JOBASFUD
Journal of Biomedical and Applied Sciences

RESEACH ARTICLE

The Interplay of Facial Features and Dominant Somatotypes: A Study on Hausa Adolescents in Kano Metropolis

*Abdulfattah Moisule Ganga[1], Maryam Isa Sharif[2], Lawan Hassan Adamu[3], Rabiu Inuwa Fage[2], Ahmad Ahmad Gaya[2]

[1]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, Yobe State University, Damaturu, Nigeria;
[2]Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Bayero University Kano, Kano, Nigeria;
[3]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medicine and Allied Medical Sciences, Federal University Dutse, Jigawa, Nigeria.

Abstract

Background: Anthropometric somatotyping is one of the most used methods of describing body shape and composition. The study aims to determine the relationship between facial anthropometry and dominant somatotype among Hausa adolescents in Kano metropolis. **Methods:** The sample size for the study was 391 subjects comprising male (196) and female (195) subjects with a median age of 15.0 from selected secondary schools in Kano metropolis. The design was a cross-sectional study. Anthropometric somatotyping was used and participants were classified into the three dominant somatotype components: endomorph, mesomorph and ectomorph. Simple random sampling was employed to select the secondary schools and the participants. Facial anthropometry and somatotype measurements were measured using standard protocol. Spearman's correlation was used to determine the relationship between the dominant somatotype components and facial anthropometry, while stepwise logistic regression analysis was deployed to predict somatotype components from facial parameters**.** **Results:** A significant correlation was found between facial measurements and dominant somatotype. Somatotype components were significantly predicted from facial parameters and facial breadth was the best predictor. **Conclusion:** From the findings, it can be concluded that there is a relationship between facial anthropometry and dominant somatotypes of the ethnicity studied.

Keywords: adolescents, lineage, somatotype, physique, regression, facial length, facial breadth.

Introduction

Anthropometric studies are scientific methods and techniques for displaying different measurement and observation on the human being as well as on a skeleton. Anthropometric studies are important for craniofacial surgery and syndromology (Choudhary and Chowdhary, 2012). Different researches show the advantage of anthropometric measurement as a tool for studying variation in human population and, more importantly, in forensic science for crime investigation (Oladipo *et al.* 2014). In the 20th century, the relevance of anthropometry to the study of different races was substituted by different sophisticated methods for determining racial variations. Nowadays, anthropometry has got recognition in medical sciences particularly in forensic medicine (Oladipo *et al.* 2014). Somatotype is a taxonomy used in describing body physique or shape. The term somatotype and its three components (endomorph, mesomorph and ectomorph) were first described in 1940 by Sheldon and his co-workers. According to him, endomorphy means the relative predominance of soft roundness throughout the various regions of the body; mesomorphy means the relative predominance of muscle, bone and connective tissue and ectomorphy means the relative predominance of linearity and fragility (Sheldon *et al.,* 1940). Later, Heath and Carter introduce the simplified method for somatotyping and in the last few decades, anthropometric somatotyping has been one of the most used methods which describes the body shape and

* Corresponding Author: Abdulfattah Moisule Ganga
E-mail: abdumoiganga@ysu.edu.ng
Tel: +2348066406474

composition. It has been the most used approach for studying body physics variations in children, adolescents and adults among populations, age changes and sex differences (Cameron and James, 2010; Carter and Heath, 1990).

Craniofacial Anthropometry is an objective technique based on a series of measurements and proportions, which facilitate the characterization of phenotypic variation and quantification of dysmorpology (Yasas *et al.,* 2014).

Many of the research studies reported sexual dimorphism in somatotypes. Bojadzieva *et al.,* (2018) report that male and female Macedonian adolescents are more endomorphic; they also report that the male Albanian adolescents are mesomorphy, while the females are ectomorphy. Buffa *et al.,* (2005) report that male Sardinians are mostly mesomorphic, while female Sardinians are mostly endomorphic. There is a study which shows that both male and female Venezuelans are mesomorphic (Herrera *et al.,* 2004). Pandey and Atreya, (2017) work on Devdaha Medical College students and report a significant sexual dimorphism in facial length and breadth. The facial length and breadth of Malay population were found to be sexually dimorphic with females having higher values (Ngeow and Aljunid, 2009). Anibeze (2013) conducts research and reports a significant correlation between somatotype and cephalic length and breadth among the Igbo tribe of Abakaliki, Nigeria.

