

ORIGINAL RESEARCH ARTICLE

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

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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 legs⁸⁻¹¹, 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

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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 Length (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 opisthocranium (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 (opisthocranium).

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 analysed 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 Length shows the highest (± 7.48). Table 4 compared the mean value of

actual stature with the stature estimated from the values.

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.

Variable	Mean (cm)	Std. Deviation	Std. Error
Max. Head Length	18.82	0.80	0.03
Max. Head Breadth	15.03	0.76	0.02
Max. Head Circumference	55.35	1.86	0.06

(P < 0.05)

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

Variable	Mean (cm)	Std. Deviation	Corr. Coeff.	Std. Error
Max. Head Length	18.82	0.80	0.34	0.29
Max. Head Breadth	15.03	0.76	0.39	0.31
Max. Head Circumference	55.35	1.86	0.49	0.12

(P < 0.01)

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

Variable	Regression equation	±SEE
Maximum Head Length (MHL)	102.75 + 3.40 MHL	±7.48
Maximum Head Breadth (MHB)	105.59 + 4.07 MHB	±7.34
Maximum Head Circumference (MHC)	50.18 + 2.11 MHC	±6.93

P < 0.01

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

Estimated stature using regression equation for :	Minimum estimated stature	Maximum estimated stature	Mean estimated stature
Maximum Head Length	158.21	181.00	166.80
Maximum Head Breadth	159.33	186.61	166.80
Maximum Head Circumference	151.30	181.85	166.80
Actual Stature	142.00	188.00	166.80

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.² 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.⁸ 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 ($SEE = \pm 6.93$) 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 Length and Head Breadth. This is because, lower SEE value indicates higher reliability and accuracy while the higher value of SEE denotes less reliability of prediction.² The present study though in line with that of Krishan and Kumar presents higher values of SEE.² Krishan and Kumar working on the male Koli adolescents from the North Indian population, reported that Maximum Head Circumference has the least value of SEE (± 4.41), an indication that prediction of stature from this measurement is higher than that from any other

cephalo-facial measurement. This difference in 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 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 SEE observed when the present study is compared with that of Krishan and Kumar.²

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 SEE for the cephalic parameters.^{21, 22}

The high values of 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

1. Stedman TL. Stedman's Medical Dictionary. Baltimore: Lippincott Williams and Wilkins. 2000, p.211.
2. Krishan K and Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian population. *Journal of Forensic and Legal Medicine*. 2007, 14(6):327-332.
3. Sopher, I.M. The dentist, the forensic pathologist and the identification of skeletal remains. *Journal of American Dental Association*. 1972, 85:1324-9.
4. Jason, D.R. and Taylor, K. Estimation of stature from the length of the cervical, thoracic, and lumbar segments of the spine in American whites and blacks. *Journal of Forensic Science JFSCA*. 1995, 40: 59-62.
5. Krishan, K and Kumar, R. Determination of stature from cephalo-facial dimensions in a North Indian population. *Leg. Med*. 2007, 9:128-33.
6. Ozaslan A, Iscan MY, Ozaslan I, Tugcu H, Koc S. Estimation of stature from body parts. *Forensic Science International*. 2003, 132:40-5.
7. Bidmos M, and Asala S. Calcaneal measurement in estimation of Stature of South African blacks. *American Journal of Physical Anthropology*. 2005, 126:335-42.
8. Krishan Kewal. Estimation of stature from cephalo-facial anthropometry in north Indian Population. *Forensic Science International* 2008, 181 (2008) 52.e1–52.e6
9. Ozaslan A, Koc S, Ozaslan I, Tugcu H. Estimation of stature from upper extremity. *Mil Med*. 2006, 171:288-91.
10. Simmons T, Jantz RL, Bass WM. Stature estimation from fragmentary femora: A revision of the Steele method, *Journal of Forensic Science JFSCA*. 1990, 35: 628-36.
11. Holland TD. Estimation of adult stature from fragmentary tibias. *Journal of Forensic Science* 1992, 37: 1223-9.
12. Zviagin VN, and Eremenko EA. Determination of some somatic body dimensions by osteometric foot measurements. *Sudanese Medical Ekspert*. 2004, 47: 29-33.
13. Oladipo, G.S., Okoh, P.D., Akande, P.A. and Oyakhire, M.O. Anthropometric study of some craniofacial parameters: Head circumference, nasal

- height, nasal width and nasal index of adult Omoku indigenes of Nigeria. *Am. J. Sci. Ind. Res.*, 2011, 2: 54-57.
14. Esomonu, U.G. and Badamasi, M.I. Cephalic Anthropometry of Ndi Igbo of Abia State of Nigeria. *Asian Journal of Scientific Research*.2012, 5:178-184.
15. Eroje, M. A.; Fawehinmi, H. B.; Jaja, B. N. & Yaakor, L. Cephalic index of Ogbia tribe of Bayesla state. *Int. J. Morphol.*, 2010, 28(2):389-392.
16. Umar, M.B.T., Ojo, A.S., Asalaand, S.A., Hambolu, J.O. Comparison of Cephalometric Indices Between the Hausa and Yoruba Ethnic Groups of Nigeria. *Research Journal of Medical Sciences*. 2011, Vol.5:(2) 83-89.
17. Mador, E.S., H.Y. Gncim, I.C. Pam, J.T. Mutihir, G.I. Adoga and J.O. Ogunranti. Cephalic index: A fetal gestational age dependent biometric parameter. *Asian J. Med. Sci.*, 2010, 1: 45-48.
18. Maina, M.B., Y.C. Shapu, S.H. Garba, M.A. Muhammad, A.M. Garba, A.U. Yaro and O.N. Omoniyi. Assessments of cranial capacities in a north-eastern adult nigerian population. *J. Applied Sci.*, 2011, 11: 2662-2665.
19. Weiner JS and Lourie JA. *Human Biology—A Guide to Field Methods*, Blackwell Scientific Publications, Oxford and Edinburgh, 1981.
20. Hall JG, Froster-Iskenius UG, Allanson JE. *Handbook of Normal Physical Measurements*. Oxford, New York, Toronto: Oxford University Press, 2003.
21. Chiba M and Terazawa K. Estimation of stature from somatometry of skull. *Forensic Science International*. 1998, 97: 87-92.
22. Patil KR and Mody RN. Determination on sex by discriminant function analysis and stature by regression analysis: A lateral cephalometric study. *Forensic Science International*. 2005, 147:175-80.