



Estimation of Stature from Some Selected Cephalofacial Parameters among Teenage Indigenes of Ogoja Local Government Area Cross River State

P. U. Lukpata^{1*}, U. G. Esomonu¹, C. A. Ogan¹ and E. O. Tessy¹

¹Department of Anatomy, Faculty of Basic Medical Sciences, Cross River University of Technology, Okuku Campus, Cross River State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author PUL designed the study, wrote the protocol and wrote the first draft of the manuscript. Author UGE managed the literature searches and statistical analysis of data and author CAO managed the experimental process and author EOT identified the research data. All authors read and approved the final manuscript.

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ABSTRACT

Estimation of stature from body segment parameters finds usefulness in forensic sciences and other medical applications. However, these parameters are highly, sex, race and age dependent. The present study measured some cephalofacial parameters with a view to providing cephalofacial anthropometric parameter that could be used in estimation of stature among teenage indigenes of Ogoja Local Government Area of Cross River State. A total of 300 teenagers (13-19 years), comprising 150 males and 150 females were used. Maximum stature, head circumference, nasal height and nasal width were obtained by direct measurement. The findings of the study showed that males mean values are significantly higher ($p < 0.05$) than females for all parameters: Stature (males, 157.30 ± 6.81 ; females, 155.70 ± 5.71), head circumference (males, 55.38 ± 1.55 ; females, 54.62 ± 1.52), nasal height (males, 4.54 ± 0.43 ; females, 4.39 ± 0.44) and nasal width (males, 4.95 ± 0.50 ; females, 4.74 ± 0.58). Results of this study reveals that male head circumference

*Corresponding author: E-mail: uhinekwamelile@gmail.com;

significantly ($p < 0.05$) correlate with stature. Hence only male head circumference (HC) could be employed in the estimation of stature using the linear regression equation ($11.48 \times HC + (-478.70)$). The analysis of the measured parameters shows that nasal height and width are not reliable tools for stature prediction amongst Ogoja teenage population.

Keywords: Stature; head circumference; nasal height; nasal width; Ogoja; Cross River State.

1. INTRODUCTION

Over the years, it's been found out that modern man is fond of making comparisons and this is to prove his superiority over other creatures. Measurements are the important tools for comparisons and the branch of physical anthropology that deals with measurements of different body parts is called Anthropometry [1]. Height, head circumference and nasal indices are amongst the clinical anthropometrical parameters. Others include mid-arm circumference, body mass index, weight etc.

It is also known that body segments exhibit consistent ratios among themselves and relative to the total body height. The ratio between body segments are age, sex, and race dependent [2,3]. Reconstruction of stature from various bones of the human skeleton has been achieved by many scientists with varying degree of accuracy [4]. Establishment of alternative methodologies for personal height estimation is important for a number of reasons. Firstly, in instances where height estimates needed to be made from fragments of bones in archeological procedures or in forensic examinations after mass disaster or genocide. Secondly estimates of pharmacokinetic parameters and evaluation of nutritional status rely on accurate measurement of not only body weight but also height. However, a number of common disease or deformities of the vertebral column makes it difficult to accurately measure standing height in many patients [5].

The problem of correlating the various metric traits of the skeletal remains with the stature of an individual has confronted scientists for a long time. Although a wide variety of long bones have been employed for stature estimation only few studies have utilized the cranial dimensions in this regard [6,4]. Although many formulae for stature estimation have been proposed, there is concern regarding the accuracy of the use of population specific formulae on other human populations [3,7]. It is obvious that there are no universally applicable formulae as the relationship between head dimensions and

cranial capacity is influenced by the age, sex and race of an individual. Thus, there is need for race, sex, and age specific stature estimation formulae [4].

Despite its significance and potential practical utility, little is known concerning the relationship between cephalofacial dimensions and stature among Ogojaindigenes in Cross River State of Nigeria. Hence, this study was designed to elucidate the norms for cephalofacial dimensions and to propose population and gender specific regression models for stature estimation using the linear dimensions from various parameters of the head and face. It will be useful to dysmorphologist to apply this in the early identification of some dysmorphic syndromes like cleft lip associated with nose disorders.

2. SUBJECTS, MATERIALS AND METHODS

2.1 Subjects

The present study was carried out in Ogoja Local Government Area of Cross River State, Nigeria. It is carried out among randomly selected indigenes of Ogoja. A total of four hundred (400) teenagers (13-19 years), comprising two hundred (200) males and two hundred (200) females were used. Subjects with Cephalofacial defects were excluded also females with obstructive hair styles were also excluded from the study.

2.2 Instruments Used for Measurements

The following Anthropometric equipments were used;

1. Anthropometer was used to measure the height
2. A non-stretchable tape was used to measure head circumference
3. A vernal caliper was used for the measurement of nasal height and nasal width.

2.3 Parameters Measured

2.3.1 Stature

The height was measured using a standard anthropometer. It is the vertical distance between vertex and heel touching the floor or ground surface, with the person standing erect and head in a Frankfort plane.