There have been cases of insurgency around the northern part of Nigeria and Nigeria as a whole. The problem of child abduction and change of identity to another region of the country is also alarming. Studies have been carried out on somatotypes (Herrera *et al.,* 2004, Buffa *et al.,* 2005, Bojadzieva *et al.,* 2018), facial aspect of the body aiming at identification of individuals, variation, ethnic and age differences (Ngeow and Aljunid, 2009, Anibeze, 2013, Pandey and Atreya, 2017) and so on. There has been scarcity of data or literatures on the relationships between somatotypes and facial anthropometry in Kano metropolis which is very important in human identification. The study aims to determine the correlation between facial measurements and dominant somatotype; prediction of dominant somatotype components from facial parameters among Hausa adolescents in Kano metropolis, Nigeria.

Materials and Methods

The study area and population

Cross-sectional design was used in the study which was conducted in the eight (8) Local Government Areas (LGAs) of Kano metropolis. Sixteen (16) secondary schools (two from each the LGAs) were randomly selected. An average of 24 participants were measured from the schools. The sample size was determined with the following formula given by Cochran, (1977).

$$n = \frac{z^2pq}{d^2} = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2} = 384$$

Where;

n = desired sample size, z = confidence level (How confident the actual mean falls within your confidence interval) 1.96 at 95%. p = prevalence/standard deviation (How much variance expect in the responses) 50% (0.5). q = 1 – p. d = degree of precision/ margin of error which is 5%.

The sample size of the study was rounded up to 391 subjects comprising of male and female participants to increase the level of precision. The participants were adolescent Hausa aged 11-19 years who were also grouped into early (11-14 years), middle (15-17 years) and late (18-19 years) adolescent stages. The study includes any student belonging to the selected secondary schools, any student that belongs to Hausa ethnicity (who were traced back to grand parenthood) and any student without physical deformity on the face, skin, elbow, and knee.

Ethical consideration

The protocol involved in the study was approved by the Committee on Ethics, Kano State Ministry of Health (MOH/Off/797/T.I/1915). Participants were included in the study voluntarily; their confidentiality and privacy were ensured throughout the study. Informed consent was also obtained from the participant’s guardians.

Methods

Collection of biodata

A simple proforma was used to collect the biodata such as sex, age and ethnicity of the participants.

Anthropometry

Facial length of the respondents was measured using a vernier caliper (model M-6 150mm LCD gauge; manufactured by Crimp Supply) as the distance between the nasion and gnathion (Farkas *et al.*, 2005).

Facial breadth was measured with a spreading caliper (model M-HT10136; manufactured by Hank Minerals) as the distance between the two zygomatic arches (Kanchankumar *et al.*, 2012).

Height was measured with a stadiometer as the distance between the calvaria and the sole of the foot (Kanchankumar *et al.*, 2012).

Body mass (weight) was measured while the subjects were wearing light clothing and standing at the center of the scale platform and were recorded to the nearest tenth of a kilogram. Skinfold thicknesses were measured by raising a fold of skin and subcutaneous tissue firmly between thumb and forefinger of the left hand and away from the underlying muscle. The edge of the plates on the caliper were placed 1 cm below the fingers of the left hand and were allowed to exert their full pressure before reading the thickness of the fold. All skinfolds were measured on the right side of the body. The triceps skinfold was measured with the subject's arm hanging loosely in the anatomical position. The skinfold was raised at the back of the arm at a level halfway on a line connecting the acromion and the olecranon processes. Subscapular skinfold was measured by raising the fold of skin on a line from the inferior angle of the scapula in a direction that is obliquely downwards and laterally at 45 degrees. The supraspinale skinfold was measured when the fold of skin was raised above the anterior superior iliac spine on a line to the anterior axillary border and on a diagonal line going downwards and medially at 45 degrees. The medial calf skinfold was measured by raising the vertical skinfold on the medial side of the leg, at the level of the maximum girth of the calf (Carter and Heath, 1990).

