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SEX AND AGE RELATED VARIATIONS IN SOMATOTYPE OF ETHNIC HAUSA ADOLESCENTS'FROM ZARIA, NORTH-WESTERN NIGERIA

Mustapha, M^{a*}, Adamu, A. A.^{a,b}, Dahiru, A. U.^a, and Maryam, M.^a

^aDepartment of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Ahmadu Bello University Zaria, P. O. Box 2555, Zaria, Kaduna state, Nigeria

^bDepartment of Radiology, Ahmadu Bello University Teaching Hospital, Zaria, Nigeria

*Corresponding author: M. Mustapha, Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Ahmadu Bello University Zaria, P. O. Box 2555, Zaria, Kaduna state, Nigeria,+2340839297156, e-mail: mmustapha@abu.edu.ng

ABSTRACT

This study was aimed at investigating the somatotype characteristics of adolescent Hausa ethnic group of Zaria Local Government Area, Kaduna State, North Western Nigeria in the context of sex- and age- related variations. A total number of 384 apparently healthy adolescent subjects aged 10-19 years (187 males and 197 females) were randomly selected and somatotyped according to the protocol of Carter and Heath (1990). The somatotype component ratings, the somatotype attitudinal distance (SAD) and somatocharts were computed using the somatotype calculation and analysis software. A somatotype analysis of variance (SANOVA) which compares the somatotype of each group by using the somatotype attitudinal distances (SAD) within and between the groups was used to test the significance of gender differences. A MANOVA analysis was used to assess the significance of age differences in somatotypes. The mean somatotype was mesomorph ectomorph (1.68-2.31-3.75) for males and central for females (3.10-2.23-3.29). The females were more endomorphic than the males ($F=240.47, P< 0.001$) while the males on the other hand were more ectomorphic than the females ($F=9.9, P=0.002$). The mesomorphic component did not differ between the sexes ($F=0.33, P=0.427$). The one-way MANOVA analysis indicated a significant effect of age on mean somatotypes in males, as well as in females. In conclusion, there were notable sex differences in the somatotypes of adolescents, with girls being significantly more endomorphic and boys being more ectomorphic. In both sexes, the somatotype showed significant changes from early adolescence to late adolescence. More studies, especially longitudinal ones, are necessary to better understand somatotype variations during adolescence.

INTRODUCTION

A growth change in humans, especially during adolescence, is characterized by significant changes in body size, composition and shape (Kalichman and Kobylansky, 2006), which can be better explained using the modus operandi of somatotype. A somatotype basically gives a gestalt summary of the overall body outlook in terms of the shape and composition independent of the body size (Carter, 1996). It has three basic components; endomorphy (fatness), mesomorphy (musculoskeletal development) and ectomorphy (leanness) (Carter and Heath, 2002). Among the different methods of obtaining somatotype, the Heath and Carter anthropometric somatotype is now the most

preferred in estimating the somatotype because studies have shown that this technique is highly reliable, simple, unique and feasible (Reis *et al.*, 2007; Choi *et al.*, 2013; Liiv *et al.*, 2013).

The changes in the somatotype components during growth in adolescents (defined as individuals between 10 and 19 years old [WHO, 2015]) can provide vital information for understanding the growth patterns, the timing, and rate of sexual maturation (Toselli *et al.*, 1997; Claessens *et al.*, 2000). It can also provide information regarding adult physique variations and can be used to compare and contrast physique patterns between different populations and ethnic groups (Malina *et al.*, 2004).

Several morphologists have documented the somatotype of Caucasian children and adolescents (Gakharand Malik 2002; Rahmawati *et al.*, 2004; Kalichman and Kobylansky, 2006; Bhasin and Jain 2007; Singh *et al.* 2007; Özener and Duyar 2008). However, in Nigeria, the most populous Black Country with diverse multiethnic groups, such studies are generally sparse or absent. A somatotype study of Andibila children aged 7-14 year in Oju, Benue, North-Central Nigeria, by Goon *et al.* (2013) is one of the few, recent and most comprehensive so far. No information, to the best of our knowledge, is available on the somatotypes of adolescent Hausa ethnic group of Zaria Local Government Area, Kaduna State. Therefore, this study was aimed at investigating the somatotype characteristics of adolescent Hausa ethnic group of Zaria, North Western Nigeria in the context of sex- and age- related variations.

radius from the PZ post office (considered as the city centre) and is well connected by roads and rail with other regions of the country. Distances from Kaduna, Kano, Jos and Sokoto are approximately; 75 km, 176 km, 387 km and 404 km respectively. Zaria is the second principal town in Kaduna state after Kaduna metropolis, and is home to Ahmadu Bello University, established in 1962. It is also host to several other Federal Government Institutions, like Federal College of Education, National Institute for Transport Technology, Federal Institute of Chemical and Leather Research, Nigerian College of Aviation Technology and Industrial Development Corporation. The population of Zaria metropolis is approximately 975,153 (National Population Commission, 2006). It is made up of two Local Government Councils, Zaria Local Government, consisting of two districts; Zaria walled city and Tudun Wada, and Sabongari Local Government which consists of three districts; Sabon Gari, Samaru, and the Government Reservation Area. The economic life of Zaria people revolves around agriculture and rearing of cattles for sale and consumption. Staple diets of the people include cereals and seasonal vegetables.

