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Anthropometric Characteristics and Somatotype Differences among Nigerian Soccer Players, in Relation to Playing Level and Playing Position

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Abstract

Introduction: Somatotype, as an evaluation of body types technique, has been studied for selection of competent sport athletes based on the correlation of sport's performance with the "ideal" human physique. This study was aimed at describing the anthropometric and somatotype differences among Nigerian soccer players at different playing levels. **Methods:** A total sample of 64 subjects which comprised of 30 professional soccer players and 34 amateur soccer players within ages 19-28 years were selected. Ten anthropometric variables were measured which consisted of; height, weight, two girths, two bone breadths and four skinfolds. The Heath and Carter anthropometric method was used. Descriptive and inferential statistics were carried on the data obtained out using the SPSS IBM software package, version 21. **Results:** The results showed that the mean somatotype for the professional soccer players was; 2.5-4.2-3.5 while that of amateur soccer players was; 2.7-2.7-4.2, with observed dominant somatotype categories as balanced mesomorph and balanced ectomorph respectively. Height, weight, BMI, ectomorphy and mesomorphy were significantly different between the two groups of playing levels (at $p<0.05$). However, the playing position showed no somatotypic variation at both playing levels. **Conclusions:** The result of the study showed that somatotype variation existed between different playing levels for the Nigerian soccer players.

Keywords: Anthropometric**,** Somatotype, Nigeria, Soccer Players

Resumen

Introducción: El somatotipo, como una técnica de evaluación de los tipos de cuerpo, se ha estudiado para la selección de deportistas competentes basándose en la correlación del rendimiento deportivo con el físico humano "ideal". Este estudio tuvo como objetivo describir las diferencias antropométricas y somatotípicas entre los futbolistas nigerianos en diferentes niveles de juego. **Métodos:** Se seleccionó una muestra total de 64 sujetos que comprendía 30 futbolistas profesionales y 34 futbolistas amateurs de entre 19 y 28 años. Se midieron diez variables antropométricas que consistieron en; altura, peso, dos perímetros, dos anchos óseos y cuatro pliegues cutáneos. Se utilizó el método antropométrico de Heath y Carter. Se realizaron estadísticas descriptivas e inferenciales sobre los datos obtenidos utilizando el paquete de software SPSS IBM, versión 21. **Resultados:** Los resultados mostraron que el somatotipo medio de los futbolistas profesionales fue de 2,5- 4,2- 3,5, mientras que el de los futbolistas amateurs fue de 2,5- 4,2- 3,5. 2,7- 2,7- 4,2, observándose categorías somatotípicas dominantes como mesomorfo equilibrado y ectomorfo equilibrado respectivamente. La altura, el peso, el IMC, la ectomorfia y la mesomorfia fueron significativamente diferentes entre los dos grupos de niveles de juego ($p<0,05$). Sin embargo, la posición de juego no mostró variación somatotípica en ambos niveles de juego. **Conclusiones:** El resultado del estudio mostró que existía variación somatotípica entre diferentes niveles de juego para los futbolistas nigerianos.

Palabras Clave: Antropometría, Somatotipo, Nigeria, Jugadores de fútbol

Introduction

Soccer as the world most popular sports, is conducted at both amateur and professional levels and involves variety of people groups of different ages involving both youth and senior's athletes. It is characterized by short

sprints, rapid accelerations and deceleration, turning, jumping, kicking and tackling (Arnason *et al.,* 2004). It is a game that lasts for at least 80-90 minutes in an official setting (Noh *et al.,* 2015). This sport is associated with high agonistic engagement such that requires the development of all conditional capacity and require general and specific motor skills (D'Isanto, 2020) and it is related with predominantly low to moderate intensity activities interspaced with periods of high intensity actions (Nobari *et al.,* 2021).

In soccer, players are assigned specific positions to fulfill particular tasks. Both tactics and player positioning on the field are essential for organizing a soccer match (Gil *et al.,* 2007; Wong *et al.,* 2009). Four conventional playing positions have been identified for soccer players: Forward (FW), Midfielder (MF), Defender (DF), and Goalkeeper (GK) (Noh *et al.,* 2015). Players are further classified according to their roles into Goalkeepers, External-defenders, Central-defenders, Central-midfielders, External-midfielders, and Forwards (Lago-Peñas *et al.,* 2011). The success of soccer players has been associated with many specific morphological characteristics (Spehnjak *et al.,* 2021). Success in soccer depends not only on physiological and metabolic factors but also on anthropometric characteristics related to body physique (build) and composition (Reilly *et al.,* 2000).