Somatotype formulae

The following formulae were used to determine the somatotypes:

Endomorphy = -0.7182 + 0.1451 (X) - 0.00068 (X^2) + 0.0000014 (X^3)

Where X = (sum of triceps, subscapular and supraspinale skinfolds) × (170.18/height)

Mesomorphy = 0.858 × humerus breadth + 0.601 × femur breadth + 0.161 × arm girth + 0.161 × calf girth height 0.131 + 4.5

Ectomorphy: The following are formulae for ectomorphy depending on the value of Height-Weight Ratio (HWR): -

$$\text{Height-Weight Ratio (HWR)} = \frac{\text{Height}}{3\sqrt{\text{Weight}}}$$

- Ectomorphy = 0.732 HWR - 28.58 **(If HWR is ≥ 40.75)**
- Ectomorphy = 0.463 HWR- 17.63 **(If HWR is < 40.75 > 38.25)**
- Ectomorphy = 0.1 **(If HWR is ≤ 38.25)**

(Carter and Heath, 1990).

Somatotype Components Classification

An extreme somatotype will be 711, 171 and 117 for Endomorph, Mesomorph and Ectomorph respectively (Carter and Heath, 1990).

Measurement Error

Reliability of the measurements was determined using Intra-Class Correlation (ICC). Repeat measure was employed at an interval of one week and the average of the two measurements was taken. The Cronbach's Alpha of the parameters measured ranged from 0.82 to 1, except for facial breadth that has 0.64, where Cronbach's Alpha of > 0.70 indicates a strong reliability (Cochran, 1977). The measurements were carried out on only 30 selected participants.

Statistical Analyses

Shapiro-Wilk normality test was performed to check the distribution nature of the data. Since the data were not evenly distributed, non-parametric tests were used. The data were expressed as median (Interquartile range), minimum and maximum for the directly measured variables. Comparisons of facial dimensions, dominant somatotype components of the two sexes were made using Mann-Whiteny U test. Relationship between the facial variables and the dominant somatotypes was measured using Spearman correlation. The stepwise linear regression analyses were performed to predict the somatotypes from the facial anthropometry. Statistical significance was declared at $P < 0.05$. The data were analyzed using SPSS (IBM, corporation, NY) version 29.

Results

In this study as demonstrated in table 1, it was observed that the average facial breadth was greater than the average facial length. In somatotype measurements, height recorded higher median (IQR) value than the rest. In somatotype dominant components, ectomorph recorded higher median (IQR) value.

Table 1: Statistics and Distribution of Selected Facial Anthropometry Somatotype Measurements and Components

Variables	Min-Max	Median (IQR)
Age (Years)	12-19	15.00 (3.0)
Height (cm)	128.00-184.30	159.00 (12.2)
Weight (kg)	25.00-96.00	45.00 (12.6)
Facial Breadth (mm)	60.00-140.00	113.2 (9.2)
Facial Length (mm)	71.67-133.57	106.1 (9.0)
Facial Index	61.07-160.46	107.3 (9.0)
Biepicondylar B H (mm)	30.09-84.90	61.38 (7.7)
Biepicondylar B F (mm)	54.24-126.91	81.60 (11.3)
Triceps S F (mm)	3.30-32.40	8.70 (4.8)
Subscapular S F (mm)	2.90-31.50	9.10 (4.0)
Supraspinale S F (mm)	2.20-30.60	8.50 (4.3)
Medial Calf S F (mm)	3.80-34.50	10.10 (5.6)
Arm Circumference (cm)	13.80-39.00	23.00 (3.5)
Calf Circumference (cm)	19.50-45.00	29.50 (4.0)
Endomorph	0.629-8.042	2.93 (1.3)
Mesomorph	-1.765-11.63	3.09 (1.9)
Ectomorph	0.100-10.322	3.68 (1.4)

BH= Biepicondylar breadth of humerus, BF= Biepicondylar breadth of femur, SF= Skinfold, IQR= Interquartile range,

Table 2 shows sexual dimorphism in selected facial anthropometry and somatotype measurements among adolescents of Hausa ethnic group in Kano metropolis. A significant sexual dimorphism was observed in age, height, facial breadth, facial length., biepicondylar breadth of humerus, biepicondylar breadth of femur, triceps skinfold, subscapular skinfold, supraspinale skinfold, medial calf skinfold and calf circumference, in all the variables that exhibited significant sexual dimorphism. The male respondents recorded higher values.

