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HEAD PHENOTYPES BASED ON CEPHALIC INDEX AMONG UKWUANI PEOPLE, IN SOUTH-SOUTH NIGERIA
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D. E. O. EBOH, D. UMUKORO and M. T. OKUMAGBA

ABSTRACT

***Background*: Head shape based on cephalic index has been used by anthropologists as a measure of classifying humans. Cephalic index is derived from head length and head width.**
***Objective*: To find out the dominant head phenotypes based on cephalic index in relation to age.**
***Design*: A cross-sectional study.**
***Setting*: The Department of Human Anatomy and Cell Biology, Delta State University, Abraka, Nigeria, between February and September, 2011.**
***Subjects*: Six hundred and five people (grouped into 6-12 years, 13-19 years and 20 years and above) were recruited to participate the study.**
***Results*: The mean cephalic index at 6-12 years is 74.37 ± 3.09 (male=73.95 ± 2.93; female = 74.78 ± 3.20). At 13-19 years, the mean cephalic index is 74.71 ± 3.52 (male = 74.04 ± 3.35; females = 75.28 ± 3.57).The mean cephalic index at 20 years and above is 76.19 ± 3.26 (male=75.90 ± 3.32; females = 76.52 ± 3.23). The dominant head phenotype at 6-12 years is dolicocephalic including males and females. At 13-19 years head type is dolicocephalic; males and females are dolicocephalic and mesocephalic head type respectively. At 20 years and above, mesocephalic head type is dominant; males and females are dolicocephalic and mesocephalic head type respectively. Poor positive linear correlation exists between cephalic index and age. There is no significant difference between cephalic indices at 6-12 years and 13-19 years. There exist statistically significant differences between cephalic index at 20 years and above, and at 6-12 years and 13-19 years.**
***Conclusion*: This is relevant in anthropology and forensic science.**

INTRODUCTION

Cephalic Index is a measure of the shape of the head used by anthropologists in classifying humans (1). Cephalic index was figured out by Swedish anatomist, Anders Retzius, in the 1840s, as the ratio of maximum width to maximum length of the head multiplied by 100. Immediately after its development, scientists in Europe and the United States attempted to use the cephalic index as a way to classify individuals into races. Human populations were classified into three primary head phenotypes:dolichocephalic (long headed), mesocephalic (medium headed) and brachycephalic (broad headed) (2). Cephalic index is inherited in a unitary fashion (2).

Presently, Cephalic index is used in determining variations in shape of the head and face in newborns (3), as well as head dimensions and in estimating the age of fetuses for legal and obstetrical purposes (4). It is also significant in Forensic anthropology as it can be used assess to sexual differences (5). Relationship between cephalic index in parents, offsprings and siblings may give an insight into genetic transmission of inherited characters among them (6).

Different studies have been carried out across the globe including Nigeria on Cephalic index and varied results of head phenotypes have been reported in different populations (3-16).

In spite of presence of researches on cephalic index in different populations including Nigeria, in the literature, similar studies among the Ukwuani of Nigeria are lacking especially as regards cross sectional studies. The purpose of the present study was to determine the cephalic index of the Ukwuani people, especially in relation to gender and age, and to provide a normative data of cephalic index which

will be useful in forensic science and anthropology.

MATERIALS AND METHODS

This was a cross-sectional study carried out in the Department of Human Anatomy and Cell Biology, Delta State University, Abraka, Nigeria, between February and September, 2011. All pupils and members of staff in public primary and secondary schools within the Ukwuani ethnic nation and who belong to the Ukwuani ethnic group formed the study population.

The sample size was 605, based on proportional stratified sampling technique. The entire process was multi-stage. The cluster sampling method was used to select the subjects into age categories of 6-12 years, 13-19 years and 20 years and above; and gender.
The subjects were pupils and teachers in public primary and secondary schools within the Ukwuani ethnic nation. The age range of the subject was 6-58 years, since the minimum age to be in primary one is six years while the retirement age for public school teachers is sixty years. The subjects were grouped into pre-adolescents, adolescents or teenagers and adults. The subjects were apparently healthy and without any craniofacial deformity.

