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Original Article

Body Composition and Physical Fitness Analysis in Different Field Position U-15 Soccer Players

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Abstract
The individual characteristics related to anthropometry, body composition, and physical capacities are important in the performance of soccer players, especially in terms of field position, which isone of the aspects to be considered in talent identification. A total of 48 soccer players under15 years of agewere evaluated using a Tanita UM076scale (body composition), Ergojump system (lower limb strength), handgrip (maximum isometric strength of hand and forearm muscles), Illinois agility test (agility), 30-meter sprint test (speed), and sit and reach test (flexibility). IBM SPSS 24 was used for data analysis, namely, descriptive analysis, analysis of variance (one-way ANOVA)andTukey posteriori test ($p < 0.05$) to confirm significant differences regarding the soccer players different field positions factor.Pearson's correlation test ($p < 0.01$ and $p < 0.05$) was used to confirm the existence of correlations between variables.
We observedstatistically significant differences between players from different field positions in terms of body composition and agility. Strong correlations were verifiedbetweenthe body composition variables, as well as between the variables of physical capacities and when analyzing body composition relationship to physical capacities. Our results point to the fact that soccer players of certain field positions present specific characteristics.This informationcan help coachesto optimize training tasks and performance enhancementsduringthe soccer game. In addition, these results canprovide support in the definition ofevaluation criteria for anthropometrics, body composition, and physical fitnesslevel fortalent identification and selection of young soccer players.
Keywords: Youth; Training; Physical capacities; Anthropometry; Talent identification; Performance

Introduction

Soccer is a team sport, which isassociated withcomplexity in collective and individual actions by the players, and individual characteristics may determine the success/outcome of the game.Anthropometry and body composition of soccer playersaffecttheir sports performance(Bilsborough, et al., 2015; Milson, et al., 2015; Silva & Morouço, 2017; Slimani & Nikolaidis, 2019).These are important factorsfor coaches, managers, sports physiotherapists, physiologists, and researchers to consider to confirm performance-influencing variables (Gjonbalaj, Georgiev, & Bjelica, 2018) and to identifycharacteristics that are required for successful high-performance participation (Slimani & Nikolaidis, 2019).

When players reach the maturation phase and specialize in certain mission-tactical game functions, anthropometric, body composition, and physical fitnesscharacteristics become relevant and possibly affect fieldpositioning and performance in soccer game. In a study conducted on 12-14-year-oldplayers, Notarnicola et al. (2018) did not identify correlations when comparing field position and physical performance, which indicated that field position in this agegroup wasnot yet affectedby anthropometric characteristics. In addition, Aurélio et al. (2016) have studied these relationships in under-12-year-old (U-12) soccer players, and statistically significant differences were observed between team sectors in weight, body mass index (BMI), and handgrip strength (HG).

Previously, Côté et al. (2009) have stressed that the beginning of specialization phase in sports for athletes occurs between 13 and 15 years of age.More recently Salinero et al. (2019) have indicated that between 13 years of age and up to 20 years of age relevant changes and improvementsare observed in anthropometric and physical variables. For example, Selmi et al.(2018) have studied soccer players and confirmed that performance in repeated-sprint sets improves during the maturation of young soccer players. The same study

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identifiedcorrelations between the sum of sprint times, body mass, and aerobic capacity foreach maturation group. In addition, negative correlations were observed between vertical and horizontal jumps and the sum of sprint times among maturity groups, which suggested that better jumpingperformance is associated with better sum of sprint times.Other studies have also demonstrating that during maturational evolution, there are differences in the level of physical capacities, body composition, and anthropometrics(Gontarev, Kalac, Zivkovic, Ameti, & Redjepi, 2016; Negra, et al., 2017; Slimani & Nikolaidis, 2019).

Therefore, at 13-15 years of age,specialization begins to gain relevance, and anthropometric, bodycomposition, and physical capacities canconsiderably affect a young player to play in one or more than one positions. Bujnovky et al. (2019)have observed significant differences between playing positions and physical fitness conditions required for each position in young soccer players (15.7 ± 0.5 years old).

