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Original Article

ASSOCIATION BETWEEN ANTHROPOMETRIC AND PHYSICAL DATA OF UNIVERSITY SOCCER PLAYERS FROM DIFFERENT POSITIONS

ASSOCIAÇÃO ENTRE DADOS ANTROPOMÉTRICOS E FÍSICOS DE JOGADORES UNIVERSITÁRIOS DE FUTEBOL DE DIFERENTES POSIÇÕES

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RESUMO

O objetivo do presente estudo foi verificar se existe associção entre as variáveis de desempenho físico e analisar a variação dos níveis de aptidão física entre as posições de jogador de futebol universitário. Foram selecionados 20 jogadores de futebol universitário (20,95 ± 1,84 anos; 71,60 ± 11,65 kg; 176,85 ± 7,28 m) divididos em zagueiros, meio-campistas e atacantes. Mensurou-se a composição corporal em uma análise transversal e correlacionou-se a massa gorda, massa magra e massa livre de gordura por meio do DXA com os testes de capacidade física. As principais evidências do presente estudo revelaram que as acelerações de 10 e 20 m tiveram correlações de moderada a grande com o teste de agilidade nas posições de jogo, porém essas acelerações foram inversamente correlacionadas com o teste de recuperação intermitente nos defensores e amplamente positiva nos meio-campistas. O teste de agilidade foi moderadamente correlacionado com o teste de recuperação intermitente YoYo nas diferentes posições de jogo. Em conclusão, a aceleração e a agilidade tiveram uma associação positiva com as diferentes posições dos jogadores de futebol.

Palavras-chave: Futebol. Balsom teste. Yoyo teste.

ABSTRACT

The present study aimed to check if there is an association between fitness performance variables and to analyze the variation of fitness levels between playing positions university soccer players. Twenty university soccer players were selected (20.95 ± 1.84 years; 71.60 ± 11.65 kg; 176.85 ± 7.28 m) divided into defenders, midfielders and attackers. Body composition was assessed in a cross-sectional analysis that correlated fat mass, lean mass and fat-free mass by DXA with the physical capacity tests. The main results of the present study revealed that both 10-m and 20-m accelerations had moderate-to-large correlations with agility tests across the playing positions, however these accelerations were largely inversely correlated with YoYo intermittent recovery test in defenders and largely positively in midfielders. The agility test was moderately correlated with YoYo intermittent recovery test across the different playing positions. In conclusion, there the acceleration and the agility had a positive association with the different positions of the soccer players.

Keywords: Football. Balsom test. Yoyo test.

Introduction

Soccer is an intermittent sport that presents periods of high-intensity activity, alternated with lower intensity periods, as well as technical and tactical components[1,2]. Adult elite soccer players cover eight to 14 km during an official match, of which 18 to 23% (1.5 to 3.3 km) are performed by high-intensity[3,4]. These data demonstrate that perform acceleration and high-speed running actions during training can be an important prerequisite for successful participation in match-play[5].

Some studies have focused on the relationship between high-intensity movements and physical match performance in soccer players. However, the findings appeared to be

inconsistent. Some studies have found a strong correlation between high-intensity movements, while other studies have found a weak correlation with physical match performance. For example, Little and Williams[6] conducting a study with one hundred and six professional soccer players 18-36 years, demonstrated a positive association between physical fitness (maximum sprint) and performance in the match. On the other hand, Salaj and Markovic[7] found weak correlations between 5-m, 10-m and 20-m speed and 20 yards shuttle run times (agility) of professional soccer players. Furthermore, few studies considered the correlation between running and physical performance in the match concerning playing positions[3,5].

In professional adult soccer players, match analyses have demonstrated that performance in high-intensity running is position-dependent. Central defenders seem to cover less total distance and performance less high-intensity running compared to other positions[3,8,9], were as fullbacks and midfielders perform seem to perform more sprint activity[10]. Yet, strikers and wings have a greater decline in high-intensity bursts when the own team has ball possession[10]. Therefore, given the reported existence of different position-specific running patterns and inconsistency in the literature, it is important to compare and associate the physical capacities of soccer players in the specific positions of the game. Also, it is known that body weight has a direct influence on acceleration, therefore the weight distribution between fat mass and muscle mass can influence the athlete negatively or positively. Thus, the aims of the present study were: i) to analyze the variation of fitness levels and ii) to check if there is an association between fitness performance variables (acceleration, velocity, agility and VO_2max) of the playing positions soccer players.