The body composition and shape of individuals are described by their somatotype, a classification system based on three main factors: ectomorphy, mesomorphy, and endomorphy. Endomorphy refers to an individual's amount of body fat, mesomorphy relates to bone structure and muscular mass, and ectomorphy measures a person's slenderness or leanness. These three elements combine to create a distinct somatotype that describes a person's physical attributes and composition (Duquet and Carter, 2009; Terzi & Kalkavan, 2024). Somatotype is a measure of the relative adiposity, muscularity, and linearity of individuals. Identifying an athlete's somatotype can help individualize exercise training programs, which may differ by position and playing level in soccer. This is due to variations in adiposity level, musculoskeletal robustness, and linearity of athletes' physiques (Nobari *et al.,* 2021).

Somatotype can be used as a screening tool in the selection of talented athletes (Terzi & Kalkavan, 2024). Players from successful teams tend to have more muscular and leaner physiques than players from unsuccessful teams (Ciftci & Kurtoglu, 2023). Moreover, regular examination of soccer players' somatotypes can help coaches and other soccer management officials determine training programs that would improve athletes' sport performance (Kastrati et al., 2022; Amin, 2023).

The relationship between anthropometric and somatotype characteristics and their connection to playing level and positions among Nigerian soccer players remains largely unexplored, particularly in the western region of the country. This significant gap in our understanding presents a compelling opportunity for research that could yield valuable insights into player physiology and performance. By focusing on football clubs in western Nigeria, this study aims to address this knowledge deficit, offering regionally specific data that may reveal unique physical attributes of players in this area. Such information is crucial for optimizing performance through improved talent identification, player selection, and position-specific training strategies. The findings of this study have the potential to inform injury prevention strategies by identifying position-specific physical attributes, as well as guide youth development programs in nurturing young talents. By bridging this research gap, our study seeks to contribute vital knowledge to the field of sports science in Nigeria, potentially influencing player development, team strategies, and overall performance in Nigerian soccer.

Material and Methods

Study design: This is a cross-sectional study

Study sample: The study sample consisted of sixty-four (64) male Nigerian soccer players; comprising thirty (30) professional soccer players and thirty-four (34) amateur soccer players, aged 19-24 years. Based on the Nigerian Football league system, the professional players were selected from the Sunshine Stars Football club, Akure, which is funded by the Ondo state government and listed in the Nigerian professional league. The amateur soccer players, were selected from Florence Joshua Football Club owned by an individual. The different football clubs in the country are categorized into professional and amateur football Leagues (of two divisions).

Sampling of Subjects

Sixty-Four (64) soccer players were randomly selected from the different football teams participated in this study which was conducted during the final half of the soccer season for the year 2023. These players were members of selected teams in the tiers of the Nigerian football league.

The Players were classified according to their playing position into Four (4) groups- Goalkeeper, Defender, Midfielder, Forwards.

The players were selected during their training seasons. The training and football season for the both professional and amateur Football leagues in the country started in September and November respectively of the previous year. The professional players usually trained for 3 hours per day and 5 days per week and the training sessions are composed of 15-25 minutes warm-up, 30 minutes technical training, 30 minutes of tactical training, 30-45 minutes of simulated competition and 10-15 minutes cool down in the course of the training season. Within the team, all players of different position trained together except the goalkeepers, whose training is dedicated to specific training sessions. The Amateur players had irregular training (twice per week) and are involved only in competitions within a state, in this study, within Ondo state.

Ethical consideration

The study was approved by the Anatomy Departmental Ethics unit, University of Medical Sciences Ondo, Nigeria. Each participant also gave their verbal consent before being recruited into the study.

Selection criteria

Only individual who had better understanding of a layman's explanation on the purpose and procedure of the study and demonstrated willingly to take part in the research. Also, all study participants were considered presumably healthy as there was no obvious illness or deformities in their body parts that could interfere with measurements carried out on them. Those unwilling to voluntarily participate in the research and anyone not healthy at the time of the study were excluded.