MATERIALS AND METHODS

Study Location

Zaria is a Hausa land in the northern part of Kaduna State, in the northern part of Nigeria and is located on latitude 11°04' north and longitude 7° 43' east. It is defined by a 15 km

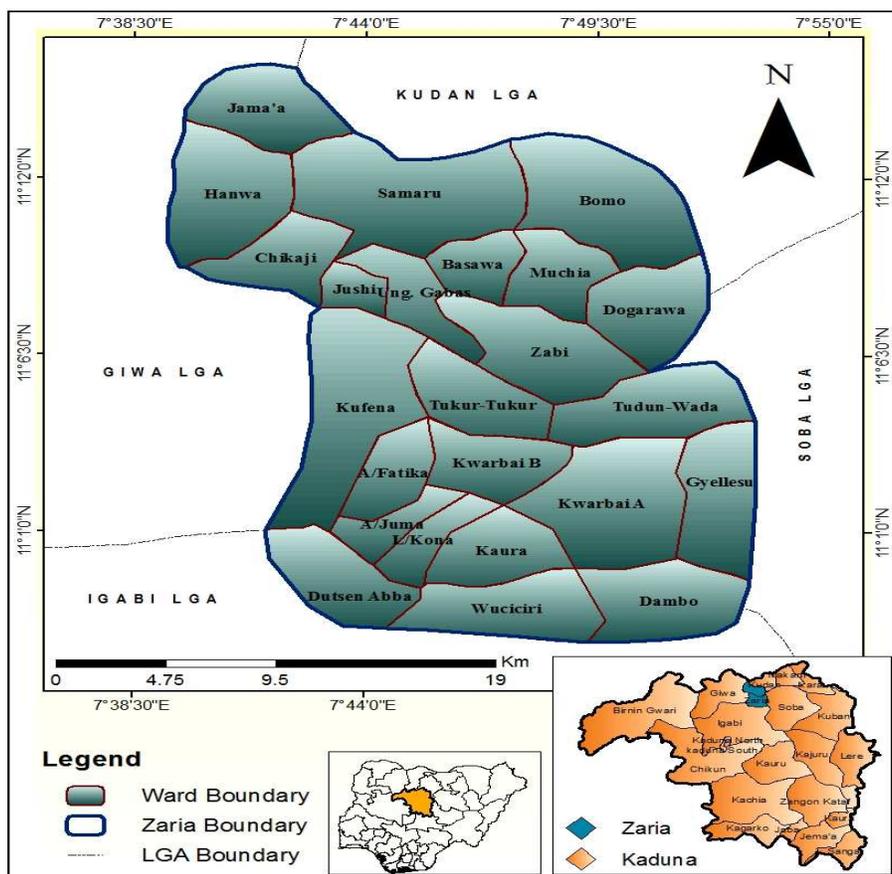


Figure 1: Map of Zaria Local Government (Quickbird, 2015)

Sample

The study sample consisted of 384 Hausa (197 girls and 187 boys) adolescents aged 10 -19 years who were randomly selected and recruited for the study. Only the apparently healthy subjects present in the schools where the study population was drawn from at the time of the research(March to July 2017) were recruited for the study. Informed consent was obtained from the children’s parents or guardians as the case may be and permission was obtained from the various schools concerned. The Ethics Committee on Human Research, Ahmadu Bello University Zaria endorsed the study protocol. Data for the present investigation was collected from five different secondary schools in Zaria

metropolis. Information about the dates of birth of the subjects was obtained from the school records and the subjects were grouped into seven age groups, of one year each, using age mid-points as shown in table 1. In each case, the following parameters were measured - height, weight, biepicondylar breadth of the humerus and femur, contracted arm girth and calf girths, and skinfold thicknesses (triceps, subscapular, medial calf and suprascapular). Standard anthropometric tools following the procedures as outlined by the International Society for the advancement of kinanthropometry (ISAK) (2001) was employed for the data collection.

Table 1: Distribution of study population based on age.

