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Full Length Research Paper

Patterns of cephalic indexes in three West African populations

Odokuma, E. I.[1]*, Akpuaka, F. C.[2], Igbigbi, P. S.[1], Otuaga, P. O.[1] and Ejebe, D.[3]

[1]Department of Anatomy, Delta State University, Abraka Nigeria.
[2]Department of Anatomy, Abia State University Uturu, Abia State, Nigeria.
[3]Department of Pharmacology, Delta State University, Abraka Nigeria.

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Several craniometric studies involving Caucasian, Mongoloid and Americans have been conducted and its usefulness in facilitating proper identification of skeletal remains and in emphasizing a common origin of studied populations cannot be overemphasized. This study involved 699 (male 361; female 338) volunteer students of Delta State University whose age ranged 18 years and over. Respondents were selected along three ethnic groups including Urhobo (male 156; female 147), Ibo (male 141; female 145) and Edo (male 64; female 46). The mean cephalic index (CI) between the sampled populations was 77.95 ± 4.34 cm. There was an observed significant effect of age on cephalic index ($p < 0.01$) but gender showed no significant effects on cephalic index. The values for the three selected tribes did not differ significantly from one another nor differ from the population mean ($p < 0.05$). The mean male and female CI values were 77.67 and 78.14 cm, respectively. The Cephalic index patterns of three indigenous West African ethnic groups (Urhobo, Edo and Ibo) was presented in this study highlighting certain features common to West African and perhaps African populations. It was shown that Cephalic index were significant indices for differentiation of population groups and cultures. In spite of these observations, differences which enable intracultural differentiation commonly occur as exhibited by the craniometric pattern in this study. Inevitably therefore, craniometric studies are most essential in the study of population dynamics especially with respect to quantitative variables.

Key words: Cephalic, mesocephalic, gender, culture, West Africa.

INTRODUCTION

Knowledge of the cranium of either a dry skull or of a living being is of significant importance to the study and comparison of populations with various fundamental differences like racial, geographic, ethnic and dietary characteristics. Medically, an analysis of cranial capacity expresses another aspect of growth and development and permits critical evaluation of unusually large, small or misshapen crania (Haack and Neihoff, 1971).

Craniometric data is used in mainstream science to compare modern-day animal species and to analyze the evolution of the human species in archeology. Fossil hominids are often found fragmented and are reconstructed upon a paradigm according to the law of correlation. Jerrison (1979) noted the paucity of whole crania of australopithecines and habilines and remarked that cranial statistics seem to conform to foci of averages based on a few reconstructions.

Attempts at explaining homogeneity of African populations have led to a number of studies. Howells (1989), Froment (1992a) and Lahr (1996) suggested that despite the general opinion that Africans did appear to be homogenous in certain morphologic characteristics, observed polymorphisms were far from homogenous. In another study, Hiernaux (1976) explained that the variations of craniometric characteristics were distinctly different from

*Corresponding author. E-mail: secretfilesl800@yahoo.com. Tel: 2348035658134.

Abbreviations: CI, Cephalic index; **L,** maximum head length; **B,** maximum head breadth.

Table 1. Cephalic indices were grouped as follows.

Females	Males	Scientific term	Meaning	Alternative term
< 75%	< 65%	*dolichocephalic*	'long-headed'	*Mesocranial*
75 to 80%	65 to 75%	*mesocephalic*	'medium-headed'	*Mesaticephalic*
> 80%	> 75%	*brachycephalic*	'short-headed'	*Brachycranial*

Table 2a. Mean cephalic index of combined populations studied.

R-Square	Coeff Var	Root MSE	Mean CI
0.29	5.23	4.07	77.95

the previous racial categorizations of Africans (Leaky, 1935; Coon, 1971). Through skull morphology, population differentiation has been explored previously by three main recent studies (Hiernaux, 1976; Howells, 1989; Froment, 1998), showing that not only vault features but also various facial characteristics are responsible for both inter and intra-regional differences within sub-Saharan Africa. Hiernaux (1966, 1968, 1974, 1976) highlighted on inter- and intra-population variability in sub-Saharan Africa.

