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Correlation of Body Composition and Coordination of Specific Footballers' Position among Professional Football Players

Emeka U Mong[1], Jeneviv N John[2], Roseline I Obianonwo[3], Lucy I Edet[4], Chiamaka S Ikwuanusi[5], Chinenye N Nwafor[6], Obinna V Asogwa[7]

[1] Department of Human Kinetics and Health Education, Faculty of Education, Ebonyi State University, Abakaliki, Ebonyi state, Nigeria.

[2,7] Department of Medical Rehabilitation, Faculty of Health Sciences and Technology, University of Nigeria, Enugu Campus, Enugu state, Nigeria.

[3] Department of Physiotherapy, National Hospital, Garki, Abuja, Nigeria.

[4] Department of Physiotherapy, Faculty of Allied Medical Science, College of Medical Science, University of Calabar, Cross River state, Nigeria.

[5] Mersey Care NHS Foundation Trust, Merseyside, United Kingdom.

[6] De-eagle Physiotherapy Clinic, Awka, Anambra state, Nigeria.

ABSTRACT: The game of football is a competitive team sport that requires an essential component of motor fitness, body composition, psychological, technical, and tactical components for enhanced performance. This study assessed the correlation of body composition and coordination of specific footballers' positions among professional football players. This study utilised a correlational research design. Participants in this study comprised twenty-nine (29) football players who play for a professional team in Nigeria. There were 12 forwards, 6 midfielders, 4 goalkeepers, and 7 defenders among the participants. The participants' hand-eye coordination was evaluated using the alternate hand wall toss test. The beurer diagnostic scale was used to measure the participants' body fat percentage and muscle mass. Results were analysed using pearson's product moment correlation and linear regression. The level of significance was set at $p < 0.05$. A significant positive moderate correlation was observed between muscle mass and coordination among forwards ($r = 0.550$, $p = 0.044$). For every one unit increase in muscle mass, an approximately 0.435 increase in coordination was observed among forwards. There was no significant correlation between muscle mass and coordination among defenders, midfielders, and goalkeepers. Likewise, there was no significant correlation between body fat percentage and coordination among football players in all the playing positions. The hand-eye coordination of forwards is significantly correlated with their muscle mass. In other words, a forward's muscle mass affects their degree of hand-eye coordination. Therefore, football regulatory bodies and trainers could utilise the muscle mass of forwards to predict their hand-eye coordination ability. This finding should be considered by the coaches and governing bodies of football teams before designating players to playing positions in the game of football. Furthermore, there is a need for training programs specifically designed to monitor and enhance the muscle mass of forwards in a football team in order to enhance hand-eye coordination.

KEYWORDS: Body Composition, Body Fat Percentage, Hand-Eye Coordination, Muscle Mass, Professional football players.

INTRODUCTION

The game of football is the most popular sport in the world [1], being played by persons of different age groups and genders. It is a competitive team sport that involves intense physical contact and high-intensity sprints interspersed with jogging and walking [2]. This game is characterised by several complex and dynamic kinesiological activities which comprise of either cyclical or acyclical movement [3]. The goalkeepers, defenders, midfielders, and forwards are the four different groups of football players that cover a specific area of the field during a football match. The forwards are the group of players closest to the opposing team's goal whose responsibility is to score goals and create scoring opportunities for their team players. The midfielders play the role of both defense and offense in a football game. They are situated between the offensive forwards and the defenders. They assist the defense in making sure the opposing team doesn't get anywhere near their goal. Also, they get the ball passed up to the forwards for them to score a goal and they make their way to the opposing team's goal and score if the opportunity arises. The defenders' primary

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responsibility is to provide support to the team and to prevent the opposition from scoring goals whereas the goalkeeper's primary responsibility is to prevent the opposing team from scoring by catching, palming, or punching the ball from shots, headers, or crosses. During the period of the game, an athlete travels between 9 and 14 km and completes about 1330 activities [4,5]. The performance of football players during a match, both professional and amateur, depends on technical, biomechanical, tactical, psychological, and physiological factors [6].