Age	10	11	12	13	14	15	16	17	18	19	Total
Male	2	2	8	22	17	29	32	36	23	16	187
Female	0	2	4	12	14	37	39	58	29	2	197

Statistical analysis

The somatotype component ratings, the somatotype attitudinal distance (SAD) and somatocharts were computed using the somatotype calculation and analysis software (Carter and Heath, 2002). Descriptive statistics were calculated for height, weight, the three somatotype components, viz. endomorphy, mesomorphy, and ectomorphy. A somatotype analysis of variance (SANOVA) which compares the somatotype of each group by using the somatotype attitudinal distances (SAD) within and between the groups was used to test the significance of gender differences. Chi-square test was used to check for associations between somatotype categories based on sex. The significance of age differences in somatotypes was assessed with the help of MANOVA analysis that used Wilk’s Lambda as test statistics (Cressie *et al.*, 1986) with Scheffe’s Post Hoc. All statistical analyses were performed with Statistical Product and Service Solutions (SPSS) version 23.0 and the significance level was set at $P < 0.05$.

RESULTS

Tables 2 and 3 display the statistical details of height, weight, endomorphy, mesomorphy and ectomorphy for the adolescent Hausa boys and girls of Sabon Gari L.G.A., Kaduna state. It can be seen from the table and figure 2 (A) and 3 (A) that height and weight showed a general increase with age. The maximum increase in height was noted from 11 to 12 years (15 cm) in

girls and from 10 to 11 years in boys (9 cm). For weight, the maximum gain was recorded from 10 to 11 years (12 kg) in boys and from 11 to 12 years in girls (14.5 kg). Figures 2 (B) and 3 (B) shows the age trends of the three somatotype components. As is evident from Table 2 and 3, the age trends of various somatotype components were variable, in both sexes. The mean ectomorphy among boys showed a marginal increase from 10 to 11 years, followed by a decreasing tendency from 11 to 19 years. On the other hand, in females, there was a general trend towards an increase in mean endomorphy with the advancement of age. In females, the mean endomorphy increased from 1.75 units at 11 years to 3.0 units at 13 years, thus recording a total gain of 1.25 units. Then a slight decrease at 14 years and thereafter an upward increasing trend was noticed. The mean mesomorphy showed a rising and falling pattern in general in both sexes. In boys, the mean mesomorphy increased from 3.0 units at 10 years to 3.9 units at 11 years, thus recording a total gain of 0.9 units. It then decreased at 12 years and subsequently gradually rose up to the age of 15 years, then marginally decreased at 16 years and finally increased afterwards. In females, the mean mesomorphy, increased from 11 years to 12 years recording a gain of 1.7 units. At 13 years a slight fall was noticed and thereafter an increase. Ectomorphy in boys also showed a rising and falling trend.

From 10 to 11 years, the boys showed an overall gain of 1.75 units in mean ectomorphy. Thereafter a decrease was observed at 12 years, then an increase at 13 years and it continued in this pattern to the age of 19 years. In girls,

there was a clear trend towards a decrease in ectomorphy with age increase. From 15 to 19 years, the ectomorphy registered a total decline of 2.96 units in girls.

Table 2: Body height, weight and somatotype components of male subjects

Age Group	n	Height (cm)	Weight (kg)	Endomorphy	Mesomorphy	Ectomorphy
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
10	2	151.00±1.41	42.50±3.54	1.65±0.35	3.00±1.70	3.15±1.20
11	2	142.00±0.00	30.00±0.00	1.25±0.35	3.90±0.71	4.90±0.00
12	8	148.13±6.88	38.25±6.54	1.65±0.44	1.40±0.83	3.74±0.91
13	22	149.23±10.73	40.14±9.47	1.74±0.68	1.68±1.05	3.52±1.12
14	17	151.00±12.03	39.71±8.79	1.30±0.38	1.88±1.11	4.01±1.61
15	29	153.03±9.73	42.50±8.82	1.72±0.83	2.37±1.80	3.78±1.82
16	32	159.81±6.49	47.56±7.81	1.50±0.47	2.14±1.57	3.85±1.37
17	36	162.00±8.19	48.60±7.73	1.95±0.94	2.73±1.37	4.08±1.29
18	23	166.85±4.51	56.50±4.37	1.70±0.32	2.82±1.38	3.28±0.88
19	16	167.13±3.93	56.19±4.87	1.78±0.41	2.41±1.23	3.41±1.01