Table 2: Sexual Dimorphism of Selected Facial Anthropometry and Somatotype Measurements in Adolescents of Hausa Ethnic Group in Kano Metropolis

Variables	Female	Male	U value	P value
	Median (IQR)			
Age (Years)	15.10±1.62	15.83±1.95	-3.61	<0.001
Height (cm)	157.11±7.89	159.07±10.97	-1.998	0.046
Weight (kg)	44.68±9.24	46.33±10.99	-1.612	0.107
Facial Breadth (mm)	111.67±8.53	115.32±8.23	-4.261	<0.001
Facial Length (mm)	104.99±8.24	107.37±7.45	-3.23	0.001
Facial Index	106.88±10.34	107.68±7.94	-0.677	0.498
Biepicondylar B H (mm)	59.51±6.12	62.87±6.00	-5.47	<0.001
Biepicondylar B F (mm)	78.08±6.74	87.28±8.59	-10.807	<0.001
Triceps S F (mm)	12.39±4.83	7.66±2.40	-12.127	<0.001
Subscapular S F (mm)	11.42±4.39	8.73±2.66	-7.374	<0.001
Supraspinale S F (mm)	10.67±4.69	8.23±3.04	-6.07	<0.001
Medial Calf S F (mm)	13.69±4.64	8.45±2.86	-12.568	<0.001
Arm Circumference (cm)	22.75±2.97	23.08±3.21	-1.025	0.306
Calf Circumference (cm)	28.99±2.92	30.20±3.41	-4.204	<0.001

BH= Biepicondylar breadth of humerus, BF= Biepicondylar breadth of femur, SF= Skinfold, IQR= Interquartile range

Table 3 shows sexual dimorphism in selected facial anthropometry and somatotype measurements in the adolescent age stages among Hausa ethnicity in Kano metropolis. In early and middle stages, we observed a significant sexual dimorphism in biepicondylar breadth of femur, triceps, subscapular, supraspinale and medial calf skinfolds, while only biepicondylar breadth of femur and triceps skinfold recorded significant sexual dimorphism in late adolescent age stage.

Table 3: Sexual Dimorphism of Selected Facial Anthropometry and Somatotype Measurements in Early, Middle and Late Adolescents of Hausa Ethnic Group in Kano State

	Early (N=128)				Middle (N=201)				Late (N=62)			
	Median (IQR)				Median (IQR)				Median (IQR)			
Variables	**Female**	**Male**	**U value**	**P value**	**Female**	**Male**	**U value**	**P value**	**Female**	**Male**	**U value**	**P value**
Age (Years)	13.50 (1.6)	14.00 (1.5)	-0.562	0.574	16.00 (1.3)	16.50 (1.4)	-0.009	0.993	18.50 (2.0)	19.00 (2.2)	-1.707	0.088
Height	153.00 (10.1)	140.50 (9.5)	-3.013	0.003	159.00 (11.0)	161.00 (11.5)	-1.28	0.201	157.50 (9.0)	166.50 (10.5)	-2.951	0.003
Weight	39.00 (10.0)	37.00 (9.5)	-2.065	0.039	46.50 (12.0)	46.00 (11.5)	-0.033	0.973	51.50 (13.0)	57.0 (15.0)	-2.006	0.045
Facial Breadth	108.00 (8.5)	111.67 (8.6)	-2.733	0.006	113.76 (8.8)	115.71 (8.9)	-1.826	0.068	114.50 (8.8)	118.98 (9.0)	-1.538	0.124
Facial Length	101.5 (8.0)	102.21 (8.1)	-0.828	0.407	107.14 (8.3)	107.80 (8.3)	-0.797	0.425	105.85 (8.1)	112.80 (7.9)	-3.118	0.002
Facial Index	106.93 (8.2)	109.56 (8.4)	-1.879	0.06	106.70 (8.3)	107.60 (8.3)	-0.148	0.882	108.48 (8.4)	105.55 (8.1)	-0.735	0.462
Biepicondylar B H	57.00 (5.9)	59.10 (6.8)	-1.086	0.277	61.00 (7.0)	62.70 (7.1)	-4.27	<0.001	64.05 (8.0)	67.00 (9.2)	-0.646	0.518
Biepicondylar B F	77.00 (8.5)	83.00 (9.8)	-4.683	<0.001	79.10 (9.0)	88.00 (10.6)	-7.754	<0.001	78.00 (8.4)	90.00 (10.2)	-3.83	<0.001
Triceps S F	11.00 (6.0)	8.00 (4.8)	-5.978	<0.001	13.25 (6.4)	7.6 (3.8)	-9.718	<0.001	14.00 (7.0)	8.00 (5.0)	-3.608	<0.001
Subscapular S F	10.00 (5.2)	8.10 (4.9)	-5.021	<0.001	11.90 (7.0)	9.20 (6.3)	-7.343	<0.001	13.00 (8.4)	11.10 (7.7)	-0.991	0.322
Supraspinale S F	9.22 (5.0)	7.00 (3.9)	-3.515	<0.001	11.00 (6.0)	8.00 (4.4)	-5.514	<0.001	13.20 (7.8)	9.10 (5.0)	-1.66	0.097
Medial Calf S F	13.00 (7.6)	8.20 (5.0)	-7.21	<0.001	14.00 (8.0)	8.50 (4.7)	-9.918	<0.001	15.00 (9.0)	9.00 (4.9)	-3.129	0.002
Arm Circumference	20.90 (10.3)	21.20 (10.5)	-2.482	0.013	24.00 (12.0)	23.10 (11.3)	-0.323	0.747	24.00 (12.0)	26.00 (13.1)	-1.51	0.131
Calf Circumference	27.00 (14.0)	28.00 (14.3)	-0.311	0.756	29.30 (15.0)	30.00 (15.5)	-2.207	0.027	31.10 (16.0)	32.00 (16.3)	-1.7	0.089