Instrumentation for Data collection

i. Height scale: for measurement of stature taken to the nearest 0.1cm

ii. Electronic digital weighing scale for measurement of weight to the nearest 0.1kg

iii. Slim Guide Skinfold Caliper (Creative Health products, Plymouth Michigan, USA) to measure triceps, subscapular, supraspinale and medial calf skinfolds thickness.

iv. Sliding Caliper (RND 555-00167, RND LAB) to measure the bone breadths of the humerus biepicondylar diameter and Femur biepicondylar diameter.

v. A non-stretchable measuring tape used for measurements of arm flexed and tensed, as well as medial calf girths.

Measurement Protocols

Height

(stature) measurement: The height of the participants from the top of the head to the ground level of the feet were measured by means of an anthropometer. The participant were asked to remove their shoes, face directly forward with their feet together, arms by their sides.

Body weight

The weight of the participants were measured to the nearest 0.1kg using an electronic weighing scale with the participants wearing no shoes and in light clothing. The weight measurement is read from the scale with each subject asked to stand on the center of the scale without support and with the weight distributed evenly on both feet. Measurement was avoided shortly after a meal.

Skinfold measurements

Each participant's skinfold as a double-fold was raised away from the underlying muscle at the appropriate marked site firmly between thumb and index finger of the left hand and the nearest edge of the contact faces of the skinfold caliper are applied 1 cm away from the edge of the thumb and finger to take the readings. The Triceps, subscapular, suprailiac and medial calf skinfolds were all taken at their respective sites as specified in the International Society for Advancement in Kinanthropometry (ISAK) manual (ISAK, 2001).

Bone breadths

Both humerus and femur biepicondylar breadths were taken from each subject using the digital bone caliper. Using the bone caliper, the distance between the medial and lateral epicondyles of the humerus and femur respectively were measured with each participant's arm flexed while standing and the knee flexed while seated respectively.

Girth circumferences

The circumference (girth) of the arm while flexed and tensed, as well as the that of the medial calf, were both measured using a non-stretchable tape. Measurements were taken to the nearest 0.1cm.

Data Analysis

The somatotypes and somatocharts were computed using the somatotype software developed by Sweat technologies (somatoype v.1.2, 2002, Sweat Technologies).which employed the Heath-Carter algorithms (Carter and Heath,1990) for estimation of the somatotype components-endomorphy, mesomorphy and ectomorphy, using the ten measurements taken.

BMI was derived from the weight and height values obtained as; BMI= Weight (kg)/square of height (m). Also, the obtained data from measurements carried out on the subjects were subjected to statistical analysis using the statistical package for social sciences (SPSS) version 21. Both Descriptive and Inferential statistics were conducted and the results presented as Means and standard deviations. For between and within group comparisons, both t-tests and ANOVA were done and P-value < 0.5 was considered as statistically significant.

Results

Table 1. Descriptive and inferential statistics of anthropometric variables and somatotype components for the studied sample.

Anthropometric and Somatotype measured variables	Professional soccer player (Mean±-*SD)	Amateur Soccer Players (Mean±-*SD)	P-value	Inference
Age(years)	24.13±1.69	22.21±1.3734	0.000*	P<0.05 significant
Height(m)	1.81±4.79	1.79±6.17	0.046*	P<0.05 significant
Weight(kg)	71.46±4.09	64.06±5.77	0.000*	P<0.05 significant
BMI (kgm^{-2})	21.64±1.01	20.05±1.90	0.000*	P<0.05 significant
Triceps SF(mm)	7.67±3.31	8.88±3.66		
Subscapular SF(mm)	12.20±2.39	12.39±2.45		
Suprailliac SF(mm)	6.75±1.83	6.96±1.35		
Medial Calf SF(mm)	4.97±1.29	5.59±1.41		
Upper-arm girth(cm)	31.95±1.67	29.95±1.94		
Calf Girth(cm)	36.64±2.54	33.87±2.34		
Humerus biepicondylar breadth(cm)	7.11±0.30	6.45±0.38		
Femur biepicondylar breadth(cm)	9.44±0.35	8.80±0.48		
Endomorphy†	2.48±0.69	2.70±0.58	0.166	P>0.05 Not significant
Mesomorphy†	4.15±0.82	2.71±1.01	0.000*	P<0.05 significant
Ectomorphy†	3.49±0.64	4.19±1.24	0.007*	P<0.05 significant

*SD:= Standard Deviation , † indicates components of somatotype which are ratings without units,

SF=skinfold, The algorithms for somatotype developed by Heath Carter (1990):