2.3.2 Head circumference (HC)

A non-stretchable plastic tape was used for the measurement of head circumference. Maximal head circumference was obtained by placing the tape just on the occipital prominence and the supraorbital ridges while an assistant viewed the subject laterally. In the cases of some hairstyles, we simply drew the tape tightly and compressed the hair as much as possible.

2.3.3 Nasal height (NH)

The nasal height was measured as the distance between the nasion to nasopinale of the nose. Measurement from nasion, the point in the midline where the general course of the frontonasal suture and the median plane

intersect, taken on the frontal, to the lowest point at the start of the nasal floor; taken on both sides and averaged to the nearest millimeter [8].

2.3.4 Nasal width (NW)

The nasal width was measured as the distance between the two alar. The subject was instructed to look forward while the sliding caliper was being placed on the nose of the subject then scrolled until it's tightly fixed on the subject nose.

The above measurements were carried out at a fixed time between 9.00-12.00 hours to eliminate discrepancies due to diurnal variation. All measurements was repeated twice and the average taken for further analysis.

Nasal Index (NI): was determined as follows:

$$NasalIndex = \frac{Nasal\ Width}{Nasal\ Height} \times 100$$

Heidari et al. (2009) classified Nasal index into three types: leptorrhine (fine) Nose with nasal index <70, and Mesorrhine (average) Nose with nasal index between 70-85 and platyrrhine Nose (broad and short) Nose with nasal index >85.



Fig. 1. Experimental measuring nasal height (left) and nasal width (right)

3. RESULTS

Results are expressed as mean±SD (standard deviation) and were analyzed using GraphPad Prism 5 (version 5.03 GraphPad Inc.). A comparison of mean value between the genders was performed using the t-test (p value<0.05). Pearson's correlation coefficient (r) was used to examine the relationship between various cephalofacial anthropometric parameters and personal height according to gender. Also linear regression was performed and linear regression equation formulated for the prediction of stature using cephalofacial anthropometric parameters where possible.

The results of the present study are shown in Tables 1-4. The mean values of the measured

parameter for both females and males are significantly different ($P>0.05$) for head circumference, nasal height, and nasal width. However, there was no significant difference between males and females for nasal index, Table 1 ($P<0.05$).

Head circumference for males significantly correlated with the stature (Table 2). The regression equations in Table 3 show that only head circumference for males is seen to adequately predict the stature of these teenagers. Table 4 represents the mean of difference between observed stature and estimated stature. Their observed stature was noted down and compared with the estimated stature.

Table 1. Cephalofacial anthropometric measurements values of teenagers in Ogoja Local Area of Cross River State (CRS)

Sex	Stature (cm)	HC (cm)	NH (cm)	NW (cm)	NI (cm)
Females	155.70±5.71 ^a	54.62±1.52 ^a	4.39±0.44 ^a	4.74±0.58 ^a	108.30±12.03 ^a
Males	157.30±6.81 ^b	55.38±1.55 ^b	4.54±0.43 ^b	4.95±0.50 ^b	109.70±12.64 ^a

HC- Circumference (cm), NH- Nasal height (cm), NW- Nasal width (cm), and NI- Nasal index (cm);
Values with different superscript in each column (^{a, b}) are significantly different at $P<0.05$

Table 2. Correlation coefficient (r) between stature and measured cephalofacial parameters

Parameter	Female	Male
Head circumference	0.0068	0.3857*
Nasal height	-0.1359	0.0006
Nasal width	-0.0308	0.0669
Nasal index	0.1007	0.0672

* Correlation is significant at $p<0.05$

Table 3. Linear regression equations to predict stature from measured cephalofacial parameters

Parameter	Female	Male
Head circumference	(555.7 × HC) + (-30197)	(11.48 × HC) + (-478.70)*
Nasal height	(-95.08 × NH) + (572.3)	(2462 × NH) + (-11022)
Nasal width	(-322.0 × NW) + (1680)	(203.6 × NW) + (-851.3)
Nasal index	(4.713 × NI) + (-355.2)	(8.027 × NI) + (- 723.4)

HC- Circumference, NH- Nasal height NW- Nasal width, and NI- Nasal index;

* Regression is significant at $P<0.05$

Table 4. Mean of difference between observed stature and estimated stature

Parameter	Female	Male
Head circumference cm	-10.27±654.4	3.16±12.41
Nasal height cm	33.69±22.32	-665.2±955.4
Nasal width cm	182.8±130.4	-12.68±85.35
Nasal index cm	-20.13±72.18	45.07±110.5

HC- Circumference (cm), NH- Nasal height (cm), NW- Nasal width (cm), and NI- Nasal index (cm);

Values are mean±SD (Standard Deviation)

4. DISCUSSION

Cephalofacial parameters are useful in forensic medicine in rhinoplastic surgery, identification of gender and ethnicity especially with facial recognition as a tool in recent advances in biometrics.

This present study provides valuable data pertaining to the principal anatomical dimensions of the head and its correlation with stature in teenagers of Ogoja population.