The performed tests included a linear running sprint for 5 m and 10 m, flying sprint for 20 m, agility 505 test with a turn on dominant and non-dominant legs, agility K-test, Yo-Yo intermittent recovery test, and repeated sprint ability. In addition, other studies conducted onyoung soccer players have identifieddifferences between different positions in the level of physical fitness,anthropometric level, and body composition (Gjonbalaj, Georgiev, & Bjelica, 2018; Sever & Zorba, 2017).However, previous studies have reported contradictory results, and these studies have been predominantly performed by evaluating teams in their entirety without considering field position criteria.

Therefore, information on anthropometrics, body composition, and physical fitness is important for talent identification,soccer player development, and training planning performed by the coach. The aim of this study was to analyze body composition, anthropometrics, and physical fitness considering the different field position of U-15 soccer players.

Methods

Participants

U-15 soccer players (n = 48) participated in this study (15.0 ± 0.5 years old; 60.2 ± 7.2 kg; 1.72 ± 0.06 m).The players were divided according to their field position during asoccer game, i.e.,goalkeepers (n = 6),defenders (n = 14), midfielders (n = 14), and forwards (n = 14). All players had a minimum of 3yearsof previous soccer-specific training, a minimum of three 1.5-hour sessions of training, and a 60-minute match per week.

Measures

The study participants were evaluated using a Tanita UM076 (body composition), Ergojump system (lower limb strength, Byomedic, SCP, Barcelona, Spain), handgrip (maximum isometric strength of the hand and forearm muscles, Camry 90 kg), Illinois agility test (agility), 30-meter sprint test (speed) and sit and reach test (flexibility). Hand grip strength (HG) and counter-movement jump (CMJ) performance were assessed. Fat mass percentage (%FM), lean mass percentage (%LM), water percentage (%H_2O), and BMI were determined.

Design and Procedures

This study wasa descriptive-correlational investigation. Specifically, we performed a descriptive analysis of youth soccer players (team) and specificteam's sectors, players field position, and compared the results related to team's sectors. Weconfirmed the existence of correlations between variables (i.e., anthropometrics, body composition, and physical fitness)forU-15 soccer players.

The data werecollected by two experienced investigatorsatthe Sport Sciences Laboratory of the Polytechnic Institute of Setúbal.AU-15 soccer team from a club in the Setúbal district participated in this study.

Statistical Analysis

Statistical analysis was performed using the *IBM SPSS Statistics 24* software. A descriptive analysis (mean and standard deviation) was performed to characterize the team and team sectors regarding anthropometrics, body composition, and physical fitness.

Using the analysis of variance (*ANOVA One-way*)and the post-hoc Tukey's analysis (p <0.05), we confirmed the existence of statistically significant differences between team's sectors. Using the Pearson test (p < 0.01 and p < 0.05), we confirmed the existence of correlations between variables.

Results

The presented results are related to the descriptive analysis of anthropometrics, body composition, and physical fitness of the team by field position. Table 1 shows the existence of statistically significant differences between team's sectors.

Table 1. *Descriptive and comparative analysis of anthropometrics, body composition, and physical fitnessbetween field positions*

