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Anthropometric Study of the Cephalic Index of the Igbos of the South-Eastern Nigeria

*UG ESOMONU , CIP ANIBEZE , FC AKPUAKA
Department of Anatomy, College of Medicine and Health Sciences, Abia State University, Uturu
*Department of Anatomy, Faculty of Medicine, Bayero University Kano.
*Author for correspondence

ABSTRACT

The human race is most times regarded as an intellectual unit made up of different races, and from the anthropologists' viewpoint the most realistic set of bones most often measured for purposes of racial classification are those of the head. The aim of the present work was to determine some relevant cephallic parameters, particularly in relation to sex and to study the distribution of basic head types among the Igbo indigenes of Nigeria. The Igbo population was recruited from Abia, Anambra, Imo, Enugu, and Ebonyi states, which are the five states of Nigeria where the Igbo ethnic group is dominant. In this cross-sectional extensive study, a total number of three thousand subjects within age range of 7-40 years old were measured (male = 1500 and female = 1500). Six hundred was selected from each of the five states to make up the 3000 subjects. The sample size from each state comprised of 100 males and 100 females for each group comprising of: Adults (26-45 years), Young adults (16-25 years), Children (7-15 years). Head length and head breadth were measured to calculate the cephalic index. Statistically significant differences between two treated groups, according to sex, were found almost in the measured variables. Such proportional difference did influence cephalic index. According to the cephalic Index, male values revealed that mesocephalic type were dominant in children and adults while brachycephalic type was dominant in young adults. In females the dominant head type is byachycephally in all age groups. Comparing previous records of the female cephalic index with recent work proves tendency towards " brachycephalisation". The data collected will be of utmost importance in forensic medicine, anthropology and in genetics.

Key words: Igbos, Head Length, head length, cephalic index, mesocephalic, brachycephally.

The human race is most times regarded as an intellectual unit made up of different races, and from the anthropologists' viewpoint the most realistic set of bones most often measured for purposes of racial classification are those of the head. The cephalic index was defined by Swedish professor of anatomyð Anders Retzius (1796-1860) as the ratio of the maximum width of the head to its maximum length, multiplied by 100 for convenience. It was first used in physical anthropology to classify ancient human remains found in Europe. The theory became closely associated with the development of racial anthropology in the 19th and early 20th century, when prehistorians attempted to use ancient remains to model population movements in terms of racial categories. Human populations were characterized as either dolichocephalic (long headed), mesocephalic (moderate headed), or brachycephalic (broad headed). Today the index has found much use in description of an individual appearance and for estimating the age of fetuses for legal and obstetrical reasons (Rajlakshmi, et al 2001).

Cephalic index can also be utilized to find out sexual differences. That is how it has a role in Forensic science. Shah and Jadhav, (2004) studied the cephalic index of the students of Gujarat and reported that the mean cephalic index for male is 80.42 and for female it is 81.20. They also reported that in males the head length varies from 16.5 cm. to 20.1 cm, with the mean head length being 18.26 cm while in females the head length varies from 14.1cm to 18.9 cm with a mean head length of 16.5cm. In their study, the mean cephalic index in both sex is 80.81, ranging from 71.10 to 89.77. According to Stewart's classification (1935) their subjects can be called mesati-cephalic.

A clue to the genetic transmission of inherited character can also be expressed when changes in cephalic index is compared between parents, offspring and siblings (Shah and Jadhav 2004). Certain diseases have been shown to be more prone in specific head type. otitis media is found to be more prone in doliocephalic persons than in brachycephalic persons (Stolovitsky and Todd, 1990). It is also reported that individuals that are hyperbrachycephalic often suffer from Apert's syndrome (Cohen and Kreiborg,1994).

A large number of reports exist on the cephalic index of Caucasians. Lobo et al (2005) studied the cephalic index of Gurung community of Nepal. A total of 267 adults were studied out of which 157 were male and 110 were females. The study subjects were aged between 25 and 45. They reported that the mean head length was 17.7 cm (SD = 0.88) and mean head breadth was 14.8 cm (SD = 0.76). For male, mean head breath was 14.9 cm (SD = 0.83) and mean head

length was 18 cm (SD = 0.85) while females, mean head breath was 14.7 cm (SD = 0.6) and mean head length was 17.4 cm (SD = 0.78). The mean CI was 83.7 (SD = 5.69). The mean CI for male was 83.1 (SD + 6.08) and female 84. 6 (SD = 5.14). The head length, head breadth and CI were compared between male and female subjects. The mean difference in the head length, head breadth and CI between the males and females was statistically significant.