BH= Biepicondylar breadth of humerus, BF= Biepicondylar breadth of femur, SF= Skinfold, IQR= Interquartile range

Table 4: Correlation Between the Selected Facial Anthropometry and the Dominant Somatotype Components among the Three Different Adolescent Age Groups of Hausa Ethnic Group in Kano Metropolis

	Early			Middle			Late		
Variables	**Endo**	**Meso**	**Ecto**	**Endo**	**Meso**	**Ecto**	**Endo**	**Meso**	**Ecto**
Facial Breadth (mm)	0.094	0.199*	-0.224*	0.005	0.235**	-0.241**	0.11	0.370**	-0.390**
Facial Length (mm)	0.231**	-0.037	-0.105	-0.011	0.094	-0.118	-0.05	0.077	-0.038
Facial Index	-0.111	0.199*	-0.118	0.034	0.062	-0.073	0.153	0.338*	-0.379**

Endo= Endomorph, Meso= Mesomorph, Ecto= Ectomorph.

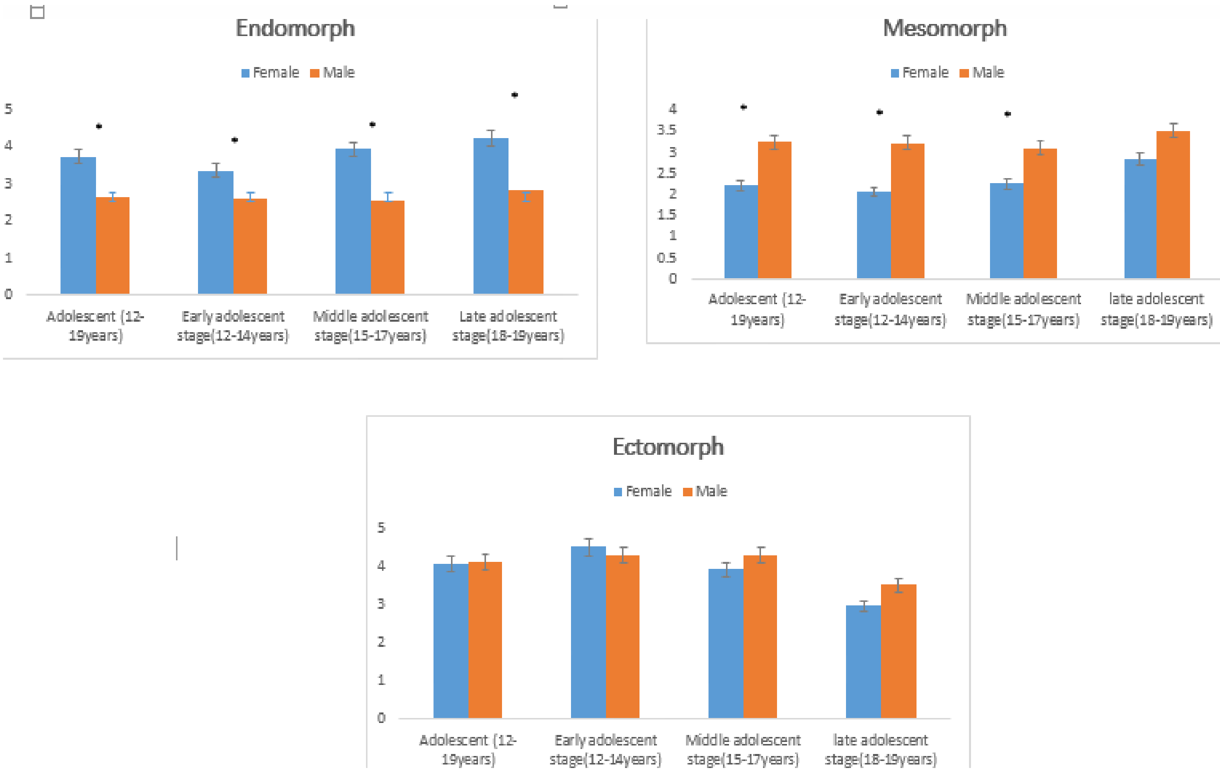

Figure 1 shows sexual dimorphism in the dominant somatotype components among the adolescent age group of the Hausa ethnic group in Kano metropolis. It was documented that endomorphs have a significant sexual dimorphism in all the age groups with females having higher values among about 75% of the total population. Mesomorphs have a significant sexual dimorphism in all age groups except in late adolescence, with males having higher values, No significant sexual dimorphism was recorded in ectomorphs.

Table 4 shows correlation between selected facial anthropometry and dominant somatotype components among the three different adolescent age group of Hausa ethnic group in Kano metropolis. In early adolescents, the facial breadth recorded a significant correlation with mesomorphs and ectomorphs. In the middle adolescent stage, the facial length recorded a significant correlation only with mesomorph and ectomorph. In the late adolescent, we observed that the facial breadth and facial index recorded a significant correlation with mesomorphs and ectomorphs.

Table 5 shows prediction of endomorph, mesomorph and ectomorph from facial anthropometry among various adolescent age stages among Hausa ethnic group in Kano metropolis. For endomorph, it was observed that the facial anthropometry significantly predicts endomorph rating. However it was best predicted in early adolescent stage using the facial length. The model with the best fitness to predict were observed in the early adolescent stage between endomorph and facial length, while the least was observed in all