Coordination is a performance-related fitness component that describes the smooth and efficient movement patterns that are parts of sports skills and tasks. It describes the synchronization of the senses and body parts in a way that enhances motor skills. During coordination, the muscles of the body work in an organised and synergistic fashion to produce both simple and complex movement patterns [7]. Therefore, hand-eye coordination is critical for every athlete and is a vital component of a football match. Similarly, the body composition of football players is important for the game of football because despite not directly supplying energy, fat mass does contribute to the weight that must be mobilised in sport and, as a result, becomes a hindrance when it exceeds the recommended values [8]. Body composition is the aggregate of the composite parts of the human structure. At all levels of competition, the relevance of body composition in sports performance is a top priority for developing athlete profiles and conditioning programs [9]. It has been reported that more time is spent on increasing the physical fitness of athletes without taking into consideration the assessment of their body composition and their nutritional status [10]. Body fat percentage is an important aspect of body composition because the fat mass contributes to the weight that must be mobilised in sport. It has been proven that a high proportion of fat mass is related to a low strength-to-weight ratio, reduced acceleration, and increased energy consumption, while the opposite is true for a high proportion of fat-free mass [11]. Another important aspect of body composition is muscle mass. According to Cabañas [12], muscle percentage is an important factor related to the distance traveled by players during a football match.

Therefore, in addition to having high levels of technical and tactical skills, a football player ought to have high levels of athletic ability, ideal anthropometric characteristics, and the appropriate body composition [13]. However, despite the worldwide popularity of the game of football in which body composition and motor fitness are important elements and determinants for success, there is paucity of studies to ascertain if there is a relationship between hand-eye coordination and body composition of football players in their various playing positions. Furthermore, understanding the relationship between these variables among football players could give coaches, trainers, and exercise scientists better working knowledge of this group of athletes. Therefore, this study determined the correlation between body composition and coordination of specific footballers' positions among professional football players.

METHODS

Participants

This study utilised a correlational research design. This was considered appropriate because it reflects the strength and/or direction of the relationship between two or more variables. The participants of this study were players of a professional football club in Nigeria whose only vocation is football and who have a signed professional contract with the football club. Football players with injuries or other co-morbidities were excluded from the study. Twenty-nine (29) out of a total of 32 football players met the selection criteria and gave consent to participate in the study. The 29 football players comprised of 12 forwards, 6 midfielders, 4 goalkeepers, and 7 defenders.

Instruments/Materials

The alternate hand wall toss test determined the participants' hand-eye coordination using a tennis ball. This test has been confirmed as valid and reliable, with scores of 0.718 (good) and 0.875 (okay) for validity and reliability, respectively [14]. The participants' stance position for the alternate hand wall toss test was indicated using a marking tape while a stopwatch was used to measure the time interval of the test. A beurer diagnostic scale (Model: BG 42, Germany) was used to measure the body fat percentage and muscle mass of the participants using the bioelectric impedance method. This device takes the age, gender, height, weight, and physical activity level into consideration to generate body composition parameters. The reliability of the body composition measurement by bioelectric impedance method has been reported. Hashim et al. (2017) reported that the test-retest reliability and interclass reliability were high (r= 0.99 and 0.96 respectively) [15]. Furthermore, an intraclass reliability coefficient of 0.97 was reported [15].

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Procedures

The professional football team's general manager granted permission for the study to be carried out. The football players were enlightened and intimated on the study. They were highlighted on the purpose, nature of the study, methods of data collection, and precautions. Football players who indicated an interest in participating and who met the selection criteria were given informed consent forms to fill. The data collection process was carried out by the researcher and the research assistant. The confidentiality of participants was ensured during the process of data collection.

To perform the alternate hand wall toss test, the researcher set up a mark on the floor at a distance from the wall (2 meters). The participants were instructed to take a position facing the wall behind the marked line. They were given a tennis ball and instructed to throw the ball against the wall using one hand in an underarm action and attempt to catch it as quickly as they could with the other hand. Then throw the ball back against the wall and catch it with the initial hand. The test continued for a period of 30 seconds. The number of successful catches in a 30-second period were recorded. The scores were rated as either excellent, good, average, fair, or poor based on the number of successful catches in a 30-second period [16].

The measurement of percentage body fat and muscle mass was carried out using the beurer diagnostic scale according to the manufacturer's instruction manual. The measurements were taken with the participants in light clothing and without shoes. The participants were asked to stand upright on the platform of the scale with the weight evenly distributed on both legs and the back maintained in a straightened position. The scale displayed the measurement of the weight. The participants were instructed to step off the scale and the researcher entered the personal parameters of the participants (height, age, gender, and degree of physical activity) into the scale. The degree of physical activity was set on the scale according to the instruction manual. It was set at 1 if there is no physical activity, 2 for low physical activity (a small amount of light physical effort (e.g. short walks, light garden work, gymnastic exercises), 3 for medium physical activity (physical effort for 30 minutes at least 2 to 4 times a week), 4 for high physical activity (physical effort for 30 minutes at least 4 to 6 times a week) and 5 for very high physical activity (intensive physical effort, intensive training or hard physical work for at least one hour daily. After all the parameters were entered, the readings of the percentage body fat and muscle mass were recorded from the display unit of the machine. Values obtained for the percentage body fat were classified into normal, overweight, and obese according to the age group adjusted body fat percentage recommendations established by Gallagher et al. [17]. Muscle mass readings were classified as those within normal limits and not within normal limits according to a previous study [18].