Few reports however exist on the cephalic index of Nigerians. Okupe *et al* 1984 compared the fetal cephalic indices of Nigerian and Caucasians with Nigerian. The cephalic index of Nigerians was also studied by Obikili and Singh (1992). Anthropometric comparison of cephalic indices between the Urhobo and Itsekiri ethnic groups of Nigeria was revealed by Oladipo and Paul (2009). The first report on cephalic indices of Ijaws and Igbos, revealed that a mean cephalic indices of 80.98, 78.24, 79.04 and 76.83 for Ijaw males, Ijaw females, Igbo males and Igbo females respectively (Oladipo and Olotu 2006) but the Igbos in their study was culled from Enugu state.

In most anthropometry research involving Igbos, reference to non African standard for cephalic index value does arise because of the non availability of a comprehensive data for the Igbos therefore the aim of the present work was to determine some relevant cephallic parameters, particularly in relation to sex, generate a database for head length, head breadth and cephalic index values and to study the distribution of basic head types among the Igbo indigenes of Nigeria since very few documented study had singled out the Igbos in respect to these anthropometric parameters.

Igbo people are an ethnic group living chiefly in south-eastern Nigeria. The CIA World Fact book puts the Igbo population (including the various subgroups of the Igbo at 18% of a total population of 152 million, or approximately 27 million. Igbos in Nigeria is found mainly in Abia, Anambra, Ebonyi, Enugu, and Imo states.

MATERIALS AND METHOD

Sample Size

The Igbo population was recruited from primary, secondary and tertiary schools from Abia, Anambra, Imo, Enugu, and Ebonyi states, which are the five states of Nigeria where the Igbo ethnic group is dominant. In this cross-sectional extensive study, the subjects were invited to participate if they met the following criteria:

Age 7 through 40 years; Normal craniofacial configuration; Both parents must come from one of the five states.

After informed consent had been obtained, the following measurements were made: Head length, Head width

A total number of three thousand subjects were measured (male = 1500 and female = 1500). Six hundred was selected from each of the five states to make up the 3000 subjects. The sample size from each state comprised of 100 males and 100 females for each group comprising of: Adults (26-45 years), Young adults (16-25 years), Children (7-15 years).

Measurement of Head Length and Breadth

All the measurements were taken with the subjects sitting on the chair; head in anatomical position and the measurements were taken to the nearest 1mm.

The head length was measured with a spreading caliper from glabella to Inion (Figure 1). Head breadth was measured as the maximum transverse diameter between the two euryons using a spreading calliper (Figure 2).The anatomical landmarks are defined as follows:

- Glabella: A point above the nasal root between the eyebrows and intersected by mid sagital plane.
- Inion: The distal most point placed on the external occipital protuberance in the mid sagital plane.
- Euryon: The lateral most point placed on the side of the head.

$$\text{C}\quad \text{Cephalic Index} = \frac{\text{Head Width}}{\text{Head Length}} \times 100$$

HEAD SHAPE	CEPHALIC INDEX (CI) RANGE (%)
Dollcocephalic	CI < 74.9
Mesochepallc	75<CI<79.9
Brahiocephal	80<CI<84.9
Hyperbrachlocephal	85<CI<89.9 and CI>89.9

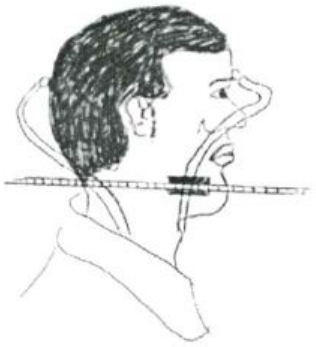

Fig. 1: Head length Measurement is taken with a spreading caliper from a point above the nasal root between the eyebrows and intersected by mid sagital plane and the distal most point placed on the external occipital protuberance in the mid sagital plane.