The present study shows that males of this age groups are significantly taller than their female counterparts ($p < 0.05$) (males- 157.30 ± 6.81 ; females- 155.70 ± 5.71). This study also shows that with males having the mean values (157.30 ± 6.81) are significantly higher ($p < 0.05$) than females for all measured cephalofacial parameters; that is; head circumference (males- 55.38 ± 1.55 ; females- 54.62 ± 1.52), nasal height (males- 4.54 ± 0.43 ; females- 4.39 ± 0.44) and nasal width (males- 4.95 ± 0.50 ; females- 4.74 ± 0.58) Table 1. The results were in agreement with [9] and [10] who reported larger values for head circumference, nasal height, nasal width and nasal index in males than females.

The mean stature for males from this study were lower than Sri Lanka population (162.95 ± 90.25) measured by [11] but not so for female participants (152.48 ± 114.98) whose mean values for stature were higher. Also the mean head circumference from this study for both males and females of Ogoja teenagers, were relatively similar with that of Omoku indigenes (males- 55.72 ± 2.79 ; females- 54.89 ± 2.82) of River State Nigeria measured by [10], but was lower compared to Ijaw indigenes (males- 57.49 ± 1.18 ; females- 56.25 ± 1.49) of Bayelsa State, as also measured by [10]. Comparing the results of nasal parameters from this study to that of [10] who also measured nasal parameters in Omoku and Ijaw indigenes, it is observed that these teenagers have larger mean values.

Esomonu et al. [12] conducted a study on the nasal index of Bekwara ethnic group of Cross River State, Nigeria, revealed the mean nasal height for Bekwarra ethnic to be 4.24 ± 0.25 cm for males and 4.28 ± 0.27 cm for females. The mean values of nasal width was 4.01 ± 0.24 cm for males and 4.01 ± 0.24 cm for females whereas the present study shows the mean nasal height value of Ogoja teenagers for males was 4.54 ± 0.43 cm and 4.39 ± 0.44 cm for females

while nasal width was 4.95 ± 0.50 cm for males and 4.74 ± 0.58 cm for female. This shows high variation between the two groups of people, all in Cross River State, Nigeria.

Obaje et al. [13] reported in their study that the nasal width of Igede and Idoma of Benue State males is 11.32 ± 0.4 cm and 9.20 ± 0.19 cm and Igede and Idoma females recorded 11.31 ± 0.35 cm and 9.30 ± 0.14 cm respectively. When comparing the results of nasal width of Igede and Idoma ethnic groups from this study. It is observed that the Igede and Idoma ethnic have larger mean values than the Ogoja teenagers and the Bekwarra ethnic group as revealed by [12].

Although variety of methodologies have been proposed to predict stature from various bones, regression analysis proved to be the easiest and the most reliable method [13]. Correlation coefficients between the total height and all the measured cranial dimensions among Sri Lankans were found to be statistically significant and positive indicating a strong relationship between the two parameters [10]. Previous studies have shown strong correlation and between cranial parameters and stature [14,6,15]. However, in the present study only head circumference measured from male teenagers showed a significant correlation ($r = 0.39$) to stature, hence only this parameter for males was able to adequately predict stature using linear regression analysis. Also the mean difference indicates that this parameter (HC-head circumference in males) shows less difference (3.16 ± 12.41) between observed stature and estimated stature as compared to other parameters in both males and females.

It is stated that the racial characters are best defined in the skull [4]. As a result cranial dimensions constitute one of the most important characters for determining the racial difference [16]. Variety of non-metric and metric parameters has been utilized in the assessment of ethnic and gender differences in craniofacial morphology. The non-metric parameters are subjective as no quantitative techniques are devised. On the other hand, features that can be expressed as actual measurements, like cranial dimensions, provide more objective racial and gender diversity assessment of the crania [4]. Diverse craniometric approaches have been utilized to estimate the cranial dimensions either on dry skulls or living subjects [17]. Direct measurements of cephalofacial dimensions are

reliable, relatively easy and quick to apply. Furthermore this approach has the added advantage as it does not require any sophisticated techniques. Taken together, these measurements continue to be one of the most versatile techniques in the investigations of the craniofacial skeleton [18].

5. CONCLUSION

The present study agrees with earlier researches that male tend to have higher values of cephalofacial parameters than females. However, this study shows that amongst these teenagers, the measured cephalofacial parameters are not reliable tools for stature prediction as only one of the parameters (HC-head circumference in males) showed correct formula for stature estimation. The result of this study will be of immense use in forensic medicine and anthropology and will also serve as a future framework for estimating the craniofacial dimensions of other Nigerians ethnic groups.

CONSENT

All authors declare that 'written informed consent was obtained from Department of anatomy, Faculty of Basic Medical Sciences, Cross River University of Technology for publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all the measurement protocol have been examined and approved by the ethical committee of the Department of anatomy, Faculty of Basic Medical Sciences, Cross River University of Technology and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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