This study used primary data that were collected at the respective sampled schools. After obtaining informed consent from the subject selected, measurements of the different parameters were done. Maximum head length was measured in centimeter as the linear distance between glabella and the opisthocranion. Maximum head width was measured in centimeter as the maximum biparietal diameter. All measurements were carried out using spreading caliper (ORION, Japan).

$$\text{Cephalic index} = (\text{Head Breadth} / \text{Head Length}) \times 100$$

Cephalic indices were calculated based on (17) these indices head phenotypes were classified as:

Dolicocephalic <74.9
Mesocephalic 75-79.9
Brachicephalic 80-84.9
Hyperbrachicephalic 85-89.9

Data generated were analysed using descriptive statistics; t-test to determine if there were significant differences between males and females in cephalic indices in all the age groups; and one way analysis of variance to ascertain if there were significant differences in cephalic indices between the respective age groups. P-value ≤ 0.05 was considered significant.
Results

Demographic data revealed a total of 605 subjects (300 male and 305 female), aged 6 to 58 years, participated in the study. Two hundred and fifteen of the subjects (106 males and 109 females) were in the age group 6-12 years; 214 (99 males and 115 females) were in the 13-19 years age group and 176 (95 males and 81 females) were aged 20 years and above.

Table 1
Descriptive statistics of parameters studied in the respective age categories

Age category (years)		N	Minimum	Maximum	Mean	Std. Deviation
6-12	cephalic index	215	66.67	82.82	74.37	3.09
13-19	cephalic index	214	65.96	86.38	74.71	3.52
20 & above	cephalic index	176	67.71	84.62	76.19	3.28

Table 1 shows total cephalic index when both genders are combined in the respective age groups. As age increases, the cephalic index also increases.

Table 2
Test of significance between males and female of parameters studied

Age category (Years)	Dimension	Gender	N	Mean	Std. Deviation	t	Df	p-valu
6-12	cephalic index	male	106	73.95	2.93	-2.00	213	0.047*
		female	109	74.78	3.2			
13-19	cephalic index	male	99	74.04	3.35	-2.60	212	0.010*
		female	115	75.28	3.57			
20 & above	cephalic index							
		male	95	75.9	3.32	-1.26	174	0.210
		female	81	76.52	3.23			

Table 2 shows in 6-12 years and 13-19 years age groups studied, cephalic indices in females were significantly greater in relation to males (P<0.05). In age group 20 years and above, though cephalic index was significantly greater in females in comparison with males, the difference was not statistically significant (P>0.05).

Table 3
Results of One-way analysis of variance and Post hoc tests

	One-WAY ANOVA			Post Hoc Multiple comparisons			
Parameter	Significance t test of homogeneity of variances	F value	Significance	Statistic	(I) age (yrs) category	(I) age (yrs) category	Significance
cephalic index	0.47	16.10	0.001	Tukey HSD	6-12	13-19	0.500
						20& above	0.001*
					13-19	6-12	0.500
						20& above	0.001*
					20& above	6-12	0.001*
						13-19	0.001*