Fig. 2: Head Breadth- Measurement of the maximum transverse diameter between the two euryons using a spreading caliper (Euryon: The lateral most point placed on the side of the head).

RESULT

Cephalic measurements were compared between males and females. All measurements are given in centimetres. Mean values, standard deviation, two-tailed significance for the head length and breadth and the cephalic index for each state and for the Igbos as a whole are shown in Tables 1to 3. Some of the variables within the states have equivalent proportions between the sexes while others appear to be sexually dimorphic relative to the age group. Statistical analysis was carried out using SPSS version 16.

An increased significant male value for head length was observed in adults (19.85±.75) and in the male group (7-40 years) of the study. 19.03±1.3cm, 19.71±.87cm and 19.85±.75cm were noted in children, young adult and adult males respectively (table 1).

Table 2 presents the results of testing for sexual dimorphism in the head breadth of the Igbo ethnic group, Abia, Anambra, Ebonyi, Enugu and Imo state respectively. Significant sexual dimorphism were observed in the values recorded for the head breadth in young adults and adults for the whole Igbo ethnic group In young adults, male value of 16.19±.85cm was significantly higher than the 15.83±.68cm observed in females while the value of 16.03±.59cm observed in female adults was significantly higher than the 15.77±.53cm noted in adult male.. In Abia state higher significant values were observed in young adults, and in adults. Anambra state values showed significance sexual dimorphism in young adults, and adults with higher value observed in young adult males ($p < .05$). In Ebonyi state, significant higher values were recorded for adult females while in males significant higher values were observed in young adults. In Enugu state it was observed that males recorded significant higher values in young adult and in adults. Imo state showed significantly higher values in young adult males.

Means and standard deviation of cephalic index for the general Igbo population were determined and it was observed that male values were 79.88, 82.30, and 79.61 while female cephalic index values were 81.21, 80.71 and 82.86 for children, young adults and adults respectively (table 3). Head was classified by cephalic index, so that in males mesocephalic type was dominant in children and adults while brachycephalic type was dominant in young adults. In females the dominant head type is byachycephally in all major age groups of the Igbo population. In the states females head type is also brachycephally in children, young adults and adults. In males the head type for all the state also showed mesocephally in children and adults except in Anambra state where the children had brachycephally as the dominant head type (table 3).

Table 1: Comparison of head length in male and female subjects in different age groups in Igbo Ethnic Group

AGE (YRS)	SEX	ABIA	ANAMBRA	EBONYI	ENUGU	IMO	IGBOS
7-15	MALE	19.82±1.2[A]	18.99±1.41	8.96±1.21	9.00±1.41	9.08±1.21	9.05±1.3
	FEMALE	18.82±1.3[A]	18.78±1.41	8.84±1.31	8.83±1.31	8.78±1.21	8.81±1.3
16-25	MALE	19.65±.84	19.86±.64[D]	19.67±.87	19.71±.94	19.65±1.0	19.71±.87
	FEMALE	19.77±.70	19.62±.77[D]	19.61±.72	19.56±.82	19.64±.85	19.64±.78
26-40	MALE	19.87±.74[B]	19.86±.68[E]	19.85±.74[G]	19.82±.70[I]	19.82±.81[K]	19.85±.75[M]
	FEMALE	19.47±.66[B]	19.28±.73[E]	19.39±.61[G]	19.45±.76[I]	19.25±.69[K]	19.37±.70
M							
7-40	MALE	19.59±.96[C]	19.51±1.1[F]	19.48±1.0[H]	19.51±1.1[J]	19.54±1.1[L]	19.53±1.1[N]
	FEMALE	19.36±1.0[C]	19.24±1.1[F]	19.29±.97[H]	19.28±1.0[J]	19.24±1.0[L]	18.28±1.0[N]

Values with similar alphabetical superscript are significant at P<0.05

Table 2: Comparison of head breadth in male and female subjects in different age groups in Igbo Ethnic Group