Endomorphy=-0.7182 + 0.1451X – $0.00068X^2$ + $0.0000014X^3$,

Meomorphy=0.858HB + 0.601FB + 0.188AG + 0.161CG – 0.131SH + 4.50

Ectomorphy=0.732HWR -28.58 (if HWR ≥ 40.75)

Ectomorphy= 0.463HWR – 17.63 (if 38.25< HWR<40.75)

Ectomorphy= 0.1 (if HWR ≤ 38.25)

where X= (170.18/SH) x SF = sum of 3 skinfolds, corrected for height; HB=humerus breadth; FB= femur breadth; AG= corrected arm girth, CG=corrected calf girth; SH=standing height (in cm), HWR= height over cube root of weight.

Table 2. A descriptive statistics of the anthropometric characteristics of professional and amateur players in regard to playing position

	Age (years)		Body Weight (kg)		Height (m)		BMI (kg/m2)	
	PP	AP	PP	AP	PP	AP	PP	AP
GK	23.50±2.08	22.67±1.53	75.00±1.63	66.67±2.88	1.85±3.11	1.82±8.71	21.77±0.86	20.09±1.51
DF	23.90±1.91	21.75±1.54	71.30±4.79	64.83±6.97	1.81±4.46	1.80±9.71	21.76±1.28	19.98±1.94
MF	24.50±1.93	22.44±1.23	68.13±3.31	63.89±5.99	1.78±3.81	1.78±3.66	21.40±0.98	20.19±2.07
FW	24.38±1.06	22.40±1.26	73.25±2S.12	62.50±4.81	1.83±4.90	1.78±7.41	21.69±0.88	19.97±2.02
Overall	24.13±1.69	22.21±1.37	71.46±4.09	64.06±5.77	1.81±4.79	1.78±6.17	21.64±1.01	20.05±1.90

GK=Goalkeepers, DF= Defenders, MF= Midfielders, FW= Forward, PP: Professional Players, AP: Amateur Players, BMI: Body mass index

Table 3. Frequency Distribution of Somatotype categories in Professional Level Soccer Players

Somatotype Categories†	Frequency distribution	Percentage (%) frequency
Endomorphic Mesomorphic	2	6.67
Balanced Mesomorph	9*	30*
Ectomorphic Mesomorph	8	26.67
Mesomorph Ectomorph	5	16.67
Mesomorphic Ectomorph	2	6.67
Balanced Ectomorph	1	3.33
Central	3	10
TOTAL	30	100

† Table only shows only somatotype categories present among players. * Dominant Somatotype category in Highest playing level is Balanced Mesomorph. Note that by definition according to Heath-Carter (1990), dominant category simply refers to the most frequent somatotype seen.

Table 4. Frequency Distribution of Somatotype categories in Amateur Level Soccer Players

Somatotype Categories†	Frequency distribution	Percentage (%) frequency
Mesomorphic Endomorph	3	8.82
Balanced Mesomorph	1	2.94
Ectomorphic Mesomorph	1	2.94
Mesomorph Ectomorph	1	2.94
Mesomorphic Ectomorph	5	14.71
Balanced Ectomorph	16	47.05*
Endomorph Ectomorph	1	2.94
Central	6	17.65
TOTAL	34	100

† Table only shows only somatotype categories present among players *Dominant Somatotype Category in Amateur Playing Level is Balanced Ectomorph