stages between endomorph and the facial breadth. The variance of endomorph explained by the facial anthropometry was best observed in early adolescent stage between endomorph with facial length, while the least was observed between endomorph and facial breadth. The best predictor was observed between endomorph and facial breadth. For mesomorph, it was significantly predicted by facial anthropometry. However, mesomorph was best predicted using the facial breadth. The variance of mesomorph explained by facial anthropometry was best observed in middle adolescent stage between mesomorph with facial breadth, while the least was observed between mesomorph and facial breadth in the late adolescent stage. And for ectomorph, it was significantly predicted by facial anthropometry. However, ectomorph was best predicted using the facial breadth. The model with the best fitness to predict was observed in the early adolescent stage between ectomorph and facial breadth and facial index, while the least was observed between ectomorph and facial breadth in the late adolescent stage. The variance of ectomorph rating explained by facial anthropometry was best observed in late adolescent stage between ectomorph and facial breadth, while the least was observed between ectomorph and the facial breadth in the early adolescent age stage.

Table 5: Prediction of Endomorph, Mesomorph and Ectomorph from Facial Anthropometry among Adolescent Stages of Hausa Ethnic Group in Kano Metropolis

	Age stage	Step	Equation (DV=β×IV + Constant)	r^2	SEE	F	P
Endomorph	**All**	**1**	Endomorph=0.018(FB)+1.153	0.018	1.150	7.012	0.008
	Early	**1**	Endomorph=0.026(FL)+0.390	0.038	0.955	5.017	0.027
		2	Endomorph=0.038(FL) +1.095	0.072	0.942	4.863	0.009
Mesomorph	**All**	**1**	Meso=0.055(FB)+(-3.194)	0.103	1.399	44.752	<0.001
	Middle	**1**	Meso=0.049(FB)+(-2.652)	0.046	1.386	15.161	<0.001
	Late	**1**	Meso=0.095(FB)+(-7.494)	0.241	1.477	17.819	<0.001
Ectomorph	**All**	**1**	Ecto=(-0.054FB)+10.242	0.093	1.431	41.103	<0.001
	Early	**1**	Ecto= (-0.038FB)+5.026	0.130	1.312	9.383	<0.001
		2	Ecto= (-0.063FB)+(0.032FI)+3.205	0.157	1.296	7.770	<0.001
	Middle	**1**	Ecto=(-0.046FB)+9.311	0.053	1.467	11.565	0.001

DV =Dependent Variable, β =coefficient of independent variable, IV =Independent Variable, FB=Facial Breadth, FL= Facial Length, FI= Facial Index.