MATERIALS AND METHODS

The sample population for this study included 699 (male 361; female 338) volunteer Students of Delta State University of both male and female whose age ranged from between 18 years and over. Data was obtained from persons whose parents and grand parents were of Nigerian origin and showed no obvious physical defect. Respondents were selected along three culture lines of Urhobo (male; female), Ibo (male; female) and Edo (male; female) speaking people and it was ensured that the population for the study was collected using a random stratified method. Sample size for studies of this nature was determined using a standard formula (Andy, 1992). Anatomical parameters measured include:

1. Maximum head length (L) (Glabellar to inion length) in (cm).
2. Maximum head breadth (B) (Distance between the two parietal eminences) in (cm).

The means obtained from the above variables were then subjected to analyses of variance (ANOVA) for comparison within cultures. Finally, multivariate analyses (MANOVA), between the studied cultures were then made for assessment of differences or similarities.

Formulae for Cephalic index

Cephalic index was taken as the ratio of the maximum width of the head to its maximum length, multiplied by 100 (Table 1).

Only individuals between the ages of 18 and 33 years were used for the study since little or no morphological change was expected in the skulls of such individuals normally. Sexual variation had previously been shown to affect gross cranial patterns hence the data was separated along gender lines

All selected individuals were all apparently able bodied volunteers whose parents and grand parents were pure breeds of the three cultures assessed. Any subject that was not able bodied or who had any obvious physical deformity affecting statues was excluded from the study. Data from closely related individuals were excluded to avoid familiar peculiarities that may occur with such measurements.

Approval for this study was obtained from Delta State Universities' ethical committee and consent was obtained from each respondent or their legal guardians and it conformed with the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh, 2000; Tyebkahan (2003).

Description of method used

The investigation was first then explained to the respondent and consent was then obtained. With the standard weighing machine the height and weight measurements were obtained. While the respondent was in sitting position, the maximum head length, maximum head breadth and auricular height were obtained using standard calipers. At each examination, measurements of height and weight were obtained by a trained observer to reduce inter observer error according to a standardized protocol. Heights, Head Length, Head width, and Auricular Height were measured to the nearest 0.01 cm with appropriate spreading calipers, weight to the nearest 0.1 kg using a balance beam metric scale and height using a standard measuring scale. The Occipito frontal circumference was obtained with a standard flexible steel tape.

RESULTS

The mean cephalic index (CI) between the sampled populations was 77.89 ± 4.31 cm as shown in Table 2a. There was an observed significant effect of age on cephalic index ($p < 0.01$) but gender and tribe showed no significant effects on cephalic index (Table 2b). The values for the three selected tribes did not differ significantly from one another nor differ from the population mean ($p < 0.05$) as shown in Table 2c. The mean male CI was 77.68 cm and female values of 78.14 cm (Table 2d).

The mean cephalic index for the Edo people was 78.21 ± 4.01 cm (Table 3a). Age had a significant effect on CI ($p < 0.001$) but there was no effect exhibited by gender (Table 3b).

The mean cephalic index of the Ibo's sampled in this study was 77.63 ± 4.20 as shown in Table 4a. Age had a

Table 2b. Effect of age, gender and tribe on combined cephalic index.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Tribe	2	9.13	4.565737	0.28	0.7592
Age	48	1313.12	27.356697	1.65	0.0048
Gender	1	4.795857	4.795857	0.29	0.5907

Table 2c. Mean variation of cephalic index between the three tribes.

Duncan Grouping	Mean	N	Tribe
A	78.2127	110	Edo
A	78.0350	303	Urhobo
A	77.6259	286	Ibo

Means with the same letter are not significantly different.

Table 2d. Mean gender variation of cephalic index for the combined population.

Duncan Grouping	Mean	N	Gender
A	78.14	338	F
A	77.67	361	M

Means with the same letter are not significantly different.

Table 3a. Mean cephalic index of the Edos.