	Team		Goalkeepers		Defenders		Midfielders		Forwards		One-way ANOVA	Tukey HSD
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Height (m)	1.71	0.06	1.71	0.04	**1.76**	0.04	1.66	0.050	1.73	0.05	0.00*	Def-Med 0.00*; Med-For 0.00*
Weight (kg)	60.22	7.22	**67.21**	10.06	62.78	6.01	55.05	5.48	59.83	5.01	0.00*	GK-Med 0.00*; Def-Med 0.01*
BMI(kg/cm^2)	20.35	2.06	**22.78**	2.98	20.12	1.7	19.92	1.98	19.95	1.44	0.01*	GK-Def 0.03*; GK-Med 0.01*; GK-For 0.02*
FM (%)	8.82	2.92	**12.51**	4.61	8.10	1.81	8.32	2.98	8.46	1.83	0.00*	GK-Def 0.00*; GK-Med 0.01*; GK-For 0.01*
LM (%)	52.05	5.01	**55.53**	5.88	54.66	4.36	48	3.58	52	3.88	0.00*	GK-Med 0.00*; Def-Med 0.00*
H_2O (%)	67.59	3.74	63.76	4.89	66.94	2.46	**69.99**	3.72	67.47	2.83	0.00*	GK-Med 0.00*
HG (Kg)	36.73	6.66	36.98	7.87	35.86	4.88	35.03	4.60	**39.20**	9.00	0.38	
CMJ (cm)	36.00	4.52	35.51	4.19	**36.93**	4.36	35.46	4.71	35.82	4.94	0.83	
Speed (s)	4.35	0.35	4.52	0.25	**4.33**	0.3	4.34	0.35	**4.33**	0.45	0.69	
Agility (s)	15.46	.693	16.37	0.71	**15.28**	0.63	15.40	0.57	15.32	0.60	0.00*	GK-def 0.00*; GK-Med 0.01*; GK-For 0.00*
Flexibility (cm)	1.16	7.85	**5.5**	7.66	1.78	7.32	−1.57	7.75	1.42	8.33	0.31	

Note.M– Mean; *SD*– Standard deviation. *Statistically significant differences for p <0.05

In relation to body composition, we confirmed that goalkeepershadhigher mean values ofweight (M = 67.21), BMI (M = 22.78), %FM (M = 12.51), and%LM (M = 55.53). Players in the defensive sector were, on average, the taller (M = 1.76);formidfielders, higher average values of %H_2O (M = 69.99) were observed.Regarding the average values of physical capacities, the goalkeepersshowed higher values in flexibility (M = 5.5); defenders showed higher values in CMJ, agility and speed (M = 36.93,M = 15.29, and M = 4.33, respectively); midfielders showed higher values in speed (M = 4.33);forwardsshowed higher values inHG (M = 39.20).

Statistically significant differences (p < 0.01)were observed: inheight between defenders/midfielders (p = 0.00) and midfielders/forwards (p = 0.00);in weight between goalkeepers/midfielders (p = 0.00) and defenders/forwards (p = 0.01);in BMI between goalkeepers/defenders (p = 0.03), goalkeepers/midfielders (p = 0.01), and goalkeepers/forwards (p = 0.02);in %FM between goalkeepers/defenders (p = 0.00), goalkeepers/midfielders (p = 0.01), and goalkeepers/forwards (p = 0.01);in %LM between goalkeepers/midfielders (p = 0.00) and defenders/forwards (p = 0.00);in %H_2O between goalkeeper/midfielders (p = 0.00);in agility between goalkeepers/defenders (p = 0.00), goalkeepers/midfielders (p = 0.01), and goalkeepers/forwards (p = 0.00).

Table 2 shows global correlations between the studied variables, involving all players without field position assumption.

Table 2. *Correlations between anthropometrics, body composition, and physical fitness in team players*

	Weight	BMI	%Fat mass	%Lean mass	H_2O	HG	CMJ	Speed	Agility	Flexibility
Height	.534**			.695**	−.381**					
Weight		.801**	.705**	.969**	−.866**					
BMI	.801**		.936**	.649**	−.759**				.334*	
% Fat mass	.705**	.936**		.517**	−.798**				.304*	
% Lean mass	.969**	.649**	.517**		−.767**				.321*	
%H_2O	−.866**	−.759**	−.798**	−.767**					−.288*	
HG								−.288*		
CMJ								−.480**	−.539**	
Speed						−.288*	−.480**		.693**	.425**
Agility	.367*	.334*	.304*	.321*	−.288*	−.194	−.539**	.693**		
Flexibility	.288*							.425**		

Note. **Significantcorrelation$p$ < 0.01 (bilateral). *Significantcorrelation$p$ < 0.05 (bilateral)

It was possible toconfirmmany correlations assuming all studied U-15 soccer players (n = 48). Of note, correlations werenot observed between both speed and CMJ with body composition variables. In what concerns to agility, acorrelation was observed with body composition (i.e., BMI,%FM, %LM, and %H_2O).Table 3 shows the existence of correlations between studied variables by sector depending on the field position in the soccer game.

