Estimation of Stature from Cephalic Parameters in South-Eastern Nigerian Population

Ewunonu, E.O.* and Anibeze, C.I.P.

Department of Anatomy, Ebonyi State University, Abakaliki, Nigeria

ABSTRACT

The aim of this study is to estimate the height of adult Igbo people of Southeastern Nigeria resident in Abakaliki from some cephalic parameters. The head length, head breadth and head circumference of a randomly selected sample of 1000 subjects whose age-range falls within 12 years to 45 years were measured directly with a pair of metal spreading calipers and measuring tape. The subjects cover a selection of 669 males and 331 females. Three cephalic parameters were measured from each subject following internationally recommended standard methods and techniques. The results show that all the three parameters correlated positively ($p < 0.01$) with stature. The Head Circumference showed stronger correlation with stature than Head Length and Head Breadth. Also, regression analysis showed that the Head Circumference gives a better prediction of stature than Head Length and Head Breadth. This could be useful in forensic investigations.

Keywords: Stature, Cephalic, Nigerian, South-eastern, Head length, Head, Breadth, Head circumference.

INTRODUCTION

Stature is the height of a person in the upright posture.\(^1\) It is considered as one of the parameters for personal identification.\(^2\) Estimation of stature has been described as a preliminary investigation in the identification of unknown human remains and therefore, an important tool in forensic examination especially, when unknown highly decomposed, fragmentary and mutilated human remains are involved.\(^3\)-\(^5\)

Studies have been conducted on the estimation of stature from different body parts \(^6\)-\(^7\) including arms and legs\(^8\)-\(^11\), hands and feet \(^11\),\(^12\), intact vertebral column\(^10\),\(^11\) as well as head, face and trunk.\(^12\) This is possible because stature has a definite and a proportional biological
relationship with each and every part of the human body. This relationship helps a forensic scientist to calculate stature from mutilated and dis-membered body parts with the aid of linear regression equations.8, 11

In Nigeria, most cephalic parameters have been studied extensively but none has correlated this to stature13-18 and, given the frequent ethnic and religious clashes often witnessed in some parts of the country, as well as incessant border clashes in many other parts of the country, the effect is devastating, leading to mass casualties. Most of the victims of these attacks were often highly mutilated and dis-membered beyond physical recognition and could not be identified by their relations. In Ebonyi state, the Abakaliki people have a long history of many of such unprecedented conflicts and casualties. This study will therefore, establish a relationship existing between stature and head dimensions as a means of establishing positive identification by stature in forensic investigations concerned with unknown fragmentary human head. This is relevant in documenting a data base that will be consulted for future references and applications on Abakaliki people.

MATERIALS AND METHODS

A randomly selected sample of 1000 male and female Igbo subjects whose age-range falls within 12 years to 45 years was presented for data collection and analysis. The subjects were born, bred and live in Abakaliki area of Ebonyi State. Maximum Head Lenght (MHL), Maximum Head Breadth (MHB) and Maximum Horizontal Circumference of Head (MHC) were measured directly by spreading caliper and measuring steel tape in centimeters to the nearest millimeter (0.1cm) according to the landmarks, techniques and procedures recommended by the authors.2, 19, 20 The anatomical landmarks used were identified keeping the head in the Frankfurt Horizontal plane. The measurements were taken after obtaining informed consent from the selected subjects. All the subjects measured were healthy and free from apparent symptomatic cephalic deformity and there was no evidence of treatment or surgery of cephalic disorders.

ANTHROPOMETRY

Maximum Head Length: It measures straight distance between glabella (the most prominent point of the frontal bone above the root of the nose, between the eyebrows) and the opisthocranion (the most prominent portion of the occiput, close to the midline on the posterior rim of the foramen magnum).

Maximum Head Breadth: It is the maximum biparietal diameter and is the distance between the eurions (most lateral points of the parietal bones.)

Horizontal Circumference Of The Head: It is the maximum circumference of the head (usually
horizontal just above the eyebrow ridges), measured from just above the glabella area to the area near the top of the occipital bone (opisthocranion).

**DATA ANALYSIS**

The Data collected were recorded and subjected to statistical analysis like Mean, Standard Deviation (S.D.), the Student t - test used to show a significant difference, Karl Pearson’s Correlation Coefficient (r) used to establish the relationship between the variables considered, Regression Analysis and Standard Error of Estimate; and were analyst using Statistical Package for Social Sciences (SPSS) for Windows XP-Professional.

Thereafter, a hypothetical regression equation was formulated using the regression coefficients as follows:

\[ S = a + bx \]

Where, \( S \) = stature i.e. the dependent variable.

\( X \) = any cephalo-facial measurement i.e. the independent variable.

\( a \) = the regression coefficient of dependent variable.

\( b \) = the regression coefficient of independent variable.

The regression formulae were calculated separately by using computerized regression analysis of the parameters with stature to derive the regression coefficients ‘a’ and ‘b’. The appropriate values of constants ‘a’ and ‘b’ were then substituted in the standard equation of regression. Standard Error of Estimate (SEE) was calculated for each and every regression equation. Subsequently, estimated stature was calculated by substituting the minimum, maximum and mean values of the measurements in their respective regression equations and the value was compared with the actual stature.

**RESULT**

Table 1 presents the average mean values of the cephalic dimensions of the Igbo people in Abakaliki as follows: Head length, 18.82 cm; Head breadth, 15.03 cm; Head circumference, 55.35 cm.

Table 2 shows the correlation coefficients between stature and the three cephalic measurements in Igbo people of Abakaliki. The result shows that all the cephalic measurements exhibited a significant correlation with stature (\( P < 0.01 \)). The highest correlation coefficient is exhibited by Head Circumference (\( r = 0.49 \)) and the least by Head Length.