Discussion

Anthropometry has been shown to play an important role in determination of body composition (Vucetic *et al.,* 2008). It is obvious that somatotype determination is important in sports in which the body may impact on the biomechanics of movement and resulting to performance (Massidda *et al.,* 2013).

Bojadzieva *et al.,* (2018) conduct a study on 11 year-old Macedonian and Alabanian adolescents and record no significant sexual dimorphism in all the somatytope components among Macedonian adolescents. This disagrees with the present study which shows a significant sexual dimorphism in endomorph and mesomorph with females being more endomorphic and males more mesomorphic. The disagreement in the findings might be because of the age difference, as the previous researcher did his work on 11 year-old subjects. Alabanian females recorded more endomorphic characters than their male counterparts; males have more mesomorphic characters than females (Bojadzieva *et al.,* 2018) which is in agreement with the present result. Similarly, in Mexico, Urrutia-Garcia *et al.,* (2015) document a significant sexual dimorphism in endomorph and mesomorph with females endomorphic and males mesomorphic which also agrees with the present finding. This is due to the fact that females are built with predominantly adipose tissue and fats within their superficial fascia, thereby bringing about roundness of the body, while males are muscular in nature.

Utilization of cephalofacial measurements in determining sex of an individual has also shown a reasonably good accuracy (Ngeow and Aljunid, 2009). The present study documents a significant sexual dimorphism in the facial parameters (facial length and breadth), which is in agreement with the work on Malaysian Indians conducted by (Ngeow and Aljunid, 2009) irrespective of racial and age difference. Pandey and Atreya, (2017) also document that face is a determinant of sex among students of Medical College in Devdaha which is also similar to the results obtained in the present study. In the present finding, facial length and breadth record a significant sexual dimorphism.

The estimation of somatotype from body parts involves specialized anthropometric techniques applied with great precision. For such estimation, regression analysis is the best method as far as the accuracy or reliability of the estimate is concerned (Iscan, 2005). Studies have demonstrated a strong correlation between cephalic measurements and somatotype, allowing for accurate prediction of somatotype from cephalic length and breadth (Agnihotri *et al.* 2011; Krishan and Kumar, 2007; Ukoha *et al.*, 2016). This correlation has been observed in diverse populations, including Malays (Ngeow and Aljunid, 2009), Igbo (Ewunonu and Anibeza, 2013), Punjabi (Seema, 2011), North Indians (Krishan and Kumar, 2007) and Kosovo Albanians (Rexhepi and Brestovci, 2015). Moreover, cephalic measurements have been shown to predict somatotype with significant accuracy independent of age and racial factors (Krishan, 2008; Wankhede *et al.*, 2015). The present study confirms these findings, demonstrating that cephalofacial measurements can reliably predict somatotype of adolescents regardless of ethnicity and race.

Conclusion

There are differences between males and females in terms of facial parameters, in which males have higher values; females are more endomorphic and males are more mesomorphic. Additionally, the dominant somatotypes can be predicted from facial measurements among adolescent population of Hausa ethnic origin in Kano metropolis, Nigeria. And facial breadth is the most accurate predictor of somatotype components.

Acknowledgements

We thank all the students that participated in the research. Likewise, the technical support provided by the team is well recognized.

Authors Contribution

Data Collection and conceptualization: AMG, MIS. Data Analyses: LHA, AMG, MIS. Research Write up: AMG, RIF, AAG

Conflict of Interest

No conflict of interest was recorded.

Funding: The research was funded by the research team.

Article History:

Received: 21st March 2024

Accepted: 22nd June 2024

Published online: 07th July 2024

References

Agnihotri, A. K., Kachhwaha, S., Googoolye, K. & Allock, A. (2011). Estimation of stature from cephalo-facial dimensions by regression analysis in Indo-Mauritian population. *Journal of Forensic and Legal Medicine*, *18*(4), 167-172.

Anup, P. and Alok, A. (2017). *Journal of Nepal Medical Association*; 56 (209): 531-34.