Table 3. *Correlations between anthropometrics, body composition, and physical fitnessfordifferent sectors of the team*

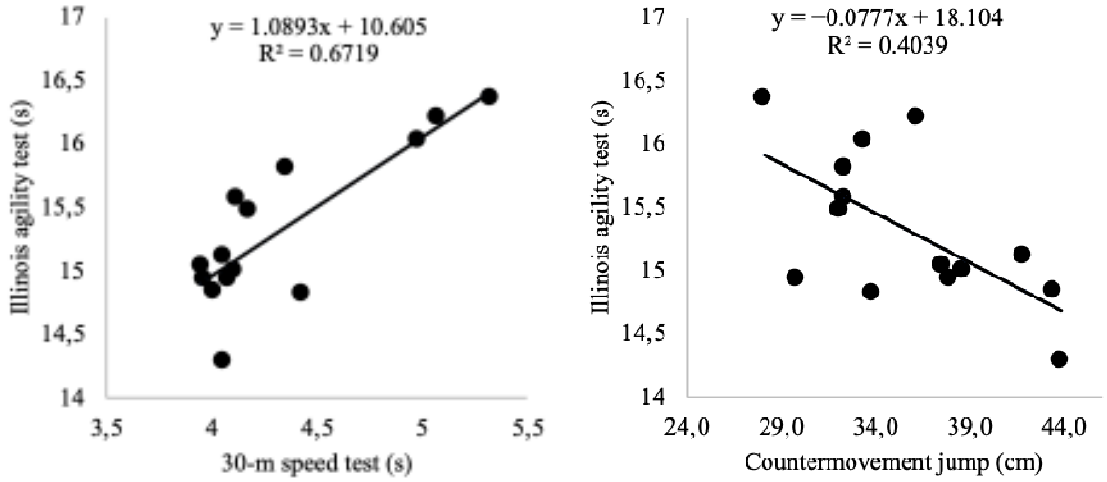
		Height	Weight	BMI	%FM	%LM	%H_2O	CMJ	Speed	Agility	Flexibility
	DEF					.572*					
	MED					.534*					
	FOR		.546*			.687**					
	GK			.942**	.891*	.977**	−.924**				
Weight	DEF			.873**	.841**	.990**	−.800**				
	MED			.830**	.638*	.947**	−.791**			.642*	
	FOR	.546*		.650*	.605*	.979**	−.825**				
	GK		.942**		.968**	.862*	−.954**				
BMI	DEF		.873**		.941**	.810**	−.627*				
	MED		.830**		.899**	.641*	−.737**			.545*	
	FOR		.650*		.924**		−.639*				.534*
	GK		.891*	.968**			−.989**				
%FM	DEF		.841**	.941**		.757**	−.798**				
	MED		.638*	.899**			−.730**				
	FOR		.605*	.924**			−.785**				.554*
	GK		.977**	.862*			−.826*				
%FM	DEF	.572*	.990**	.810**	.757**		−.761**				
	MED	.534*	.947**	.641*			−.605*			.554*	
	FOR	.687**	.979**				−.746**				
	GK		−.924**	−.954**	−.989**	−.826*					
%H_2O	DEF	−.800**	−.627*	−.798**	−.761**						
	MED		−.791**	−.737**	−.730**	−.605*				−.614*	.593*
	FOR		−.825**	−.639*	−.785**	−.746**					
CMJ	GK								−.813*	−.834*	
	DEF								−.559*	−.556*	
	FOR									−.636*	
	GK							−.813*			
Speed	DEF							−.559*		.771**	
	FOR									.820**	.556*
	GK							−.834*			
Agility	DEF							−.556*	.771**		
	MED									.583*	
	FOR							−.636*	.820**		
Flexibility	MED						.593*				
	FOR			.534*	.554*				.556*		

Note. **The correlation is significant at level 0.01 (bilateral). *The correlation is significant at level 0.05 (bilateral)

It was clearly observed that there weredifferences when we analyzed the data globally(i.e., as a team) and by separating and assuming field position. Correlations were not observed between agility and body composition when field positions were assumed for analysis (which was the case when data was globally analyzed) except between BMI and %FM with flexibility (in forward soccer players) and between %$H_2O$and flexibility (in midfielders).

