill Execution Index; SEI = Support Index; PI = Participation Index; GPI = Game Performance Index; WISC-IV = Wechsler Intelligence Scale for Children IV; PSI = Processing Speed Index; D2 = D2 test; TET = total effectiveness in the test; VAR = variation index; R = coefficient of determination; R^2 adjusted = coefficient of determination adjusted; *D–W* = Durbin–Watson; *T* = Tolerance; *VIF* = Variance Inflation Factor.* p < 0.05; ** p < 0.01.

3.5. Cluster Analysis

Finally, differences in game performance were determined between those participants who had greater cognitive ability. To build the groups, k-mean cluster analyses were performed. For this, three measures were used: the D2-TET, the D2-CON, and the WISC-IV cognitive Processing Speed Index. Two groups were generated (G1, *n* = 48 cases; G2, *n* = 37 cases), characterized respectively by higher and lower scores in the three tests (D2 attention test, Coding and Symbol Search tests). All cases were correctly classified, as the maximum distance between each case and the center of its group (40.51) was always less than the distance between clusters (120.21).

Table 6 shows the descriptive and normality statistics of the GPAI scores for each cluster. Skewness and kurtosis were calculated, and the Shapiro–Wilk test was performed, indicating some normality problems (GPAI-DMI, GPAI-SI, and GPAI-GPI). For these variables, non-parametric tests had to be used (Mann–Whitney U). Student's t-tests (G1 vs. G2) indicated statistically significant differences in SEI (t_{83} = 3.97; p < 0.001; Cohen's *d* = 0.89; 95% CI (0.44–1.34)) and PI (t_{83} = 2.04; p < 0.05; Cohen's *d* = 0.45; 95% CI (0.01–0.88)). Mann-Whitney U tests (G1 vs. G2) also indicated significant differences in DMI (*Z* = −3.51; p < 0.001; Cohen's *d* = 0.85, 95% CI (0.40–1.30)), SI (*Z* = −2.11; p < 0.05; Cohen's *d* = 0.58; 95% CI (0.14–1.01)), and GPI (*Z* = −3.98; p < 0.001; Cohen's *d* = 0.93; 95% CI (0.48–1.38)).

Table 6. Descriptive measures and Kolmogorov–Smirnov test for GPAI measures for each cluster.

	G1					G2				
	M	*SD*	*S*	*K*	*S–W*	*M*	*SD*	*S*	*K*	*S–W*
GPAI-DMI	0.80	0.08	−0.10	0.19	0.98	0.72	0.11	−1.06	1.86	0.92 *
GPAI-SEI	0.75	0.09	0.04	−0.60	0.98	0.67	0.09	−0.52	0.31	0.97
GPAI-SI	0.95	0.06	−1.53	3.31	0.82 ***	0.91	0.08	−0.55	−0.94	0.89 **
GPAI-PI	26.88	5.70	0.04	−0.67	0.97	24.32	5.78	−0.31	−0.55	0.98
GPAI-GPI	0.83	0.06	0.31	−0.58	0.96	0.77	0.07	−1.41	2.69	0.89 **

Note: *M* = mean; *SD* = standard deviation; *S* = skewness; *K* = kurtosis; *S–W* = Shapiro–Wilk; DMI = Decision-Making Index; SEI = Skill Execution Index; SI = Support Index; PI = Participation Index; GPI = Game Performance Index. * p < 0.05; ** p < 0.01; *** p < 0.001.

4. Discussion

The objective of this study was to understand the relationship between cognitive functioning, physical fitness, and playing behavior in adolescent soccer players. The aim was to determine which variables are associated with and predict game performance, by analyzing actions in a small-sided playing format in soccer. To resolve these questions, correlation analyses, stepwise linear regressions, and group comparisons were performed after constructing two groups through cluster analysis.

The results showed no relationship between fitness level and performance in the small-sided games proposed. Although the level of physical performance is a variable that could modulate the success of players [56,57], it has not been highlighted in this study. This may be because differences in the speed or strength of the participants were not decisive for the proposed task. With respect to cardiorespiratory fitness, studies indicate that this small-sided playing format involves intense work, which may be conditioned by cardiorespiratory fitness [58]. However, the format used in this study involved a total duration of 12 min with intermediate breaks, and this may have had less effect on those of lesser physical capacity, as it is not a very long time. Moreover, the entire sample consisted of athletes who trained regularly, so the differences between them may have been smaller than would have been the case if there had been non-athletes participating. However, the differences between the players were not specifically explored, and this limits the ability of this type of explanation to account for our results.

However, the results do show relationships between cognitive functioning variables and GPAI measures, in line with previous studies that showed links between differences in cognitive abilities and sports performance in soccer [21,22,24–28]. Specifically, it can be seen that the main D2 test scores are positively related to the GPAI Decision-Making Index, Skill Execution Index, Support Index, and Game Performance Index, and that the WISC-IV Processing Speed Index is related to all of them except the Support Index and the Participation Index. However, the measures of the Global-Local Attention test are not related to the GPAI. Furthermore, the group with higher scores for these cognitive abilities attained higher values than the group of lesser cognitive ability in all the GPAI indexes.

This suggests that selective attention ability and cognitive processing speed can be considered to be positively related to better decision-making, better technical execution, better game reading, and greater efficiency in performing the task [10,59–62]. These results are in line with previous studies that pointed out this phenomenon and suggest that soccer players with better cognitive functioning are better equipped to focus their attention on relevant stimuli, avoid shifting their interest towards elements that could interfere with the game, and handle information involved in the task more effectively, making them more successful [59,63]. Therefore, it would be interesting to implement cognitive training programs in the soccer players' preparation process. As highlighted by Reigal et al. [38], cognitive training programs can be implemented for soccer players with the aim of improving their abilities. Among others, it is considered that the tactical knowledge of sport is related to the cognitive effort during sport practice. Thus, increasing cognitive ability in aspects such as attention or processing speed can promote learning processes and optimize resources (e.g., tactical knowledge) so that the athlete performs effectively [64].

Divided attention, however, does not appear to be a determining factor of athletes' performance, which is an unexpected finding and does not coincide with the postulates of previous studies [65,66]. It seems likely that this result could be due to the fact that the task was very limited and that the athletes were used to performing it, so that it had become automatic. Thus, perceiving and processing relevant information and solving the task quickly is one element affecting performance, but not for a complex task requiring handling different sources of information in parallel or performing different actions simultaneously.

This study has some limitations. The sample size is relatively small, so a larger sample could contribute to making the findings more generalizable. The sample is made up exclusively of boys, so the inclusion of a group of girls would make it possible to identify existing gender differences. Finally, several sessions of assessment of cognitive functioning would avoid a possible decrease in performance

due to fatigue. Future lines of research may therefore emerge aimed at correcting these limitations and helping to deepen and consolidate the results obtained here. An in-depth study covering the relationship between executive functions and physical fitness and their effects on performance would also be interesting.

In any case, this study provides a new perspective on the effects of physical fitness on attention and processing speed and on the influence that high performance in these variables can have on performance in the game in general, and in soccer practice in particular.

5. Conclusions

The results show a positive correlation of attention and processing speed with performance in the game. In addition, these cognitive tasks can predict the level of efficiency in decision-making, skill execution, and performance in the game. However, there was no relationship between fitness level and performance in the small-sided games proposed.

Putting these findings into practice could be very useful when designing training exercises, so that the importance of cognitive functioning for playing performance is taken into account and this dimension is included in the training and preparation of athletes, leading to greater progress in sport and more complete development of athletes.

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