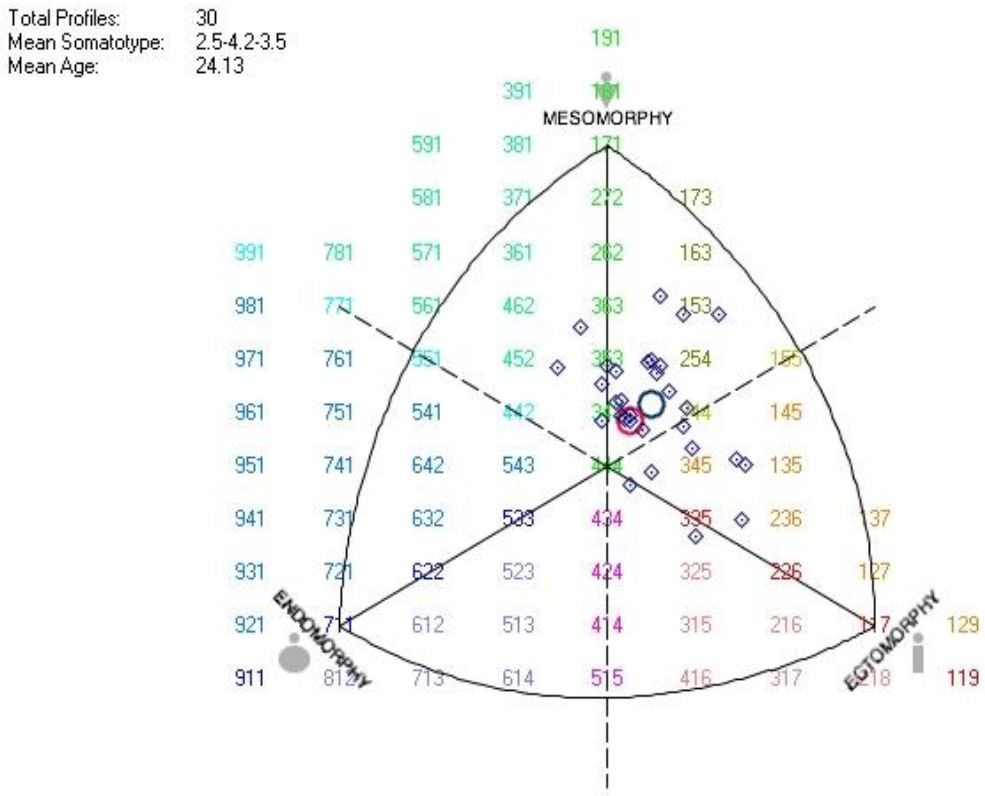

Figure 1. Somatochart for Professional Soccer Players

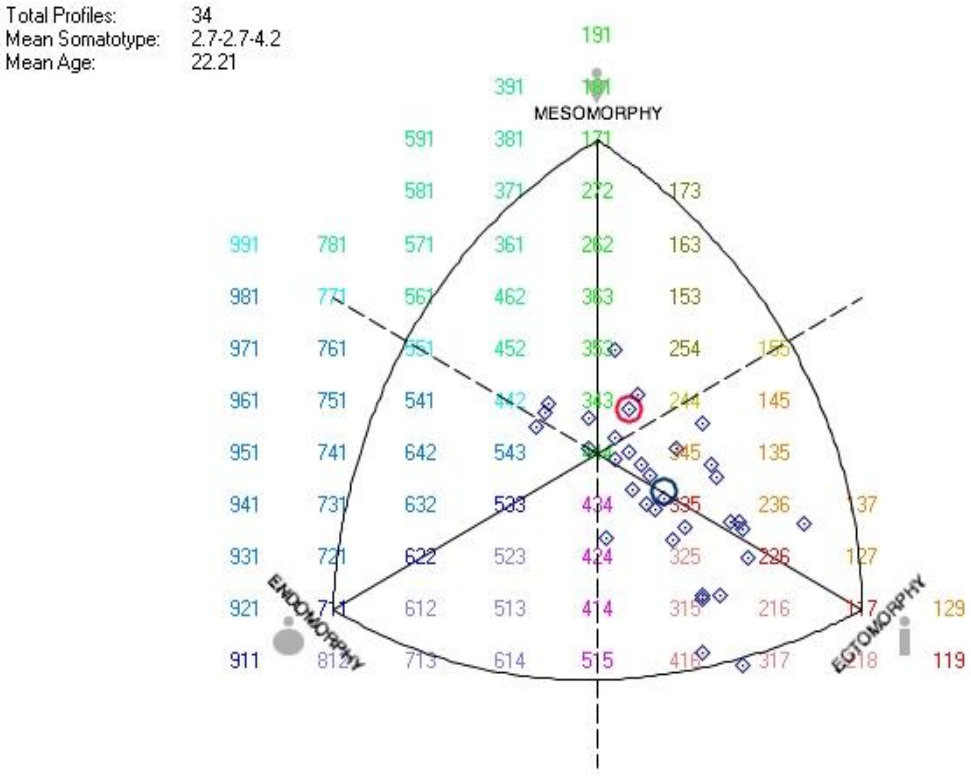

Figure 2. Somatochart for Amateur Soccer Players

Table 5. Frequency Distribution of Somatotype categories in Professionals according to different playing position: Goalkeepers, Defender, Mildfielder & Forward