Methods

Participants

Twenty university soccer players participated in this study, divided into defenders, midfielders and attackers, all players were on pre-season. For inclusion in the study, all participants had to have a medical certificate indicating that they were able to play sports. The exclusion criterion was athletes who did not attend the dates scheduled at the laboratory. The characteristics of the sample are described in Table 1.

Procedures

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (CEP-UniCEUB with the number 2.533.743) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

All evaluations were made at the university with a total of three days of tests. On the first day, anthropometric and body composition data were collected. On the second day, the 30-meter sprint test and the Balsom agility test (BAT) were performed; the latter was made just after the former, that is after the 30-meter test was performed by all players, following the order of execution of the athletes, stipulated in the first test, both tests with two attempts using the highest value obtained. On the third day, the YoYo intermittent recovery test (YYIRT) recovery test was performed.

The anthropometric data were collected through an electronic/digital balance with a resolution of 100 grams (Filizola®, “PersonalLine” model) and stadiometer (Country Tecnology®), with a resolution of one centimeter. Body composition was measured using the dual energy X-ray absorptiometry (DXA) equipment (GE Eletric Company®, model Lunar), allowing the evaluation of lean body mass (LM) in kg, fat mass (FM) in kg and fat-free mass

(FFM) in kg. For body composition measure were recommended that athletes do not perform physical activities 48h before the test.

The data of the physical tests were collected in field 01 of the university. The tests were performed in two days (Tuesday and Thursday) between 4:00 p.m. to 6:00 p.m. and with a 24-hour interval between them. Before the tests started each day, a warm-up was performed, which consisted of a light intensity run (trot) with a speed of approximately 9 km/h. After the run, some dynamic stretching exercises were performed for the muscles of the lower limbs - gluteus, posterior and anterior thigh, fascia lata tensor and iliopsoas. Also, as a form of warm-up, four exercises were performed in the agility ladder and, also, coordinating exercises of running: high and low skipping, hopserlauf, hop and jump-running.

On the second day, marking cones were used for the route, also chronometers and whistles for the evaluators. On the third day, there were cones for demarcation the route, amplified soundbox, pen drive with a sound file in the mp3 extension and individual evaluation cards for each athlete.

Measures

Acceleration and Maximal Velocity

The 30-meter sprint test was used to measure the parameters of initial acceleration (10 meters), total acceleration (20 meters) and maximal velocity (30 meters).

The test was performed on a specific surface of the sport, the soccer field. The player used cleats suitable for soccer. In the output, the starting position is the low output. The marking was performed in the 10, 20 and 30 meters which correspond, respectively, to the initial Acceleration indicators; Total acceleration and Maximum speed. It should be noted that the evaluators, equipped with a stopwatch, positioned themselves in each of the three marks (10, 20 and 30 meters) [11].

Balsom Agility Test

The agility test protocol followed the guidelines of Balsom[12]. Such a test is designed for the soccer player, in which subjects are required to make several directions changes and two turns.

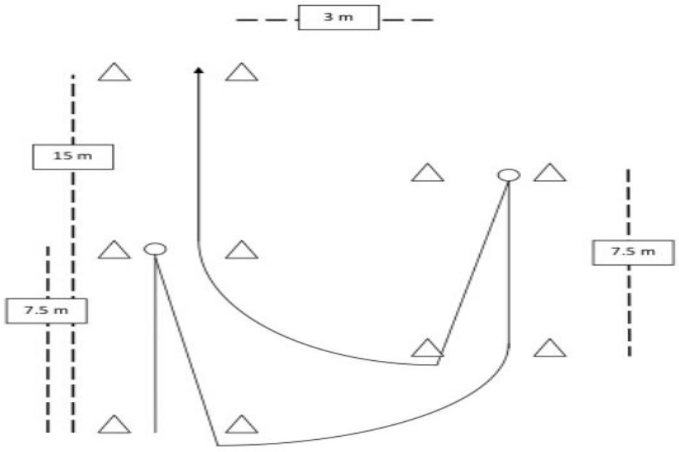

Figure 1. Balsom agility test course, 1994. The player positions behind the line between the initial cones. The course is detailed in the image above. The total execution time of the test is marked, positioning the evaluator at the end of the course[12]

Source: Authors

YoYo Intermittent Recovery Test

The application of the test was performed observing the protocol established by Bangsbo, Iaia and Krustrup[13]. In this sense, four batteries were carried out with 5 athletes in each course. An amplified soundbox was used, which was located on the side of the course. The sound file was recorded on a thumb drive in mp3 format. Before the beginning of the test, the evaluators guided the athletes regarding the test protocol, alerting them to the importance of reaching the end of the course at the right time, to the sound of the beep. The main feature of the test is that athletes do not run continuously.