SD: Standard deviation

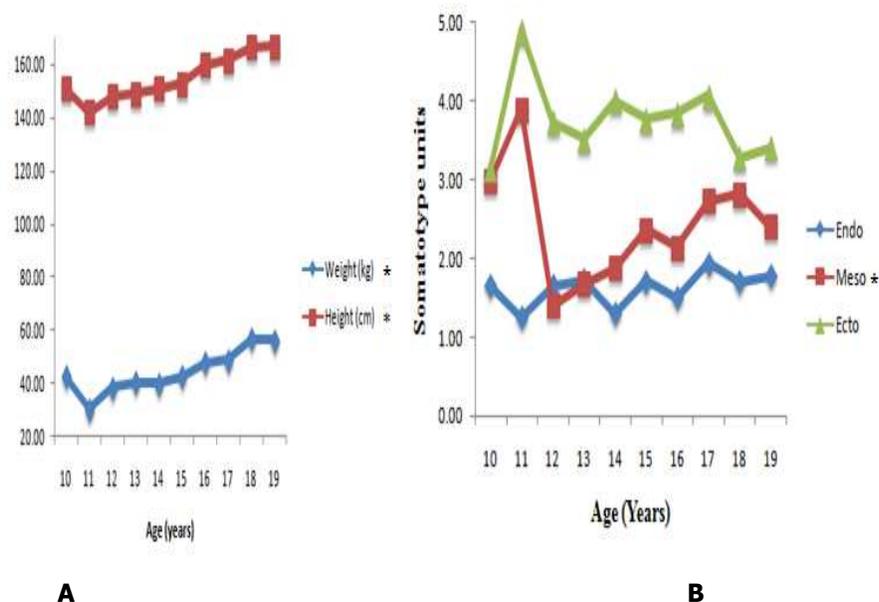
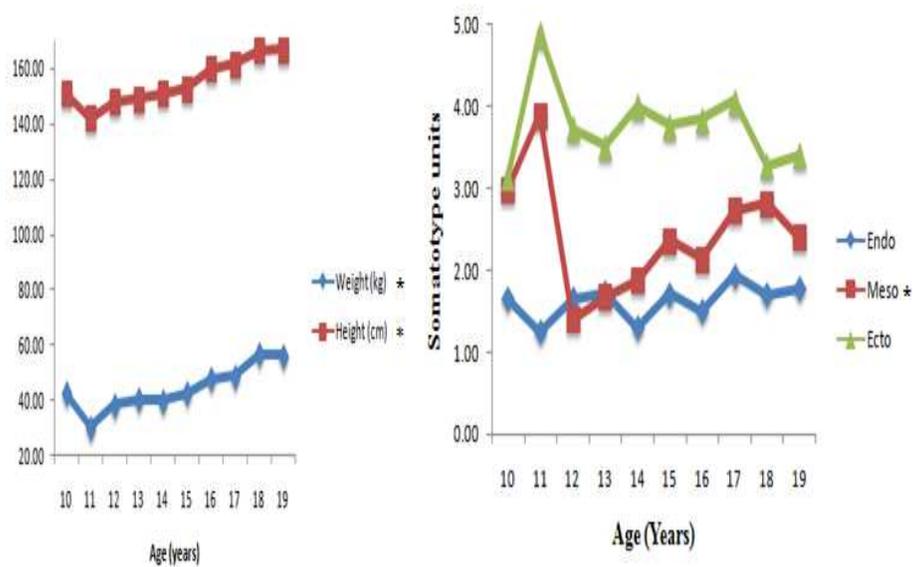


Figure 2: (A) Age trends in mean height (Ht) and weight (Wt) of the male subjects (B) Age trends in mean endomorphy (Endo), mesomorphy (Meso) and ectomorphy (Ecto) of the male subjects (* $P < 0.05$)

Table 3: Body height, weight and somatotype components of the female subjects

Age Group	n	Height (cm)	Weight (kg)	Endomorphy	Mesomorphy	Ectomorphy
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
11	2	142.50±0.71	32.75±7.42	1.75±1.06	0.35±0.35	4.20±2.69
12	4	157.50±13.40	47.25±9.67	2.13±0.73	2.05±0.77	3.40±0.91
13	12	152.42±6.36	41.58±10.07	3.00±0.88	1.98±1.09	3.88±1.41
14	14	152.79±4.44	43.75±7.37	2.45±0.76	2.29±0.92	3.33±1.37
15	37	156.41±4.84	43.78±7.24	2.83±1.01	1.91±1.35	4.11±1.56
16	39	158.12±6.69	48.88±7.50	3.38±0.99	2.25±1.55	3.24±1.44
17	58	157.60±6.51	49.39±7.66	3.25±1.10	2.31±1.16	3.04±1.43
18	29	156.59±5.23	50.56±8.85	3.37±1.17	2.64±1.22	2.64±1.39
19	2	161.50±0.71	66.25±13.08	3.20±1.41	2.75±1.77	1.15±1.48

SD: Standard deviation



A **B**
 Figure 3: (A) Age trends in mean height (Ht) and weight (Wt) of the female subjects (B) Age trends in mean endomorphy (Endo), mesomorphy (Meso) and ectomorphy (Ecto) of the female subjects (* $P < 0.05$)

