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ANATOMICAL FAT PATTERNING IN MALE NIGERIAN SOCCER PLAYERS

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ABSTRACT

Soccer is the most popular sport in the world. Due to its global acclaim, a lot of scientific studies have been undertaken on different aspects of the sport, particularly in Europe. Few studies have investigated patterns of body fat distribution in African soccer players, in general and patterns of fat distribution of soccer players by playing positions, in particular. The purpose of this study was to determine the patterns of body fat distribution among Nigerian university soccer players and the possible effect of fat pattern on playing positions. Skinfold measurements were taken on 20 soccer players, using ISAK procedures. Results showed that the midfielders had the least (13.5 ± 3.7 %), while the goalkeepers had the highest percentage body fat (16.8 ± 2.3 %). Skinfold values were found to vary by playing positions. Goalkeepers had the highest biceps skinfold thickness (7.2 ± 2.8 mm). Supra iliac skinfold thickness was least in the defenders (5.2 ± 0.4 mm) but highest in the midfielders (13.1 ± 6.5mm). Chest and waist girths were least in the midfielders (86.5 ± 5.3 cm; 82.3 ± 3.6cm). It was concluded that the differences in anthropometric variables among soccer players could be due to the demands of the playing positions. This view is, however, contestable in view of the present playing style requiring all players (except the goal keepers) to assume different playing positions in actual competition.

Key words: BMI, WHR, body fat distribution, soccer playing positions.

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INTRODUCTION

Obesity and fat distribution are well known risk factors of cardiovascular disease. The 1985 Consensus Conference on the Health Implications of Obesity (Bjorntop, 1998), noted that the location of body fat is an important predictor of health hazards. Investigators therefore refined the study on obesity by differentiating anatomic patterns of the physical location of adipose tissue on the body. Body Mass Index (BMI), a height-weight measure, becomes important, since it has been shown to be a better predictor of obesity-related diseases than body weight. These findings indicate that estimation of regional adipose tissue is important as predictors of cardiovascular risk (Kissebah, Videlingum, Murray, Evans, Hartz, Kalkhoff & Adams, 1982).

In 1947, Vague postulated male or android type obesity as the predominance of obesity in the upper half of the body, that is, the neck, cheeks, shoulders and the upper half of the abdomen.

The female or gynoid form of obesity predominates in the lower half, that is, the hips, buttocks, thighs and the lower half of the abdomen (Lohman, Roche & Martorell, 1988). Thus investigators used subscapular and triceps skin-fold thickness as measures of central and peripheral fatness, respectively.

Nevertheless, waist to hip ratio (WHR) is used as an indicator of the amount of fat deposited on the trunk. A high ratio indicates upper body or male -type obesity pattern and a low ratio indicates lower body or female type obesity. Moreover, waist circumference alone was suggested to be a better indicator of cardiovascular disease risk than WHR and was recommended as a tool for identifying a need for weight management (Lean, Han & Morrison, 1995). Hip measurement, however, was shown to provide information as a contributor to type 2 diabetes (Bjorntop, 1998).

Soccer is the most popular sport in the world, with soccer games, and the FIFA World Cup usually attracting millions of spectators. Because of soccer's global acclaim, a lot of scientific studies have been undertaken on the different aspects of the sport, particularly in Europe (Reilly, 1990; Reilly, Bangsbo & Frank, 2000; Clark, 2007).

Physical, physiological, psychological and technical factors contribute to performance in soccer (Hoff, 2005; Stolen, Chamari, Castagna & Wisløff, 2005). The physical demands required from soccer players are immense. Players need explosive power and speed to curtail the movements of their opponents as well as execute attack strategies. Since all players are involved in quick and fast acceleration and deceleration (except the goalkeeper) with their body mass, excess body fat and weight would be a disadvantage, as these will impede the players' movement.

Although soccer is Africa's most popular sport, few studies have examined the anatomical effects of competitive soccer on different players' playing positions, especially regarding fat distribution. Studies on university soccer players are few and have not addressed the anatomical factors of the game. The purpose of this study was to examine the pattern of fat distribution among university soccer players and the possible effects of anatomical fat patterning on player playing position.