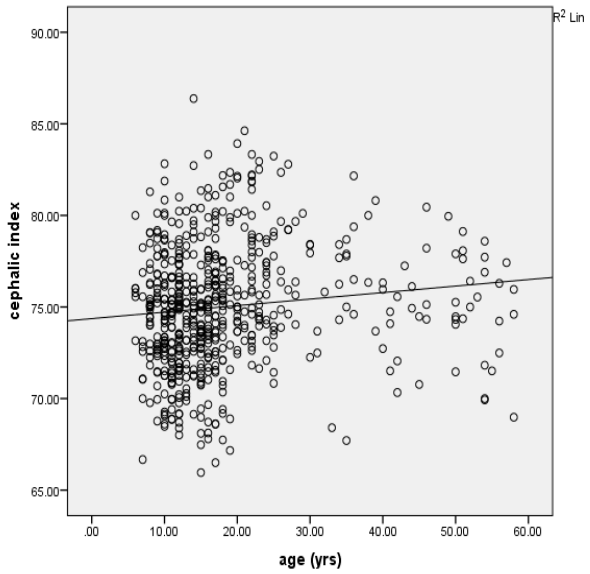
Table 3 shows one way analysis of variance and post hoc multiple comparisons of parameters studied among the age categories. There was no significant increase in cephalic index as age increases from 6-12 years to 13-19 years ((P>0.05). There was significant increase in cephalic index (P<0.05) as the age increases from 13-19 years to 20 years and above.

Table 4
Distribution of head phenotypes based on Cephalic Index

Age (Years)	Phenotype	Percentage distribution		Total
		Male	Female	-
6-12	Dolicocephalic	64= 60.4%	54=50.0%	118= 54.9%
	Mesoocephalic	40=37.7%	47=43.0%	87=40.5%
	Brachycephalic	2=1.9%	8=7.0%	10=4.6%
Total	-	106=100%	109=100%	215=100%
13-19	Dolicocephalic	64=64.6%	49=42.6%	113=52.8%
	Mesoocephalic	30=30.3%	53=46.1%	83=38.8%
	Brachycephalic	5=5.1%	13=11.3%	18=8.4%
Total	-	99=100%	115=100%	214=100%
20 +	Dolicocephalic	44=46.3%	28=34.6%	72=40.9%
	Mesoocephalic	39=41.1%	40=49.4%	79=44.9%
	Brachycephalic	12=12.6%	13=16.0%	25=14.2%
Total	-	95=100%	81=100%	176=100%
Total	-	300=100%	305=100%	605=100%

Table 4 shows the dominant head shape was dolicocephalic followed by mesoocephalic in 6-12 years and 13-19 years age categories while 20 years and above mesoocephalic was dominant followed by dolicocephalic.

Figure 1
Scatter plot and fit line between Cephalic index and Age



Pearson correlation coefficient between cephalic index and age was low (0.11) but significant (P<0.05). The scatter plot and fit line is shown in figure 1.

DISCUSSION

In the present study, the total mean cephalic indices place 6-12 years and 13-19 years age groups in the dolichocephalic category; 20 years and above age group in mesocephalic category (Table 1). Regarding gender, both genders in the 6-12 years age group and males in the 13-19 years age group are dolicocephalic. Females in the 13-19 years age group and both genders in 20 years and above age group are mesocephalic (Table 2). The dominant head phenotype in 6-12 years age group in both genders is dolichocephalic followed by mesocephalic. In the 13-19 years and 20 years and above age groups, dolicocephalic is dominant followed by mesocephalic in males while in females mesocephalic dominates followed by dolichocephalic (Table 4).

The values of total mean cephalic indices in 6-12 years and 13-19 years age groups are higher than a related study among 2-18 years old in Ogbia, Nigeria Eroje *et al*., (18). The general head phenotype of dolicocephalic in 6-12 years and 13-19 years age groups in the present study is in tandem with the report of Eroje *et al* (18). On the other hand, it is not in agreement with Akinbami (7), which observed that the dominant type of head shape among subjects of Ogbia tribe in Nigeria, aged 11-20 years, was mesocephalic. In a related study among the Indi Igbo of Abia State, Nigeria, Esomonu and Badamasi (13), observed that dominant head shape in 7-15 years old were dolicocephalic and brachycephalic in males and females respectively; 16-25 years old were hyperbrachycephalic and brachycephalic in males and females respectively; 26-40 years old were mesocephalic and brachycephalic in males and females respectively.