Figure 4 is a somatochart showing the somatotype distribution of the study population based on sex. For the males, the mean age was 15.72 years and the majority of the somatotype means clustered on the South Eastern and North Eastern Axis of the boundary of the somatochart. Also, on the Somatochart, is the profile marker inside an empty circle which represents the mean somatotype for all the profiles in the document. Hence the mean

somatotype for all the male profiles was mesomorph-ectomorph (1.7-2.3-3.8). For the females on the hand, mean age was 15.56 years with the somatotype means clustering in near-equal proportion on the South Western, North Western, North Eastern and South Eastern Axis of the boundary of the somatochart. Thus, the mean somatotype for all the female profiles was central (3.1-2.2-3.3).

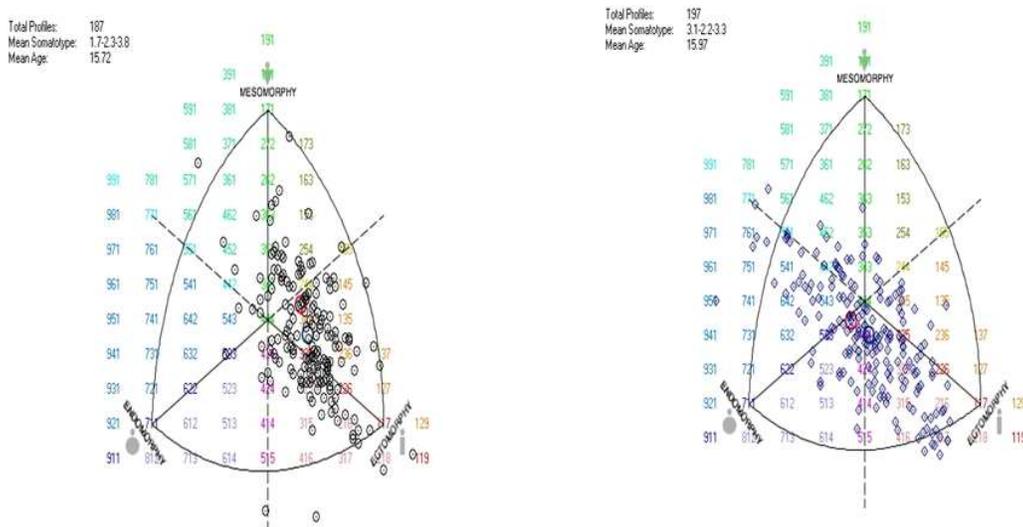


Figure 4: Somatotype distribution of the female and male subjects respectively

The somatotype analysis of variance (SANOVA) table for the overall study population, which compares the somatotype of each group by using the somatotype attitudinal distances (SAD) within and between the groups, is presented in table 4. The males had a low endomorphic rating of 1.68 while the female on the other hand had a moderate endomorphic rating of 3.1. Both males and females had a low mesomorphic rating of 2.31 and 2.23 respectively (Table 4). The ectomorphic ratings for both males and females were moderate

(3.75 and 3.29 respectively) (Table 4). There was a statistically significant difference in the overall somatotypes of both male and female subjects ($F= 45.00, P< 0.001$) (Table 4). Also shown in table 5, is a univariate analysis of the dominant somatotype component of males and females. The females were more endomorphic than the males ($F=240.47, P< 0.001$) while the males on the other hand were more ectomorphic than the females ($F=9.9, P=0.002$) (Table 5). The mesomorphic component did not differ between the sexes ($F=0.33, P=0.427$).

Table 4: Somatotype analysis of variance (SANOVA) for the female and male subjects

Group	Frequency	Mean	Standard Deviation
Male	187	1.68-2.31-3.75	0.66-1.44-1.34
Female	197	3.10-2.23-3.29	1.07-1.28-1.52
ANOVA	F=45.53	$P< 0.001$	

Table 5: Univariate analysis of variance of the individual somatotype components in both sexes

Variable	DF-within	DF-between	F-ratio	p-value
Endomorphy	382.00	1.00	240.47	<0.001
Mesomorphy	382.00	1.00	0.33	0.427
Ectomorphy	382.00	1.00	9.90	0.002

In terms of the distribution of the subjects according to the regions in the somatocharts (Figure 5), ten major somatotype categories were found for the males: endomorph-ectomorph (7), balanced endomorph (1), mesomorph-endomorph (2), endomorphic mesomorph (4), balanced mesomorph (12), ectomorphic mesomorph (17), mesomorph-ectomorph (22), mesomorphic ectomorph (37), balanced ectomorph (80) and central (3). The females on the other hand had twelve categories: endomorph-ectomorph (22), ectomorphic endomorph (10), balanced endomorph (9), mesomorphic endomorph (19), mesomorph-endomorph (17), endomorphic mesomorph (6), balanced mesomorph (3), ectomorphic mesomorph (2), mesomorph-ectomorph (3), mesomorphic ectomorph (14), balanced ectomorph (73) and central (22).