METHODS

Subjects

Twenty soccer players from the Obafemi Awolowo University, Ile-Ife, Nigeria, volunteered to participate in the study. Although they indicated an average of 10 years of continuous soccer playing experience, nevertheless, the different measurements were taken just prior to a major national sports competition, the Nigerian Universities Games Association (NUGA), when level of fitness is usually adjudged to be highest among university athletes in Nigeria. Table 1 shows descriptive data of the players by playing position.

Table 1: Descriptive data of the players by playing position

Variable	Playing Positions				
	Goalkeepers (n= 3)	Defenders (n = 5)	Midfielders (n = 7)	Strikers (n = 5)	All Players (n=20)
Age (years)	25.8±2.0	26.2±3.4	22.2±1.0*	23.8 ± 2.3	24.5±1.6
Height (cm)	182.0±2.1*	179.0±3.5	167.0±5.1*	175.0±3.7	175.0±0 3
Body Mass(Kg)	74.5±4.0 *	72 2± 4.5	68.5±5.0*	70.8±4.2*	69.5±4.8

*$p < 0.05$

Anthropometry

The standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) were followed to measure height, body mass and a series of other anthropometric parameters, including skinfolds, breadths and girths, as described by Lohman, Roche and Martorell (1988). A SECA digital weighing scale was used to measure body mass (to the nearest 0.1kg) after an initial calibration with a known weight. Height was read (to the nearest mm) from a scale marked on a calibrated wall.

The Lange skin-fold calipers were used to measure skin-fold on the right side of the body. Sub-scapular, supra-iliac, abdominal, chest, biceps, triceps, thigh and medial calf skin-fold thickness were measured. A flexible Lufkin steel measuring tape was used to measure body girth at the chest, waist, hip, thigh, arm (flexed, relaxed), forearm and wrist.

Waist circumference was measured horizontally at the narrowest part of the torso, between the ribs and the iliac crest, as seen from the anterior aspect. Hip circumference was taken at the level of the buttocks and thus the widest circumference over the greater trochanters (Lohman, Roche & Martorell, 1988).

Body density for the soccer players, was computed using skinfold thickness at the chest, triceps and sub-scapular (Pollock, Schmidt & Jackson, 1989). Percent body fat was derived from body density according to Amusa, Igbanugo and Toriola (1998). Body Mass Index (BMI), Fels Index (FI) and Waist to Hip Ratio (WHR) were also computed (Amusa, Igbanugo & Toriola, 1988; Lohman, Roche & Martorell, 1988). Arm circumference and triceps skin-fold thickness were used to estimate cross sectional area of adipose tissue of the arm (Lohman, Roche & Martorell, 1988). Arm adipose tissue is said to be slightly more correlated with total body fat than triceps skinfold (Himes, Roche & Webb, 1980; Frisancho, 1981).

Statistical Analysis

The anthropometric data were analysed by one way ANOVA. The Scheffe post hoc analysis was used to delineate where any significant difference was identified. This analysis was selected because of the presence of unequivalent groups in the study (Pallant, 2001).

RESULTS AND DISCUSSION

Anthropometric data for the Nigerian university soccer players are presented in Tables 2, 3 and 4. The soccer players in this study were 24.5±1.61years old, 174.55±10.23cm tall and weighed 69.45±4.83kg. They also had the following physical characteristics: percent fat (15.7±1.1), BMI (23.18±0.84), WHR (0.95±0.1), Fels Index (24.2±2.4), tissue area (1.1±0.2) and bone area (2.2±0.1). In general, these subjects appeared to be older, heavier, taller and had higher percentages of body fat than those of Malaysian and English players (Reeves et al., 1999) and Indian soccer players (Bandyopadhyay, 2007). The soccer players were similar in age, height and weight but had higher fat percentage than those of Nigerian Division I league soccer players (Amusa, Sohi & Adelabu, 1988), Spanish league football players (Alburquerque, 2007) and South African soccer players (Clark, 2007).