R-Square	Coeff Var	Root MSE	Cepindex Mean
0.372390	4.49	3.513638	78.21

Table 3b. Effect of age and gender on mean cephalic index of Edo people.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Age	13	494.4136897	38.0318223	3.08	0.0008
Gender	1	8.6415678	8.6415678	0.70	0.4050
Age*Gen	6	62.6731521	10.4455254	0.85	0.5378

significant effect on CI ($p < 0.001$) but gender had no effect $p < 0.05$ (Tables 4b and 4c).

The mean cephalic index of the Urhobo's was 78.04 ± 4.52 (Table 5a). Gender had a significant effect on CI in this population ($p < 0.05$) as shown in Table 5b. The cephalic index of males was significantly different from that of female.

DISCUSSION

The Cephalic index (CI), the ratio of the maximum width of the head to its maximum length (Williams et al., 1995), had a mean value of 77.95 ± 4.34 with male of 77.67 and female 78.14. The percentage distribution of cephalic index was dolichocephalic 26.7%, mesocephalic 49.0%, brachycephalic 17.6% and hyperbrachycephalic 6.7%. In this study, the index was observed to be mainly within the medium sized (mesocephalic) head (Bannister, 1995). This finding was similar to the findings of Golalipour et al. (2006). The results were however different from reports from studies amongst south Africans (Jordan, 1976) which showed brachiocephaly. A similar study in India on 302 male students showed that 41% of the students were mesocephalic, 37% brachycephalic, 14% hyperbrachy-

Table 4a. Mean cephalic index of the Ibos.

R-Square	Coeff Var	Root MSE	Cepindex Mean
0.410102	4.793886	3.721296	77.62587

Table 4b. Effect of age and gender on cephalic index of the Ibos.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Age	44	1260.792806	28.654382	2.07	0.0003
Gender	1	5.961115	5.961115	0.43	0.5125
Age*Gender	25	561.430589	22.457224	1.62	0.0362

Table 4c. Mean gender cephalic index variation for the Ibos.

Duncan grouping	Mean	N	Gender
A	77.6793	145	F
A	77.5709	141	M

Table 5a. Mean cephalic index of the Urhobos.

R-Square	Coeff Var	Root MSE	Cepindex Mean
0.160906	5.777095	4.508155	78.03498

Table 5b. Effect of age and gender on cephalic index of the Urhobos.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Age	29	432.8554210	14.9260490	0.73	0.8395
Gender	1	114.0216601	114.0216601	5.61	0.0186
Age*Gen	17	454.9725375	26.7630904	1.32	0.1816

cephalic and 7% dolichocephalic (Shah and Jadhav, 2004).

In another study involving 953 adult male (22 - 24 years old) in Tehran-Iran in 2003, 36.6% of the individuals were brachycephalic, 29.9% hyperbrachy-cephalic, 24.5% mesocephalic and 9% dolichocephalic (Abolhasanzadeh and Farahani 2003). Gender had no significant effect at 0.05 level of significance thus cephalic index may therefore not be useful in sex determination. The cephalic indexes of Ibo, Edo and Urhobo tribes were similar ($p > 0.05$). This craniometric parameter may therefore be an important measure for identification of individuals from these populations. The reason for this close semblance may have arisen from possible migration that may occurred away from the equator with attendant environmental effects which would have resulted in shaping of the head size from the medium sized (mesocephalic) heads to the more broader (brachycephalic) forms. Hence the finding in this study of mesophalic heads as was also observed in southern India is in opposition to the observation in southern Africa and Iran. These changes were not however without exceptions owing to current intercultural and interracial interactions that may have occurred over the years. Thus Golalipour (2006) observed that variations observed in the sizes of the head may be the result of inheritable factors as well as environmental effects. Moreover, the above findings further emphasize that cephalic indices may be quite useful in defining population.

Conclusions

The cephalic index patterns of three indigenous West African cultures has been presented highlighting certain features common to West African and perhaps indeed African populations. It has also been shown that craniometric patterns are significant indices for differentiation of population groups and cultures. In spite of these observations, differences which enable intracultural differentiation occur as exhibited by Cephalic index patterns in this study. Inevitably therefore, craniometric studies are most essential in the study of population dynamics especially with respect to quantitative variables as shown in this study. More importantly, the benefits of this study in forensic medicine are far reaching.

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