The test is performed with repeated sprints in a circuit of 20 meters, back and forth, totaling 40 meters and is intended to evaluate aerobic power. At each level the running speed is increased and is interspersed by an active rest of 10 seconds, being such rest executed in the route of fewer than 5 meters at the end of the circuit. Through an evaluation form, each athlete was analyzed by an evaluator. The evaluator followed the run throughout the test and noted if the athlete failed to reach the end of the course at each level three times. Individuals who failed to reach the end of the course in the beep three times, not necessarily in a consecutive manner, had their test closed, their respective values being considered around the previous lap of the incomplete one.

To calculate the VO_2max the following formula was used: VO_2max = distance traveled (in meters) x 0.0084 + 36.4; also, it was possible to verify the speed that it took to reach this VO_2max[13].

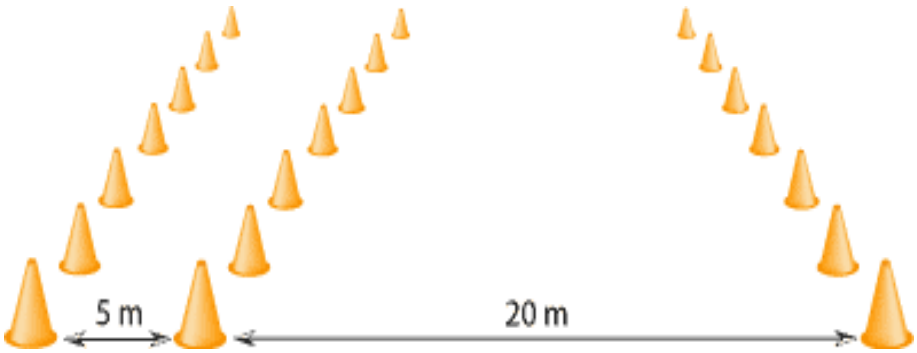

Figure 2. Resistance test course, *YoYo intermittent test*
Source: Authors

In the course of 20 meters, the player must perform the sprints stipulated by the test, in the respective speeds controlled by the "beep". The 5-meter course is intended for the brief recovery which will be carried out after each 40-meter (round trip). The test must continue until the athlete can no longer execute it Bangsbo, Iaia and Krustrup[13].

Statistical analysis

Data were presented as mean ± standard deviation. Initially, the normality and the homoscedasticity of the data were verified, through the tests Shapiro-Wilk and Levene, respectively. Due to the size of the sample, the non-parametric tests were used to treat the data. The Spearman test was used to correlate the data. The Kruskall-Wallis test was used to check the difference between positions. The level of significance was plotted at 5% ($p < 0.05$). SPSS software version 22.0 was used for analysis.

Results

Table 1 shows the sample characteristics.

Table 1. Sample characterization

Measures	Defenders (*n* = 10)	Midfielders (*n* = 5)	Attackers (*n* = 5)
	Mean ± DP	Mean ± DP	Mean ± DP
Weight (kg)	74.37 ± 14.42	67.26 ± 11.11	70.42 ± 3.06
Height (cm)	180.60 ± 8.05	173.20 ± 5.21	173.00 ± 2.91
Age (years)	21.10 ± 2.13	21.20 ± 1.92	20.40 ± 1.34
Fat mass (kg)	12.10 ± 8.01	9.22 ± 3.89	8.52 ± 1.88
Lean mass (kg)	60.15 ± 7.18	54.99 ± 8.55	57.91 ± 2.72
Fat free mass (kg)	63.66 ± 7.52	58.20 ± 9.06	60.90 ± 2.89
Initial acceleration 10m (s)	2.07 ± 0.15	1.98 ± 0.09	2.19 ± 0.09
Total acceleration 20m (s)	3.26 ± 0.17	3.24 ± 0.13	3.32 ± 0.14
Maximal velocity 30m (s)	4.61 ± 0.24	4.30 ± 0.27	4.62 ± 0.13
Balsom Agility Test (s)	12.23 ± 0.47	12.38 ± 0.82	12.41 ± 0.29
YoYo Intermittent Recovery Test VO_2 maximum (ml/kg/min)	44.73 ± 2.51	44.26 ± 0.77	45.94 ± 1.92

Source: The authors

For Defenders, the initial acceleration have a significant association with FM (Table 2).