In an age and gender related study in Malaysian School Children, Swamy *et al* (10) reported head type in 7-9 years old, 10-13 years old 14-17 years old as brachycephalic in males, but mesocephalic, brachycephalic and mesocephalic respectively in females, based on the cephalic indices. Swapnali *et al* (11) carried out a study of cephalic index on 17-23 years old in Mumbai, and reported that based on the mean cephalic indices, the head types in the study population were brachycephalic for males and mesocephalic for females. The dominant head type in the population was mesocephalic.The general head phenotype of mesocephalic in the 20 years and above age group in this study is at variance with Oladipo *et al* (12) in a study of adults, 18-70 years old, which reported that generally, Itsekiri and Okpe of Nigeria, aged 18-70 years old, have dolicocephalic head type. Kumar and Gopichand (9) in a study of adult population in Haryanvi, reported cephalic index consistent with dolicocephalic which is also the dominant head phenotype in both genders.The values of cephalic index for both genders in the present study are lower than in Shah *et al* (14), but the two studies are similar in the sense that the cephalic indices place both genders in the mesocephalic head shape and also, the dominant head phenotype is dolicocephalic and mesocephalic in males and females respectively. Nemade and Nemade (8) in study of 20-30 years old Maharashtrians, reported total population, males and females cephalic indices higher than the present study and place the respective group in the mesocephalic head shape.The dominant head phenotype in both genders is mesocephalic followed by brachycephalic head. Genetic, environmental factor and geographic factors may be the reasons for occurrences of different head phenotypes in different populations.

At 6-12 years and 13-19 years age groups, the mean cephalic index in females was significantly greater in males, exhibiting sexual dimorphism. At age 20 years and above, there was no sexual dimorphism. This is similar to Oladipo *et al* (12) in a study among the Itsekiri and Okpe in which there was sexual dimorphism with males having greater cephalic index in an adult population. In

a related study among children 3-18 years in Port Harcourt, Ligha and Fawehinmi (15) reported sexual dimorphism with females having significant higher values than males in the 7-10 and 11-14 years age groups, while in 15-18 years age group, no significant sex difference was observed. Eroje *et al* (18) in a study in Ogbia, Nigeria, among subjects 2-18 years old, reported cephalic index in males to be significantly greater than in females. Oladipo *et al* (16) in a study of cephalic indices among 25-45 years old Ogoni in Nigeria, reported males had significant greater cephalic index than females. In a study of medical students in Gujarat Region, Shah *et al* (14) reported cephalic index in females was significantly different from males.

The varied outcome of cephalic index regarding sexual dimorphism in different populations may be ascribed to genetic and environmental factors as they are known to affect human dimensions. It could be possible that other factors intrinsic to the different populations may also be at play.

This present cross sectional survey on head phenotypes showed that cephalic index increases with increase in age (Table 1). There was no significant difference between total mean cephalic index at 13-19 years and 6-12 years age groups. However, the differences between total mean cephalic index at 20 years and above and 13-19 years age groups as well as between total mean cephalic index at 20 years and above and 6-12 years age groups were significant (Table 3). There exist poor positive linear correlations between cephalic index and age. It would have been more interesting if similar studies based on age categories were available for comparison. Nonetheless, this will provide a significant foundation for later studies in other populations. Regarding cranial growth and shape, it has been posited that patency of the metopic and sagittal as well as coronal and lambdoid sutures is responsible for the adequate growth of cranial vault in the anterior-posterior and transverse directions, respectively, based on Virchow's law of parallel and perpendicular bone expansion. It was also opined that metopic suture fuses between 3 and 9 months, while others fuse between 22 and 39 months (7-19). Premature fusion of the sagittal suture will increase the entire length of the head anterior-posterior while only the length of the anterior is reduced in early metopic fusion. Early fusion of bilateral coronal sutures results in increased biparietal diameter and reduced head length (classical brachycephaly) (6,7).

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