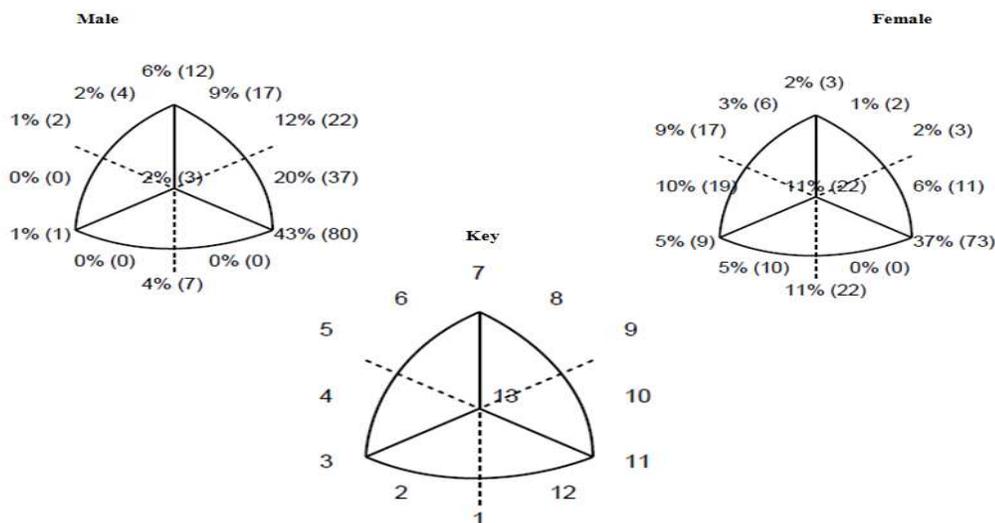


Figure 5: Category chart showing the percentage/frequency profile of the major somatotype categories based on sex (Keys: 1= endomorph-ectomorph; 2=ectomorphic endomorph; 3= balanced endomorph; 4= mesomorphic endomorph; 5= mesomorph-endomorph; 6= endomorphic mesomorph; 7= balanced mesomorph; 8= ectomorphic mesomorph; 9= mesomorph-ectomorph; 10= mesomorphic ectomorph; 11= balanced ectomorph; 12= endomorphic ectomorph; 13= central

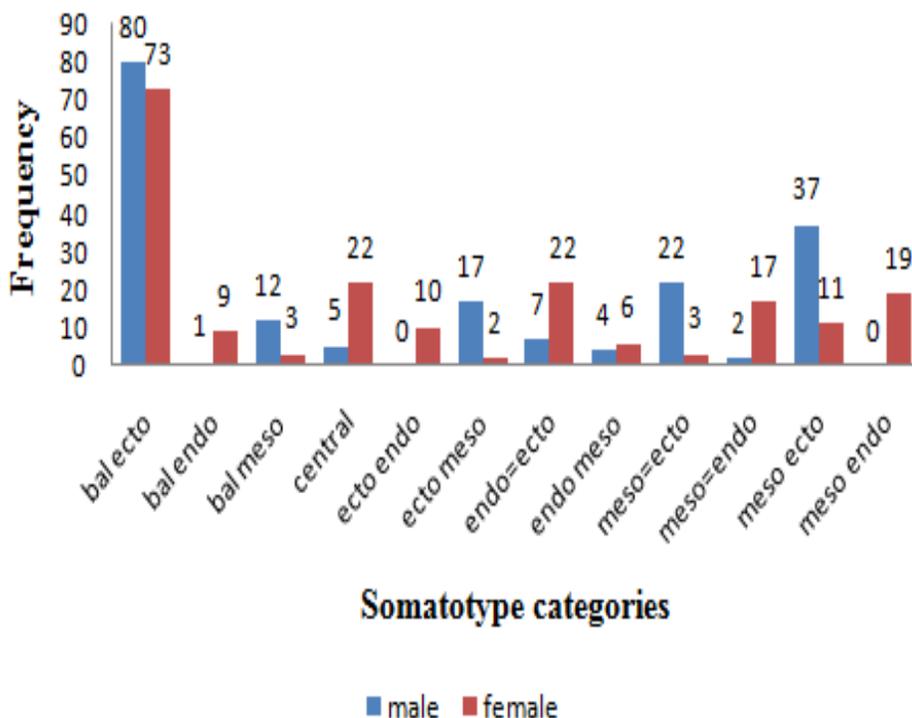


Figure 6 is a chart comparing the somatotypes categories according to the sex. There was a statistically significant association for male and female subjects ($\chi^2 = 112.001, P < 0.05$) based on the somatotype categories.