Table 2. Spearman Correlation of Defenders (*n* = 10)

		FM	LM	FFM	10m	20m	30m	BAT	YYIRT
Initial acceleration 10m (s)	rho	0.74	-0.16	-0.11	-	0.37	0.85	0.68	-0.64
	P	0.01	0.65	0.75	-	0.29	0.002	0.02	0.04
Total acceleration 20m (s)	rho	0.19	0.09	0.006	-	-	0.54	0.63	-0.39
	P	0.58	0.80	0.98	-	-	0.10	0.04	0.25
Maximal velocity 30m (s)	rho	0.58	-0.33	-0.29	-	-	-	0.81	-0.52
	P	0.07	0.34	0.40	-	-	-	0.004	0.11
Balsom Agility Test	rho	0.43	-0.006	0.006	-	-	-	-	-0.54
	P	0.21	0.98	0.98	-	-	-	-	0.10
YYIRT (ml/kg/min)	rho	-0.75	-0.11	-0.16	-	-	-	-	-
	P	0.11	0.76	0.65	-	-	-	-	-

Note: FM = Fat mass ; LM = Lean mass ; FFM = Fat free mass ; 10m = Initial acceleration 10m ; 20m = Total acceleration 20m ; 30m = Maximal velocity 30m ; BAT = Balsom Agility Test ; YYIRT = YoYo Intermitent Recovery Test
Source: The authors

For Midfielders, BAT have a significant association with FM, also YYIRT have a significant association with both accelerations and velocity (Table 3).

Table 3. Spearman Correlation of Midfielders (*n* = 5)

		FM	LM	FFM	10m	20m	30m	BAT	YYIRT
Initial acceleration 10m (s)	*rho*	0.30	-0.60	-0.60	-	0.97	-0.87	0.40	0.87
	P	0.62	0.28	0.28	-	0.005	0.05	0.50	0.05
Total acceleration 20m (s)	*rho*	0.35	-0.41	-0.41	-	-	-0.78	0.35	0.81
	P	0.55	0.49	0.49	-	-	0.11	0.55	0.09
Maximal velocity 30m (s)	*rho*	0.41	0.66	0.66	-	-	-	-0.61	-0.94
	P	0.49	0.21	0.21	-	-	-	0.26	0.01
Balsom Agility Test	*rho*	0.90	-0.30	-0.30	-	-	-	-	0.35
	P	0.03	0.62	0.62	-	-	-	-	0.55
YYIRT (ml/kg/min)	*rho*	0.20	-0.56	-0.56	-	-	-	-	-
	P	0.74	0.32	0.32	-	-	-	-	-

FM = Fat mass ; LM = Lean mass ; FFM = Fat free mass ; 10m = Initial acceleration 10m ; 20m = Total acceleration 20m ; 30m = Maximal velocity 30m ; BAT = Balsom Agility Test ; YYIRT = YoYo Intermitent Recovery Test
Source: The authors

For Attackers, initial acceleration and maximal velocity have a significant association with LM (Table 4).

Table 4. Spearman Correlation of Attackers (n = 5)

		FM	LM	FFM	10m	20m	30m	BAT	YYIRT
Initial acceleration 10 m (s)	*rho*	-0.103	-0.82	-0.66	-	0.56	0.97	0.66	0.10
	P	0.87	0.08	0.21	-	0.32	0.005	0.21	0.87
Total acceleration 20m (s)	*rho*	-0.70	-0.30	-0.50	-	-	0.40	0.80	0.70
	P	0.18	0.62	0.39	-	-	0.50	0.10	0.18
Maximal velocity 30m (s)	*rho*	0.10	-0.90	-0.70	-	-	-	0.50	0.000
	P	0.87	0.03	0.18	-	-	-	0.39	1.00
Balsom Agility Test	*rho*	-0.80	-0.30	-0.40	-	-	-	-	0.50
	P	0.10	0.62	0.50	-	-	-	-	0.39
YYIRT (ml/kg/min)	*rho*	-0.70	-0.20	-0.60	-	-	-	-	-
	P	0.18	0.74	0.28	-	-	-	-	-