AGE (YRS)	SEX	ABIA	ANAMBRA	EBONYI	ENUGU	IMO	IGBOS
7-15	MALE	15.18±1.1	15.26±1.2	15.12±1.1	15.10±1.1	15.19±.93	15.17±1.1
	FEMALE	15.20±.98	15.34±1.1	15.31±.98	15.16±1.1	15.21±1.1	15.24±1.0
16-25	MALE	15.22±.88[A]	16.10±.67[C]	16.18±.93[E]	16.25±.85[G]	16.22±.93[I]	16.19±.85[J]
	FEMALE	15.94±.81[A]	15.81±.64[C]	15.70±.52[E]	15.85±.68[G]	15.84±.73[I]	15.83±.68[J]
26-40	MALE	15.78±.49[B]	15.73±.50[D]	15.72±6.1[F]	16.79±.51[H]	15.83±.55	15.77±.53[K]
	FEMALE	16.11±.69[B]	15.94±.60[D]	15.97±.42[F]	16.12±.59[H]	16.01±.59	16.03±.59
K							
7-40	MALE	15.74±.96	15.73±.97	15.70±1.0	15.73±.98	15.77±.94	15.74±.97
	FEMALE	15.74±.92	15.69±.83	15.65±.74	15.70±.89	15.68±.90	15.69±.86

Values with similar alphabetical superscript are significant at P<0.05

Table 3: Comparison of cephalic index in male and female subjects in different age groups in Igbo Ethnic Group

AGE (YRS)	SEX	ABIA	ANAMBRA	EBONYI	ENUGU	IMO	IGBOS
7-15	MALE	79.13±6.1[A]	80.66±7.2	79.96±6.4	79.78±6.3	79.86±5.9	79.88±6.4
	FEMALE	80.95±5.6[A]	81.86±5.5	81.46±5.1	80.65±48	81.15±5.1	81.21±5.2
16-25	MALE	82.71±5.7[B]	81.14±4.0	82.39±5.3[G]	82.58±5.3[I]	82.71±5.5	79.61±3.8[L]
	FEMALE	80.68±4.4[B]	80.73±4.5	80.16±4.1[G]	81.15±4.1[I]	80.81±4.7	82.86±4.0[L]
26-40	MALE	79.59±3.1[C]	79.28±3.5[E]	79.42±4.6[H]	79.78±4.0[J]	79.96±3.9[K]	82.30±5.2[M]
	FEMALE	82.83±4.4[C]	82.81±4.1[E]	82.47±3.6[H]	82.99±4.0[J]	83.23±3.8[K]	80.71±4.4[M]
7-40	MALE	80.48±5.3[D]	80.80±5.9[F]	80.73±5.6	80.84±5.5	80.87±5.5	80.73±5.6[N]
	FEMALE	81.45±4.9[D]	81.71±4.8[F]	81.28±4.4	81.53±4.4	81.62±4.7	81.51±4.7[N]

Values with similar alphabetical superscript are significant at P<0.05

DISCUSSION

This study is focused on cephalic anthropometrical measurements of Igbo ethnic group, subjects chosen were those that have no apparent dysmorphological features and no known family history of genetic defects affecting the cephalic region. The research was tilted towards identifying the average cephalic parameters that are inherent to the Igbo ethnic group. These data invariably can assist in the diagnosis of most genetic pathology involving the cephalofacial region like: certain craniofacial syndromes, and as such dependable data are needed for the identification of some of these anomalies inherent to a particular group of people (DeMyer 1967 Pryor 1969, Farkas et al 1992a, 1992b). For these reasons, standards based on ethnic or racial data are desirable because these standards reflect the potentially different patterns of cephalofacial growth resulting from racial, ethnic, and sexual differences. Many investigators have already shown that significant differences in cephalofacial complex among ethnic and racial groups does exist (Hwang et al 2002, Miyayima et al 1996, Cerci et al 1993, Swelererenga et al 1994). Several other investigators (Livhits et al 2002) suggested also that genetic factors exert a substantial influence on the individual difference in body shape and configuration. Therefore they could be considered in developing standards for various populations.

The obtained data were separated according to state and sex. As expected, sexual dimorphism was found to be statistically significant ($P<0.05$) in most of the parameters that were measured base on advancing age and sex (Tables 1 to 3).