Somatotype categories							
Playing position	Endomorphic Mesomorphic	Balanced Mesomorph	Ectomorphic Mesomorph	Mesomorph Ectomorph	Mesomorphic Ectomorph	Central	Total Frequency of occurrence
Professionals Goalkeepers		2				2	4
Defender	1	1	5	1	2		10
Mildfielder	1	5	1			1	8
Forward		3	2	2	1		8
Total	2	11	8	3	3	3	30

Table 6. Frequency Distribution of Somatotype categories in Amateurs according to different playing position: Goalkeepers, Defender, Mildfielder &Forward

	Mesomorphic Endomorph	Mesomoprh Endomorph	Balanced Mesomorph	Ectomorphic Mesomorph	Mesomorph Ectomorph	Mesomorphic Ectomorph	Balanced Ectomorph	Endomorph Ectomorph	Central	Total frequency
Goal Keeper						1	1		1	3
Defender			1	1	1	2	5	1	1	12
Mildfielder		2				2	4		1	9
Forward	1						6		3	10
Total	1	2	1	1	1	5	15	1	6	34

Discussion

This study examined the anthropometric and somatotype characteristics of 64 Nigerian soccer players. The data were grouped by position and playing level. Thirty (30) soccer players represented the professional level, while thirty-four (34) represented the amateur level. The findings revealed significant differences between playing levels and positions.

The mean age of professional players (24.13 years) was higher than that of amateurs (22.21 years), with an overall range of 19-28 years. Professional players' ages ranged from 19 to 28 years, while amateurs had an average age of 22.21 years, demonstrating a significant difference in mean age across playing levels. This observation aligns with Hazir's (2010) findings on similar playing tiers but contrasts with the older average age of 27.4 years reported for players in the 2018 FIFA World Cup by Perevoznik et al. (2018). These age distinctions correspond to Golomazov and Chirva's (2003) delineated zones: Prospect phase (up to 20 years), Growth of skill phase (25-29 years), Extinction phase (30-34 years), and Veteran stage (34 years and above). The diverse age demographics among professional and amateur players highlight the dynamic nature of sporting careers and the evolving landscape of competitive football (Кос & Улан, 2022).

Professional players were significantly taller and heavier (181cm, 71.5kg) compared to amateurs (179cm, 64.1kg) (Table 1). These measurements are comparable to findings from several studies. Hazir (2010) reported similar height but dissimilar weight between different playing levels. European players in leagues such as the Turkish Super League (Hazir, 2010; Orhan *et al.,* 2013), Spanish La-Liga (Cavia *et al.,* 2019), Greek leagues (Leao *et al.,* 2019), Serbian national team (Joskinov *et al.,* 2019), and Slovak soccer players (Kaplanova *et al.,* 2020) had mean

heights ranging from 172cm to 186cm, aligning with this study. The height range of European national teams in the 2018 FIFA World Cup (Perevoznik *et al.,* 2018) was 182-186cm, consistent with the professional players in this study.

Asian players in the Iranian professional league (Mevaloo *et al.,* 2021), Qatar Star league (Wik *et al.,* 2018), Qatar National Team (Brocherie, 2014), and Korean youth players (Noh *et al.,* 2015) had heights between 173cm and 187cm, corroborating this study's findings. Nigerian football league players (Akinbiola *et al.,* 2017) showed heights between 172cm-182cm, while Zimbabwean players (Masocha *et al.,* 2014) were shorter (166cm-174cm). However, African national teams in the FIFA World Cup (Perevoznik *et al.,* 2018) had heights between 182cm-186cm, higher than this study's findings.

American players in leagues such as the Campeonato Brasileiro (Fidelix *et al.,* 2014) and various national teams (Perevoznik *et al.,* 2018) had heights between 177cm and 182cm, similar to this study. Joskinov et al. (2019) attributed the differences in height and body weight to ethnic and cultural influences or different styles of football.

Height varied among soccer players relative to playing positions, consistent with other studies. Goalkeepers were marginally taller than other players at both playing levels (Table 2). However, Croatian amateur goalkeepers (Erceg *et al.,* 2013) and German amateur goalkeepers (Rogan *et al.,* 2011) had heights of 188cm and 187cm respectively, higher than those in this study.