Note: FM = Fat mass ; LM = Lean mass ; FFM = Fat free mass ; 10m = Initial acceleration 10m ; 20m = Total acceleration 20m ; 30m = Maximal velocity 30m ; BAT = Balsom Agility Test ; YYIRT = YoYo Intermitent Recovery Test
Source: The authors

There are no difference between positions for physical capacities (Table 5).

Table 5. Significance test of Kruskall-Wallis

Tests	*p*-value
Initial acceleration 10m (s)	0.64
Total acceleration 20m (s)	0.65
Maximal velocity 30m (s)	0.19
Balsom Agility Test	0.65
YoYo Intermittent Recovery Test VO_2 max (ml/kg/min)	0.36

Source: The authors

Discussion

This study had two main purposes: i) associate fitness performance variables, and ii) analyze the variation of fitness levels between playing positions. The main results of the present study revealed that both 10-m and 20-m accelerations had moderate-to-large correlations with agility test across the playing positions, however these accelerations were largely inversely correlated with YYIRT in defenders and largely positively in midfielders. Agility test was moderately correlated with YYIRT across the different playing positions.

Regarding the associations, it was found that 10-m and 20-m accelerations were moderately correlated in defenders and forwards, but largely correlated in midfielders. In a previous study, it was found moderate to large associations between acceleration and maximal speed based on the fact that the horizontal component of the total force is directed forward to achieve maximal speed[5]. Our results are in line with the previous studies conducted by Little and Williams[6] and Köklü and Alemdaroğlu[14] that found moderate-to-strong correlations between acceleration and maximal velocity achieved in 20-m and 30-m. Despite that, correlations varied between playing positions suggesting that the specificity of actions may constraint the performance in these tests[15]. In this study, the accelerations correlated to the midfielders are related to the function and behaviou on the field and physical characteristics of these athletes.

Associations between acceleration profile at different distances and agility test were also conducted, revealing moderate-to-large correlations. Accelerations and agility are

assential physical capacitys for soccer players. In previous studies conducted in soccer players, it was found weak-to-moderate correlations between 9.1-m sprint and both Illinois and Pro-agility test[16] and between T-test and 40-yard sprint time[17]. These associations can be caused by the specific demands requested in both types of tests recruiting a high level of horizontal power and capacity of re-start and change direction quickly after a deceleration caused by the agility tests[18]. For that reason, it is highly recommended to develop lower-limb power based on eccentric training and also consider the body composition that maybe influence the performance in these actions[19].

Relationships between YYIRT and accelerations/agility tests were also conducted. The results between playing positions revealed a different type of inferences. In the case of defenders were found some inverse correlations between YYIRT and accelerations, however in midfielders, it was found largely positive correlations. In a previous study conducted in collegiate female players were found small inverse correlations between YYIRT and speed tests[20]. In the case of rugby, it was also found inverse moderate correlations between YYIRT and lower-limb power[21]. These results may suggest that YYIRT may explain little of the variance in locomotor performance during the match activities of players, thus being highly random between positions. In the present study, the difference in functions between defenders and midfielders is evident, characteristics that are used in the game.

Despite this, results between YYIRT and agility tests revealed moderate correlations in forwards and midfielders and inverse correlations in defenders, but not with significant values. This results might be caused by the sample of this study, because they are not professional players and YYIRT performance in professional football leagues are highly variable with playing position[4] being the capacity of performing intermittent endurance exercise greater for defenders compared to other positional players[3].

Our study has some limitations, such as a reduced sample, lack of evaluation of biochemical and molecular factors that could offer additional information in the understanding the association between body composition and performance in physical capacity tests in soccer.

Conclusions

There is no variation of fitness levels in soccer players at pre-season, therefore the acceleration and the agility had a positive association with the different positions of the soccer players. From a practical point of view, it is important to direct the training to activities that contemplate the specifics of each position, and regardless of the position, it is important to develop acceleration and agility on soccer athletes. It is suggested studies with other categories and different competitive levels of soccer.

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