Table 3 shows the regression equations for estimation of stature (in cm) with their respective standard error of estimate (SEE). The Head Circumference exhibits the lowest value of SEE (±6.93) while the Head Lenght shows the highest (±7.48). Table 4 compared the mean value of
actual stature with the stature estimated from the cephalic parameters. There is no difference in the

Table 1: Descriptive Statistics of the Cephalic Measurements (cm) of Abakaliki Igbo Residents showing Mean, S.D., and S.E.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (cm)</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Head Length</td>
<td>18.82</td>
<td>0.80</td>
<td>0.03</td>
</tr>
<tr>
<td>Max. Head Breadth</td>
<td>15.03</td>
<td>0.76</td>
<td>0.02</td>
</tr>
<tr>
<td>Max. Head Circumference</td>
<td>55.35</td>
<td>1.86</td>
<td>0.06</td>
</tr>
</tbody>
</table>

(P < 0.05)

Table 2: Correlation Coefficients between stature and various Cephalic Measurements in Igbo People in Abakaliki (cm)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (cm)</th>
<th>Std. Deviation</th>
<th>Corr. Coeff.</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Head Length</td>
<td>18.82</td>
<td>0.80</td>
<td>0.34</td>
<td>0.29</td>
</tr>
<tr>
<td>Max. Head Breadth</td>
<td>15.03</td>
<td>0.76</td>
<td>0.39</td>
<td>0.31</td>
</tr>
<tr>
<td>Max. Head Circumference</td>
<td>55.35</td>
<td>1.86</td>
<td>0.49</td>
<td>0.12</td>
</tr>
</tbody>
</table>

(P < 0.01)
Table 3: Regression equations for estimation of stature (in cm) for the cephalo-facial measurements of Igbo People resident in Abakaliki

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression equation</th>
<th>±SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Head Length (MHL)</td>
<td>102.75 + 3.40 MHL</td>
<td>±7.48</td>
</tr>
<tr>
<td>Maximum Head Breadth (MHB)</td>
<td>105.59 + 4.07 MHB</td>
<td>±7.34</td>
</tr>
<tr>
<td>Maximum Head Circumference (MHC)</td>
<td>50.18 + 2.11 MHC</td>
<td>±6.93</td>
</tr>
</tbody>
</table>

P < 0.01

Table 4: Comparison of actual stature and stature estimated from Cephalic measurements in Igbo People in Abakaliki

<table>
<thead>
<tr>
<th>Estimated stature using regression equation for :</th>
<th>Minimum estimated stature</th>
<th>Maximum estimated stature</th>
<th>Mean estimated stature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Head Length</td>
<td>158.21</td>
<td>181.00</td>
<td>166.80</td>
</tr>
<tr>
<td>Maximum Head Breadth</td>
<td>159.33</td>
<td>186.61</td>
<td>166.80</td>
</tr>
<tr>
<td>Maximum Head Circumference</td>
<td>151.30</td>
<td>181.85</td>
<td>166.80</td>
</tr>
<tr>
<td>Actual Stature</td>
<td>142.00</td>
<td>188.00</td>
<td>166.80</td>
</tr>
</tbody>
</table>
DISCUSSION

Stature estimation has been considered as one of the parameters of forensic anthropology and will assist in establishing the biological profile of a person. The findings in the present study (table 2) indicate that all the three cephalic measurements are positively and significantly correlated with stature ($P < 0.1$). Similar observations on stature have been reported in other races. The Head Circumference shows stronger correlation (0.49) with stature than any of the variables.

Table 3 indicates that the Head Circumference shows a lower value of the standard error of estimate ($\text{SEE} = \pm 6.93$) when compared with the other two parameters. This is an indication that the regression equation calculated for the Head Circumference gives a higher degree of reliability and accuracy in the estimation of stature of Igbo subjects in Abakaliki than any of the Head Lenght and Head Breadth. This is because, lower $\text{SEE}$ value indicates higher reliability and accuracy while the higher value of $\text{SEE}$ denotes less reliability of prediction. The present study though in line with that of Krishan and Kumar presents higher values of $\text{SEE}$. Krishan and Kumar working on the male Koli adolescents from the North Indian population, reported that Maximum Head Circumference has the least value of $\text{SEE}$ ($\pm 4.41$), an indication that prediction of stature from this measurement is higher than that from any other cephalo-facial measurement. This difference in $\text{SEE}$ value could be attributed to environmental and genetic factors. The Koli is an endogamous group and the greater reliability of the study based on lower $\text{SEE}$ values could be attributed to the homogenous nature of the sample population. On the contrary, the Igbo people in Abakaliki are a mixed population and the sample population is extended to include both sexes from the age of 12 to 45 years. This gap in sample population must have created room for the high value of $\text{SEE}$ observed when the present study is compared with that of Krishan and Kumar.

Moreover, it is of great interest to note that the result of the present study falls in line with previous reports from studies on mixed population samples which reported higher $\text{SEE}$ for the cephalic parameters.

The high values of $\text{SEE}$ observed by using regression equations to estimate stature from cephalic measurements in the present study notwithstanding, the results from the present study show a high degree of reliability and accuracy. Table 4 which presents a comparison of actual stature and stature estimated from cephalo-facial measurements using regression analysis show that the mean value estimate in each of these variables is the same (166.80 cm) with the actual stature. This is an indication that the regression equations obtained in the present study are highly accurate.
and reliable for the estimation of stature of Abakaliki people from the cephalic measurements.

CONCLUSION

This study has successfully established the mean values of the stature of Igbo people resident in Abakaliki from different Cephalic parameters through regression analysis.

REFERENCES


13. Oladipo, G.S., Okoh, P.D., Akande, P.A. and Oyakhire, M.O. Anthropometric study of some craniofacial parameters: Head circumference, nasal