Midfielders were the shortest at both playing levels (Table 2), although the mean difference was not statistically significant. Among professional players, defenders had the second-highest height, followed by forwards. For amateurs, defenders also had the second-highest height, but there was no statistical difference between forwards and midfielders. This contrasts with Noh et al. (2015), who found that Korean defenders were taller than players in other positions.

Analysis of soccer players' body weight revealed statistically significant variations by playing level, with professionals averaging more than amateurs (Table 1). The average weight of professional players in this study (71.40kg) was lower than that of elite Nigerian players (72.7kg) (Akinbiola *et al.,* 2017). Goalkeepers had the highest weight at both levels (Table 2), consistent with previous studies. This may be due to the pattern of goalkeeper play, which involves fewer runs in a game, allowing them to conserve energy (Booysen *et al.,* 2019). Among professional soccer players, midfielders were the lightest across all positions, although not statistically different from other positions. In contrast, among amateur players, forwards were the lightest, while they had the second-highest weight among professionals. Defenders had the second-highest weight among amateur players.

These findings for amateur players align with several studies. Miçooğulları (2024) reported that goalkeepers were heavier compared to other positional players. Similarly, Taskin et al. (2016) and Can (2018) found that goalkeepers and defenders had higher weights compared to other positions. In a related study, Atli (2021) reported that central players had higher body weights than wingers.

Body Mass Index (BMI) among players was within the normal range. Professionals had a higher average BMI (21.64kg/m²) than amateurs (20.05kg/m²), a statistically significant difference likely due to weight variations. Among professionals, goalkeepers had the highest average BMI, while midfielders had the highest among amateurs (Table 2). However, these positional differences were not statistically significant. The positional findings for amateurs were inconsistent with other studies (Hazir *et al.,* 2010; Joskinov *et al.,* 2019; Cavia *et al.,* 2021; Nobari *et al.,* 2021).

This study also examined somatotype distributions among professional and amateur soccer players, revealing significant differences in mesomorphic and ectomorphic components between playing levels. Professional players exhibited a mean somatotype of 2.5-4.2-3.5, predominantly balanced mesomorph, while amateurs showed 2.7-2.7-4.2, tending towards balanced ectomorph. These findings contrast with previous studies that generally report mesomorphic characteristics across soccer players (Mathur *et al.,* 1985; Apor, 1988; White *et al.,* 1988; Ramadan and Byrd, 1991; Rienzi *et al.,* 2000; Casajús, 2001; Bandyopadhyay, 2007; Rahmawati *et al.,* 2007; Hazir, 2010; Orhan *et al.,* 2013; Brocherie *et al.,* 2014; Fidelix *et al.,* 2014; Kaplánová, *et al.,* 2020).

The study also analyzed somatotypes by playing positions, finding variations between professionals and amateurs. Notably, goalkeepers in both groups showed higher endomorphy levels, consistent with previous research (Cavia *et al.,* 2019). Professional defenders were predominantly ectomorphic mesomorphs, aligning with findings from Spanish and Iranian leagues (Cavia *et al.,* 2019; Mevaloo *et al.,* 2021).

The somatotype differences between professional and amateur players may result from variations in training intensity, frequency of competitive matches, and access to nutritional and medical support (Hazir, 2010). However, the study found no particular relationship between players' somatotypes and playing positions within each level, supporting Orhan et al.'s (2013) who reported in their study that here is no specific relationship between somatotype and playing position in football.. This trend may reflect the evolving nature of soccer, which increasingly demands versatile performance across all positions.

The study emphasizes that while a mesomorphic component can be advantageous in soccer due to the sport's physical demands (Perroni *et al.,* 2017), the observed diversity in somatotypes suggests that success in soccer is not limited to a single body type. These findings contribute to the understanding of morphological characteristics in soccer players and may have implications for player selection and training strategies at different competitive levels.

Conclusion

This study demonstrates that anthropometric characteristics and somatotypes of soccer players vary based on playing level and position. The heterogeneous somatotypes observed among Nigerian soccer players highlight the potential influence of morphological characteristics on soccer performance. Professionals tend towards balanced mesomorphy, while amateurs lean towards balanced ectomorphy. These findings can be considered with other physiological and performance tests that evaluates players accomplihment when selecting players and assigning position of play in the game for optimal performance.

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Full access to data on request.

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The Authors have no conflict of interest to declare

Informed Consent Statement

All the athletes included in the study provided written informed consent.