Figure 6: Comparison of somatotype categories according to sex ($\chi^2 = 112.001, P < 0.001$)
 Bal-Ecto: Balanced-Ectomorph; Bal-Endo:Balanced-Endomorph; Bal-Meso: Balanced-Mesomorph;
 Ecto-Meso: Ectomorph-mesomorph; Endo-Meso: Endomorph-mesomorph; Meso=Ecto: Mesomorph
 Ectomorph; Meso-Ecto: Mesomorph-Ectomorph; Endo-Meso:Endomorph-
 Mesomorph;Endo=Ecto:Endomorph-Ectomorph; Meso=Endo:Mesomorph-Endomorph; Ecto-
 Endo:Ectomorph-Endomorph

To see the effect of age, according to sex, on various parameters, a MANOVA analysis with Scheffe's Post Hoc procedure was done. Tables 5 and 6 contain the results of the analysis. In the case of boys, the F-value ($F_{45, 777}$) for the test (Wilk's Lambda = 0.424) was 3.650 and Noncent parameter= 145.405 which was highly significant ($P < 0.05$). In girls also, the F-value of the test ($F_{40, 806}$) for the test (Wilk's Lambda = 0.569) was 2.778 and Noncentparameter = 96.044 which was highly significant ($P < 0.05$). Hence the MANOVA analysis has proven the significant effect of age on various parameters in boys, as well as in girls. The table also displays the F-values for the effect of age on various dependent variables. In the case of boys, the F-values for mesomorphy was significant ($P < 0.05$), indicating the significant effect of age. On the other hand, in the case of girls, the endomorphy and ectomorphy F-values were significant ($P < 0.05$), which suggests significant age influence on these two somatotype

components. However, height and weight showed significant F-values ($P < 0.05$) in both sexes.

Scheffe's Post Hoc tests for multiple comparisons did not reveal significant differences between various age groups for endomorphy and ectomorphy except for mesomorphy (years) among boys. In boys Scheffe's Post Hoc tests revealed significant differences in mesomorphy between age groups 10 and 11. Among the girls, Scheffe's Post Hoc tests revealed significant differences in endomorphy between age groups 11 and 13, and 14 and 16 years. As was the reverse case with boys, pairwise age comparisons of mesomorphy among girls were not significant for the majority of age groups. Scheffe's Post Hoc tests for multiple age comparisons in ectomorphy in girls were significant between 15 and 18 years. However, in boys as well as in girls, the differences were significant ($P < 0.05$) for height and weight for the majority of age groups.

Table 6: Results of MANOVA analysis to see the effect of age on height, weight, endomorphy, mesomorphy and ectomorphy among male adolescent Hausa

Dependent variable	Wilks' Lambda	F	df	Sig.	Noncent parameter	Observed power
Overall	0.424	3.650*	45, 777	0.001	145.405	1.000
Height (cm)	-	13.773*	9, 177	0.001	123.960	1.000
Weight (cm)	-	13.758*	9, 177	0.001	123.823	1.000
Endomorphy	-	1.743	9, 177	0.082	15.686	0.778
Mesomorphy	-	2.162*	9, 177	0.027	19.455	0.875
Ectomorphy	-	1.034	9, 177	0.415	9.305	0.504

* $P < 0.05$

Table 7: Results of MANOVA analysis to see the effect of age on height, weight, endomorphy, mesomorphy and ectomorphy among female adolescent Hausa

Dependent variable	Wilks' Lambda	F	Df	Sig.	Noncent parameter	Observed power
Overall	0.569	2.778*	40, 806	0.001	96.044	1.000
Height (cm)	-	3.413*	8, 188	0.001	27.301	.975
Weight (cm)	-	5.575*	8, 188	0.001	44.599	1.000
Endomorphy	-	2.621*	8, 188	0.010	20.968	0.917
Mesomorphy	-	1.353	8, 188	0.220	10.828	0.608
Ectomorphy	-	3.338*	8, 188	0.001	26.701	0.972

* $P < 0.05$

DISCUSSION

As a whole, the mean somatotype of the adolescent Hausa ethnic group of SabonGari L.G.A., Kaduna State was mesomorph-ectomorph (1.68-2.31-3.75) for males and central for females (3.10-2.23-3.29). When compared with age-matched samples of Andibila males and females of Benue State by Goon *et al.* (2013), whose mean somatotypes for male and female were found to be mesomorph-ectomorph (1.20-2.41-2.58) and mesomorph-ectomorph (1.36-2.16-2.67) respectively, adolescent Hausa are more endomorphic, ectomorphic and less mesomorphic. Similarly, Gaur *et al.* (2014) on the somatotype of Rajput adolescents in India found the mean somatotypes as a whole to be 3.45-2.48-4.63 (endomorph-ectomorph) for girls and 1.61-3.20-4.38 (mesomorph-ectomorph) for boys and these are dissimilar with the present studies. The somatotype of Chinese boys and girls was found to be ectomorphic mesomorph and central respectively (Ji and Ohsawa, 1996). The morphological variation seen may be attributable to some measure of genetic factors, nutrition, geographical location, physical activities, hormonal and other sociocultural or environmental factors.