Curiously, correlations were not observed between physical fitness and height, weight and %LMfor all field positions. In relation to physical fitness, many correlations were observed; however, the soccer field position of U-15 soccer players seems to determine the relationships. Forgoalkeepers, CMJ was significantly($p < 0.01$) correlated withphysical capacities, which are very important for performance (i.e., speed and agility). The same result was obtained for defenders, but with lower correlation values.Fewer correlations were observed for midfielders.

ForwardU-15 soccer players were the only field position with acorrelation between flexibility and speed. The correlationofagility with speed and CMJ was also observed. Figure 1 shows the linear relationship of agility with speed and CMJ in forward youth soccer players.



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composition in athletes may provide relevant information fortheoptimizationof competitive performance and training, which is of considerable interest to sports professionals (Ackland et al., 2012).

Previously, it has beenshown that the improvement in body composition in athletes is associatedwithenhancements in cardiorespiratory fitness (Brun et al., 2011; Hogstrom et al., 2012) and strength (Granados et al., 2011). Likewise, body composition is important for avoidinghealth complications, i.e.,medical problems that may arise in athletes with a very low body mass, relevant mass changes related to dehydration, or even eating disorders (Nattiv et al., 2007).Power and speed are influencing players' decision-making in specific game situations, such as in finishing moments for goal(Faude et al., 2012). Furthermore, high and relevant degree of stress is imposed on the neuromuscular system of players owing to deterministic actions during a soccer game, which allows players to cope with these essential force-based actions that are frequently associated with deceleration and acceleration (Osgnash et al., 2010; Gaudino et al., 2013).

Body composition is one of the factors that isintegrated into the holistic concept of soccer talent identification (Unnithan et al., 2012). Specifically, anthropometric profile has been repeatedlyused as a method for evaluating body composition both for accessibility and as a relevant predictor for identifying talented young soccer players (Gil et al., 2007).In addition, another indicator, which is usually integrated in talentidentification in soccer, is the height and jump power (Unnithan et al., 2012). However, although vertical jump tests have been repeatedly used owing to their relationship with performance in soccer(Gil et al., 2007) and as a way to prevent injuries (Menzel et al., 2013), the analysis of vertical jump height and power has not been widely studied during different stages of soccertrainingby taking into account the positioning in the field and its relationship with talentidentification in this sport (Gil et al., 2007; Lago Peñas et al., 2011).

In thisstudy,we confirmed that goalkeepers hadhigher mean values ofweight, BMI, %FM, and %LM. Players in the defensive sector were, on average, taller; in the midfield sector, players hadhigher average values of $\%H_2O$.Regarding the variables of physical capacities, statistically significant differences were observed between the different field positions. This result was obtained possibly because at thischronological age (13, 14, and 15 years of age), weight, height, and body circumference rapidly change. These characteristics will stabilize in the following years, influence certain aspects of the game and used as a starting point to optimize performance. Also,change indirection speed is associatedwiththe dynamics of soccer game. It is difficult to identifywhich force/power qualities (e.g., horizontal and lateral) and technical aspectsaffectthe sport-specific ability (Brughelli et al., 2008).

The association between team success and jump abilities was previously indicated (Arnason et al., 2004). Also, other studies were conducted verifying that starter players demonstrate higher strength and power than non-starter colleagues (Kraemer et al..2004; Sporis et al., 2011). More recently, Silva et al. (2013), observed that greater neuromuscular capabilities have been associated with game-related physical parameters and lower fatigue development during matches.However, most of previousstudies have been conducted onsenior and, consequently, mature soccer players.Our study confirmed many correlations when evaluating all studied U-15 soccer players. Of note, correlations werenot observed between both speed and CMJ with body composition variables. However, forwards were the only soccer field position where correlations were observed between flexibility and speed. In addition, correlations were observedforagility with speed and CMJ.