Bojadzieva, S. B., Matveeva, N., Zafirova, B., Trpkovska, B. and Kavecan, I. (2018). Somatotype in 11 years old Macedonian Adolescents: *Journal of Medical Science* 1(1): 31-37.

Cameron, N., James Mourilyan, T. (2011). Anatomy Human Biology; 38(3):243-6.

Carter, J.E.L. and Heath, B.H. (1990). *Somatotyping - Development and Applications*. Cambridge: Cambridge University Press.

Choudhary, A. & Chowdhary, D. (2012). Comparative anthropometric study of nasal parameters between two ethnic groups of Rajasthan state. *International Journal of Medicine and Public Health*, *2*(2), 46-48.

Cochran, W. G. (1977). *Sampling techniques*. 3rd edition, John Wiley & Sons, NewYork. from Foot and Boot Dimensions. *Journal of Forensic Science*, 37: 771-782.

İşcan, M. & Shihai, D. (1995). Sexual dimorphism in the Chinese femur. *Forensic Science International*, *74*(1-2), 79-87.

Jerković, I., Bašić, Ž., Kružić, I. & Anđelinović, Š. (2016). Sex determination from femora in late antique sample from eastern Adriatic coast (Salona necropolis). *Anthropological Review*, *79*(1), 59-67.

Kanchankumar, P.W., Namdeo, Y.K., Madhukar, P.A., Vaibhav, P.A. & Rajesh, V.B. (2012). Estimation of stature from maxilla-facial anthropometry in a central Indian population. Journal of Forensic Dental Sciences, 4(1): 34-37.

Krishan, K. & Kumar, R. (2007). Determination of stature from cephalo-facial dimensions in a north Indian population. *Legal Medicine*, *9*(3), 128-133.

Krishan, K. (2008). Estimation of stature from footprint and foot outline dimensions in Gujjars of North India. *Forensic Science International*, *175*(2-3), 93-101.

Mall, G., Graw, M., Gehring, K. & Hubig, M. (2000). Determination of sex from femora. *Forensic Science International*, *113*(1-3), 315-321.

Mall, G., Hubig, M., Büttner, A., Kuznik, J., Penning, R. & Graw, M. (2001). Sex determination and estimation of stature from the long bones of the arm. *Forensic Science International*, *117*(1-2), 23-30.

Massidda, M., Toselli, S., Brasili, P. & Calo, C.M. (2013). Somatotype of elite Italian gymnasts. *Collegium Antropologicum*, 37(3): 853-57.

Monum, T., Jaikang, C., Sinthubua, A., Prasitwattanaseree, S. & Mahakkanukrauh, P. (2017). undefined. *Australian Journal of Forensic Sciences*, *51*(4), 417-425.

Ngeow, W. & Aljunid, S. (2009). Craniofacial anthropometric norms of Malaysian Indians. *Indian Journal of Dental Research*, *20*(3), 313.

Oladipo, G. S., Anugweje, K. C. & Bob-Manuel, I. F. (2014). Dolicocephalization in cephalic indices of adult Yorubas of Nigeria. *Journal of Anthropology*, *2014*, 1-5.

Perret, V.A., Staccini, P., Quatrehomme, G. (2008). Sex determination from distal part of the femur in a French contemporary population. *Forensic Science International*. 175: 113-117.

Sheldon, W.H., Stevens, S.S. & Tucker, W.B. (1940). The varieties of human physique. *American Psychological Association*. Harper.

Shrout, P. E. & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin*, *86*(2), 420-428.

Soni, G., Dhall, U. & Chhabra, S. (2010). Determination of sex from femur: Discriminant analysis. *Journal of Anatomical Society of India*, *59*(2), 216-221.

Soni, G., Dhall, U. & Chhabra, S. (2013). Determination of sex from humerus: discriminant analysis. *Australian Journal of Forensic Sciences*, *45*(2), 147-152.

Steyn, M. & İşcan, M. (1997). Sex determination from the femur and tibia in South African whites. *Forensic Science International*, *90*(1-2), 111-119.

Urrutia-García, K., Martínez-Cervantes, T., Salas-Fraire, O. & Guevara-Neri, N. (2015). Somatotype of patients with type 2 diabetes in a university hospital in Mexico. *Medicina Universitaria*, *17*(67), 71-74.

Vucetic, V., Matkovic, B.R. & Sentija, D. (2008). Morphological differences of elite Croatian track and field athletes. *Collegium Antropologicum*, 32(3): 863-68.