In the present study, the female Hausa adolescents had a moderate endomorphic rating i.e., obese physique with large deposits of subcutaneous fat while the males on the other hand had a low rating, which implies marked lean physique with minimum subcutaneous fat.

This finding is consistent with the general understanding that females of the human species have more fatness overall than males (Pavlovsky and Kobylansky, 1997; Kalichman and Kobylansky, 2006). Girls tend to have more subcutaneous fat at all ages and the differences in fatness between boys and girls become more pronounced during adolescence (Roemmich and Rogel, 1995; Rolland-Cachera, 1995; Jurimae and Jurimae, 2001; Gaur *et al.*, 2014). Traditionally, while the boys are performing physically demanding jobs like farming, cutting firewood and helping to rear domestic animals, the girls are often restricted to household chores, which require less physical activity. Additionally, it is possible that while the girls remain at home, they tend to eat more than the boys. These explanations, though non-empirical, should not be ignored as possible factors accounting for girls being more endomorphic compared to the boys (Goon *et al.*, 2013). Hormonal influence (Gaur *et al.*, 2014) is also a potential reason for the observed disparity.

The Hausa males and females had low mesomorphic ratings which were not significantly different. This denotes small bone and muscle mass plus small bone diameters relative to stature. The implication of these is that both Hausa boys and girls may be less involved in recreational games associated with high levels of physical activity, and less activity tends to disfavour musculoskeletal development (mesomorphy).

This is incongruent with the general pattern of boys having greater average muscle mass at all ages than girls (Roemmich and Rogel, 1995; Rolland-Cachera, 1995; Malina *et al.*, 2005; Arce *et al.*, 2012; Gaur *et al.*, 2014).

Similarly, the ectomorphic ratings in both sexes were a moderate one, though males are significantly more ectomorphic than the females. This characterizes them as having little mass relative to stature plus relatively elongated limb segments. However, according to Carter and Heath (1990), there are fewer differences in general in ectomorphy between males and females. Rebato *et al.* (1996) noted that in a sample of Basque boys and girls, ectomorphy values were closer in both sexes compared with the other two components, with higher mean values for males. Several other researchers also found no difference in ectomorphy between boys and girls (Kalichman and Kobylansky, 2006; Gaur *et al.*, 2008, 2014).

The disparity in the results of our study with other reports could stem from ethnic differences, genetics, nutrition, hormonal and environmental influence, type of study and methodological inconsistencies.

In general, males are more mesomorphic, slightly more ectomorphic, and less endomorphic than females, from preschool ages through to young adulthood (Malina, 2004). Variations in various components during adolescence can be translated in terms of growth and development in humans that characterize changes in size and shape relative to time (Cameron, 2012).

The one-way MANOVA analysis indicated a significant effect of age on mean somatotypes in boys, as well as in girls. Also, the F-test did show significant age differences in the dominant mesomorphy in males and dominant

endomorphy and ectomorphy in females. In congruence with the present findings, some studies have shown significant changes in component dominance in both sexes during growth from early to late adolescence (Rebato *et al.*, 1996; Tamazo-Ravnik, 1996; Hebbelinet *et al.*, 2005)). Also, in a recent study by Gaur *et al.* (2014) on Indian children and adolescents, the instability of somatotype was also demonstrated. However, several other researchers reported no significant changes in component dominance during growth (Claessens *et al.*, 1986; Bhasinand Singh, 1991; Singh and Singh, 2006). Thus the evidence is still inconclusive and needs further exploration.

CONCLUSION

There were notable sex differences in the somatotypes of Hausa adolescents of Zaria, Nigeria, with girls being significantly more endomorphic and boys being more ectomorphic. Mesomorphy did not significantly differ between the sexes. In both sexes, the somatotypes (mesomorphy in males and endomorphy and ectomorphy in females) showed significant changes from early to late adolescence. More studies, especially longitudinal ones, are necessary to better understand somatotype variations during adolescence.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

Contributions of Authors

Aurthors	Lit. Rev.	Methodology	Results	Discussion	Conclusion	References
Mustapha M	✓	✓	✓	✓	✓	✓
Adamu AA		✓		✓		
Dahiru AU			✓		✓	
Maryam M	✓	✓				

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