Table 2: Patterns of body fat distribution of soccer players by playing positions

Variable	Playing Positions				
	Goalkeepers (n 3)	Defenders (n 5)	Midfielders (n 7)	Strikers (n 5)	All Players (n 20)
% Body Fat	16.8 ± 2.3*	16.2 ± 2.0	13.5 ± 3.7*	15.8 ±1.4	15.7 ± 1.1
BMI	22.5 ± 0.8	22.5 ± 14	24.6 ± 1.5	23.1 ± 3.5	23.2 ± 0.84
WHR	0.94 ±0.03	0.96 ± 0.03	0.92 ± 0.04	0.96 ± 0.13	0.94 ± 0.01
Fels Index	23.5 ± 2.3	24.7 ± 3.0	23.6 ± 1.3	24.2 ± 2.4	24.5 ± 2.3
Tissue Area	0.88 ± 0.2	0.75 ± 0.6*	1.13 ± 0.05*	0.90 ± 0.4	1.1 ± 0.2
Bone Area	2.04 ± 0.2	2.0 ± 0.4	2.07 ± 0.09	2.03 ± 0.19	2.2 ± 0.1

*p< 0.05.

Table 3: Skin-fold measures of soccer players by playing positions

Variable	Playing Positions				
	Goalkeepers (n 3)	Defenders (n 5)	Midfielders (n 7)	Strikers (n 5)	All Players (n 20
Sub scapular	8.1 ± 1.1	11.9 ± 1.8	11.1 ± 3.0	7.8 ± 1.4	10.3 ± 2.7
Supra iliac	12.3 ± 2.5	5.2 ± 0.4*	13.1 ± 6.5*	9.2 ± 0.7	12.4 ± 4.6
Abdominal	9.4 ±1.4	12.4 ± 4.0	9.4 ± 2.7	8.4 ± 0.4	10.2 ± 3.1
Biceps	7.2 ± 2.8*	5.2 ± 0.4	5.2 ± 1.6	5.1 ± 0.5	5.6 ± 1.8
Triceps	6.0 ± 1.3*	7.9 ± 1.4	8.2 ± 3.5	5.9 ± 2.8	7.3 ± 2.6
Thigh	7.6 ± 0.7	8.6 ± 2.2	9.1 ± 3.6	5.9 ± 0.1	8.2 ± 2.7
Medical calf	5.6 ± 1.1	6.6 ± 1.3	6.2 ± 2.4	5.1 ± 0.3	6.1 ± 1.7

*p<0.05.

Table 4: Body girth of soccer players by playing positions

Variable	Playing Positions				
	Goalkeepers (n 3)	Defenders (n 5)	Mildfielders (n 7)	Strikers (n 5)	All Players (n 20)
Chest(cm]	90.0 ± 1.0	92.7 ± 5.9	86.5 ± 5.3*	92.5 ± 3.0	89.7 ± 5.5
Waist(cm)	83.8 ± 2.4	84.8 ± 5.6	82. 3 ± 3.0*	85.2 ± 3.7	83.7 ± 0.1
Hip(cm)	89.3 ± 1.1	88.2 ± 4.2	88.7 ± 5.5	88.8 ± 4.3	88.7 ± 4.1
Thigh(cm)	54.8 ± 0.1	54.2 ± 3.6	56.3 ± 3.3	54.8 ± 2.4	55.7 ± 2.0
Arm relaxed(cm	28.2 ± 0.7	27.6 ± 1.8	27.1 ± 2.0	26.8 ± 1.3	27.4 ± 1.7
Arm flexed(cm)	32.0 ± 1.0	27.3 ± 0.58	26.4 ± 1.0	26.0 ± 1.4	26.7 ± 1.2
Forearm(cm)	26.5 ± 1.5	31.2 ± 2.1	30.2 ± 2.6	31.5 ± 2.5	31.0 ± 2.3
Wrist(cm)	17.5 ± 0.87	16.8 ± 0.8	16.4 ± 0.6	16.7 ± 0.6	16.7 ± 0.8

*$p<0.05$.

Tables 1 and 2 further show that the midfielders were youngest, shortest, lightest and had the least percentage of body fat than those in the other playing positions. The strikers were significantly lighter than defenders and goalkeepers. The goalkeepers were the heaviest, tallest and had the highest percentage of fat. The value for tissue area was least in the defenders but highest in the midfielders. There were no significant differences among the players regarding the various positions in WHR and BMI.