The data obtained from this research were analysed using SPSS (Statistical Package for Social Sciences) Version 23.0 (SPSS Inc, Chicago, IL). Pearson's product-moment correlation and linear regression analysis were used to determine the relationship between the variables. Correlation values were adapted from the recommendations of Akoglu [19] and were interpreted as: ≤ 0.2 = weak, $0.2 < r \leq 0.5$ = fair, $0.5 < r \leq 0.7$ = moderate and $r > 0.7$= strong. The level of significance was set at $p < 0.05$.

RESULTS

Average coordination scores were obtained by all the forwards [12(100%)] and defenders [7(100%)]. Most of the midfielders [5(83.3%)] scored average for coordination. Half of the goalkeepers [2(50.0%)] had ultrafast scores while the rest [2(50.0%)] had superb scores. Greater number of the forwards and defenders had normal percentage body fat scores [10(83.3%) and 5(71.4%) respectively] while a greater number of the midfielders and goalkeepers were obese based on their percentage body fat scores [4(66.7%) and 2(50.0%) respectively]. Most of the forwards had muscle mass scores that were within normal limits [8(66.7%)]. On the other hand, most defenders, midfielders, and goalkeepers had muscle mass scores that were not within normal limits [4(57.1%), 4(66.7%), and 3(75.0%) respectively. Table 1 shows that non-significant negative fair and negative weak correlations were observed between percentage body fat and coordination among forwards and defenders respectively. On the other hand, non-significant positive moderate and positive weak correlations were observed among these variables in midfielders and goalkeepers respectively (Table 1). Table 1 also shows that a significant positive moderate correlation was observed between muscle mass and coordination among forwards. Non-significant negative moderate and negative weak correlations were observed between these variables in midfielders and goalkeepers respectively while defenders showed a non-significant positive poor correlation between these variables (table 1).

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Table 1: Relationship between hand eye coordination and body composition parameters of the participants

Playing positions			Forwards Coordination	Defenders Coordination	Midfielders Coordination	Goal keepers Coordination
Forwards	**PBF**	**r**	-0.466			
		p	0.127			
Defenders	**PBF**	**r**		-0.149		
		p		0.749		
Midfielders	**PBF**	**r**			0.536	
		p			0.273	
Goalkeepers	**PBF**	**r**				0.057
		p				0.943
Forwards	**MM**	**r**	0.550			
		p	0.044*			
Defenders	**MM**	**r**		0.196		
		p		0.674		
Midfielders	**MM**	**r**			-0.552	
		p			0.256	
Goalkeepers	**MM**	**r**				-0.028
		p				0.972

Key: * correlation is significant at p< 0.05, PBF- Percentage Body Fat, MM- Muscle Mass, r-Pearson's Product Moment Correlation Coefficient

Table 2 shows that there is no significant relationship between the percentage body fat and coordination among forwards, defenders, midfielders, and goalkeepers (p>0.05). The table indicates that for every one unit increase in percentage body fat, there is an approximately 0.200 decrease, 0.026 decrease, 0.151 increase, and 0.004 increase in the coordination of forwards, defenders, midfielders, and goalkeepers respectively, though not significant. Table 3 shows that there is a significant relationship between muscle mass and coordination among forwards (p=0.044). Hence, for every one unit increase in muscle mass, there is an approximately 0.435 increase in coordination among forwards. No significant relationship was observed between muscle mass and coordination in defenders, midfielders, and goalkeepers (p>0.05) (table 3). For every one unit increase in muscle mass, there is an approximately 0.070 increase, 0.350 decrease, and 0.004 decrease in the coordination of defenders, midfielders, and goalkeepers respectively, though not significant.

Table 2: Results of Linear Regression analysis between percentage body fat and coordination among football players based on playing position.