The importance of sprinting in professional soccer is well-established, and the need for speed is clear (Faude et al., 2012; Haugen et al., 2013). Training at full speed can contribute to improving acceleration capacity. However, players who want improvement in acceleration should choose the training of the maximal

horizontal strength production capacity (Los Arcos et al., 2014; Meylan et al., 2014).These characteristics have gained importance in soccer in recent decades (Carling et al., 2005), and their influence on the final outcome of games is currentlypertinent. They are essential for game analysis e attracted considerable attention in recent years (Carling et al., 2005; Janković et al., 2011). Our results confirmed that field position is associated withphysical fitness; specifically, it has been observed that goalkeepers show higher values in flexibility; defenders in CMJ, agility and speed; midfielders in speed; forwards in HG.

The observeddifferences between physical fitness in different field position soccer players also confirmsthat,for these age groups, there is a tendency for the initiation of specialization, which, in our opinion, should be accompanied by maturation evaluation. Our results clearly show that strength is not well-developed in the soccer players of this age, and physical capacities(e.g., speed and agility) better characterize the athletes and, consequently, their game performance.In fact, the activity of players in the game of soccer is characteristic and associated with constant accelerations, decelerations, braking, changes of direction, jumps and shocks, which leads us to consider the need for a specific work of strength and muscle power.

Strength and power performance are associated withlean body mass (Milanese, Cavedon, Corradini, De Vita, &Zancanaro, 2015).Thisresearch teamhas reported significantly largerbody weight and height in goalkeeperscomparedto midfielders in English Premier League and U-18 teams. According to the authors, goalkeepers are the tallest and heaviest players in the team. Similarresultsare also presented in other studies (Deprez et al., 2015; Perroni, Vetrano, Camolese, Guidetti, & Baldari, 2015).

In this study, the correlations observed between physical fitness and body composition,especially in some field positions, highlight the importance of anthropometric and body composition analysis and monitoringinage-group teams and, naturally, in talent identification in soccer. Duringdaily training in soccer, it is important that soccer coachesuse the correlations observed in this studytoenhance certain physical capacities that are important to the soccer game, i.e.,speed and agility. These results suggest the importance of individualizing the training tasks and respecting the individual characteristics of the players and the specific demands of the position on the field, as has been previously suggested (Mendez-Villanueva, et al., 2011).Although the majority ofprevious studies have beenconducted onmature or even senior soccer players,our study onU-15soccer players revealed theimportance of deeper studiesontheseearlier stages of soccer career.

Conclusions

This study confirmsthat statistically significant differences exist between the physical profile ofdifferent soccer U-15 field position players. Because these players are moving towards a soccer game-specific position specialization, these results can help coaches and scouters to set a player profile for certain tactical missions. At the level of physical capacities, it was possible to confirm that there weredifferences between the position of goalkeeper and other sectors of the team.

In this study we confirmed correlations between body composition and physical fitnessdepending on different field positions in U-15 soccer players, which allowed us to concludethatspecific characteristics wereassociatedwithspecific positions onthe soccer field. The obtained results can help coachesenhance training practices. The variables of our study should be considered in talent identification in U-15 soccer players and monitored during training with the aim to improve players' condition and build successful teams. It is also essential to work on the specific individual needs of players according to their field positions during the soccer training process to promote the achievement of necessary required fitness levels to efficiently perform on match days.

Agility and speed are physical capacities that need to be workedon and developed by coaches in a contextualized way related to the characteristics of the sport and by considering the sectors of the team and team game plan.Strength workout tasks with youth players is very relevant by considering the U-15 maturation phase and the specific demands of the soccer game. Soccer coaches should also promote training tasks containing constant accelerations/decelerations, braking, jumps, and changes of direction to prepare U-15 players for the specificity of the competition.

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