Skinfold values were found to vary by playing positions (Tables 3). Goalkeepers had the highest biceps but the least triceps skinfold thickness. The other categories of players had comparable biceps and triceps skinfold values. Supra-iliac skinfold thickness was lowest in the defenders but highest in the midfielders. Chest and waist girths were lowest in the midfielders (Table 4).

The findings of this study corroborate those of previous research that reported goalkeepers to be the tallest and heaviest than soccer players in other playing positions. Midfielders were also reported to be generally shortest and lightest.

Studies have also suggested that larger individuals are best suited as goalkeepers, whereas leaner, lighter and shorter players who are more mobile perform best as outfield players (Reilly, 1990; Reilly et al., 2000; Clark, 2007). Although Indian soccer players were of the same age as the subjects in the present study, Indian players were shorter and much lighter. Bandyopadhyay (1999) stated that the physique of Indian soccer players could be a disadvantage to them since the deficiencies would neither make them to achieve the optimal height needed in winning aerial soccer contests nor make them to produce the momentum required to achieve success when they compete for balls with their taller and bigger counterparts.

Table 2 shows that the values of percent fat in the present study are higher than those of the Indian, Spanish, Malaysian, English and South African soccer players (Bandyopadhyay, 2007; Alburquerque, 2005; Reeves et al., 1999; Clark, 2007). Our results support other findings that indicated that goal-keepers had the highest percentage of fat than players in the other playing positions. Wilmore and Costill (1999) proposed that the percent fat values for soccer players should be between 6 and 14 %. Rico-Sanz (1998) stated in his review paper on footballers that soccer players should have a body fat percentage of around 10 %. The present findings agree with the former but could not corroborate the latter suggestion. This could be because the subjects of this study were not league soccer players or professionals, they were university students, who were not probably as involved in the rigours of training connected with playing the game of soccer as league or professional players. Alburquerque (1999), Bandyopadhyay (2007) and Clark (2007) reported similar values to those proposed by Willmore and Costill (1999) and Rico-Sanz(1998). Their subjects were professional league soccer players.

Skinfold thickness and body girth values of the university soccer players are presented by playing positions in Tables 2 and 3, respectively. Studies that reported detailed skinfold thickness of African soccer players by playing positions are very rare. Elsewhere, Bandyopadhyay (2007) reported skin-fold measurements of Indian soccer players at ten sites. He also reported two girth measurements. Alburquerque (2005) reported skinfold measurements of Spanish league football players at 4 sites.

Specifically, the triceps, sub-scapular and abdominal skinfolds of the Spanish league football players are comparable to those of players in this study. The skinfold thicknesses of Indian soccer players are lower than those of players in the present study. Neither Bandyopadyay (2005) nor Alberquerque (2005) reported data on skinfold measures by soccer playing positions.

In the present study, low triceps skinfold thickness in the goal-keepers could indicate little peripheral fatness, while low suprailiac skinfold in defenders could indicate a low central type fatness. Goalkeepers and strikers had high arm cross sectional area of adipose tissue but also high muscle plus bone area of the arm. To perform their role effectively, goalkeepers need to kick, catch and throw the ball powerfully. They are therefore muscular in the arms, hips, thighs and legs.

Table 2 shows that WHR was not significantly different by playing positions. BMI and Fels Index were not also significantly different by playing positions. Han, Tijhuis, Lean and Seidell (1998) reported average WHR values of 0.80 for the female and 0.90 for males aged 17 to 39 years. They surmised that values of WHR increase with age, with the female increasing to 0.90 and the male to 0.98. They suggested that values higher than these could predispose the individual to health risks.

CONCLUSION

The present study has two important limitations. Firstly, there were few subjects in each of the playing positions. The team coach was asked to recommend the players for this investigation. The subjects for this study were those who featured regularly during practices and competition and who he felt should participate in the study based on their performance. Secondly, the study was carried out on university soccer players. Their standard of play is therefore lower than those of professional soccer players. It is suggested that future investigations increase the size of samples by playing positions. Also, such studies should examine comprehensively the anatomical and anthropometric profile of soccer players by playing positions focusing on variables not studied in the present study, such as somatotypes. Such information will provide additional knowledge on the major physical and anatomical requirements needed for successful soccer performance.

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