Football players based on position		Unstandardized coefficients		Standardized coefficient	T	Sig.	95% Confidence interval for B	
		B	**Std. Error**	**Beta**			**Lower bound**	**Upper bound**
Forwards	PBF	-0.200	0.120	-0.466	-1.665	0.127	-0.468	0.068
Defenders	PBF	-0.026	0.078	-0.149	-0.338	0.749	-0.226	0.174
Midfielders	PBF	0.151	0.118	0.536	1.272	0.273	-0.178	0.479
Goalkeepers	PBF	0.004	0.052	0.057	0.080	0.943	-0.219	0.227

Key: * significant at p< 0.05, PBF- Percentage Body Fat

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Table 3. Results of Linear Regression analysis between muscle mass and coordination among football players based on playing position.

Football players based on position		Unstandardized coefficients		Standardized coefficient	T	Sig.	95% Confidence interval for B	
		B	Std. Error	Beta			Lower bound	Upper bound
Forwards	MM	0.435	0.209	0.550	2.080	0.044*	-0.031	0.901
Defenders	MM	0.070	0.156	0.196	0.446	0.674	-0.331	0.470
Midfielders	MM	-0.350	0.265	-0.552	-1.323	0.256	-1.085	0.385
Goalkeepers	MM	-0.004	0.108	-0.028	-0.039	0.972	-0.468	0.459

Key: * significant at p< 0.05, MM- Muscle mass

DISCUSSION

In addition to being regarded as a requirement for health, body composition is also closely integrated into the framework of athletic performance and together with other variables, may influence the degree of performance attained. Previous studies have shown high correlations between body fat percentage and sporting performance [20,21]. It has also been reported that excess adipose tissue serves as dead weight in activities during which the body mass must be repeatedly lifted against gravity during locomotion and jumping [22]. This in turn lowers performance and increases the energy demands of the activity. Despite these findings, the current study observed no significant relationship between the participants' percentage body fat and hand-eye coordination in the different playing positions. Additionally, there was no correlation between body fat percentage and coordination among football players in various playing positions, despite the fact that a greater proportion of midfielders and goalkeepers were obese based on their body fat percentage scores. Therefore, though there are paucity of studies on the relationship between these variables among football players, the findings of his current study though surprising may be because hand-eye coordination is more of a cognitive than physical ability. Hence, though it has been said that excess weight due to increased body fat levels affects performance, it is logical to assume that this influence will be more on physical performance abilities compared to the cognitive abilities of a football player. The forwards in this study showed a significant positive moderate correlation between muscle mass and hand-eye coordination whereas significance wasn't attained between these variables in other playing positions. The results of the current study showed that a one unit increase in the muscle mass of forwards significantly increased their level of hand-eye coordination by 0.435 units. Interestingly, despite majority of the forwards having muscle mass scores that were within normal limits compared to players in other playing positions, a significant relationship between muscle mass and hand-eye coordination was observed among the forwards in this current study. Though there are scarcity of studies on the relationship between muscle mass and coordination among football players, previous research has shown a strong positive correlation between core muscle strength and hand-eye coordination in non-athletes with low back pain [23]. Their study opined that core muscle strength is a vital component of skill output of the upper extremity. Though muscle strength and muscle mass are different entities, the process of coordination reportedly results in the activation of motor units of multiple muscles with simultaneous inhibition of all other muscles to carry out the desired activity [24]. It has also been stated that muscle mass percentage is an important factor related to the distance traveled by players during a football match [10]. Therefore, in the game of football forwards cover most of the distance during a football match and they are frequently the players who receive the most attention because of their diverse roles. They have the main objective of scoring goals, and because their role is designed to be in a scoring position, they are also the players who take penalty kicks and corner kicks when the opposition team kicks the ball out of bounds, as well as kicking off at the beginning of the game and at halftime. As a result, coordination is a critical motor fitness trait for the efficient performance of their role. Hence the finding of this current study implies that as the forwards' muscle mass increases, there is a simultaneous increase in the number of motor units that are activated and a resultant increase in their level of coordination. This finding which could be linked to the vital and divergent roles that forwards play during a football match compared to players in other playing positions, still needs to be

substantiated by future research in this area. On the other hand, based on the findings of this current study it may be assumed that the hand-eye coordination of defenders, midfielders, and goalkeepers does not have a relationship with their muscle mass.

CONCLUSION

The hand-eye coordination of forwards in this study significantly correlated with muscle mass, a body composition measure. This study also showed non-significant correlations between muscle mass and coordination among defenders, midfielders, and goalkeepers. More so, there was no significant correlation between body fat percentage and coordination among football players in all the playing positions. Therefore, findings regarding body composition and motor performance are of crucial importance for complex sports games such as football. This may give coaches and trainers a better working knowledge of this group of athletes by guiding them towards creating athletic profiles and formulation of their training and conditioning programmes to enhance performance.

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