Head dimension changes followed different pattern in different population. In the European derived and American black population the skull has become narrower and the vault has increased in height and length (Wescot and Jantz 2005). The key factor in the process of head dimension changes is small increase in the growth rate in a specific direction during infancy and childhood. These increases involve the posterior cranial base and occur in a posterior inferior or lateral direction resulting in significant changes of the vault shape (Wescot and Jantz 2005, Kouchi 2000).

The result obtained revealed that head length, head breadth and cephalic index showed significant difference between male and female. Head length showed significant difference from childhood to adulthood. The difference shown could be due to slight increase in head growth at these ages. Differences shown from young adults to adults could be due to changes in growth at attainment of pubertal age. The result obtained by Oladipo *et al* (2010) for the Ibibios shows that cephalic length is 19.06cm for males and 18.80 cm for females, when compared to that of the adult Igbos, the Ibibio males recorded lower value but the female value was higher than the reported value for the Igbo adult female. Although like in the Igbos, Ibibio male value was higher than their female counterpart. This is speculated to be due to the fact that head length is related to posterior growth of the brain and development of super structures (Trinkaus and Lemay, 1982). It is logical to infer that causes of secular changes are different or that reactions to common factors between males and females are different. It was speculated that earlier attainment of adult size reduces the time used for later posterior growth of the head and this leads to shorter cranial length (Kouchi 2000). This is most especially seen in girls because girls attain adult size earlier than boys of the same age, and that could reduce the time used for later posterior growth of the head. It could also be deduce that the Lamboid suture in girls appears to close earlier than that in boys (Danbronu et al 2008). Also environmental influence on prenatal and post natal exposure may be different in boys and girls leading to higher head length in boys. It may also be attributed to differences in the dominant direction of growth vectors (Kouchi 2000). Also, expanding neural mass by neural fibers may preferentially be in the vertical direction in boys. It may well be explained that this mainstream of thought could have been responsible for the very little difference in head length in boys and girls.

Regarding head breadth, significant difference was noted in young adults and in adults. In young adults, male value was significantly higher than that of the female, although in children female value was higher but statistical test showed insignificant difference between their mean head breadth this trend was also noted in the works of Danbronu et al (2008) on the growing Nigerian child between age range 5-15, they revealed that the mean head breadth in girls was greater than that of boys for all the ages, but as is evident from the current study, statistical test showed insignificant difference between the mean head breadth of the Nigerian boys and girls yet they believed that the higher rate observed in females could be due to dominant lateral direction of expanding neural mass by neural fibers in females (Danbronu et al 2008). The result obtained by Oladipo *et al* (2010) for the adult Ibibios on cephalic breadth is 15.20cm for males and 14.70 cm for females differs from that of adult Igbos since their value is lower than the reported values for the Igbos (male 15.77±.53cm and female 16.03±.59cm) unlike

in Ibibio the adult Igbo female has head breath significantly higher than their male counterpart.

Another interesting finding is seen in cephalic index where sexual dimorphism was noted in young adults and in adults. Male value for cephalic index was significantly higher in young adults while females showed higher significant value in adults. It was observable that the head form in female for all the age group falls under brachycephally. Whereas in males there was a gradual change in head form from mesochycephally in children to brachycephally in yound adults which transcends back to mesochycephally in adults. However, the predominant head form in males and females as a whole is brachycephally.

A large number of reports exist on the cephalic index of Caucasians. Few reports however exist on the cephalic index of Nigerians. Anthropometric comparison of cephalic indices by Oladipo and Paul (2009) between the Urhobo and Itsekiri ethnic groups of Nigeria revealed a mean cephalic index of 82.16 and 86.80 among the Itsekiris and Urhobos respectively this result showing brachycephalic amongst Urhobos and Itsekiris is also similar to the reported head type noted in the Igbo females irrespective of state, age and sex.

The cephalic indices of adult Ijaws and Igbos from Enugu state of Nigeria was reported by Oladipo and Olotu (2006). They revealed that the mean cephalic indices of 80.98, 78.24, 79.04 and 76.83 for Ijaw males, Ijaw females, Igbo males and Igbo females respectively. These mesocephalic head type reported for the adult male Igbos from Enugu State is also similar to the reported values for Enugu state adult males for the current research (79.78) as for the females of the current research, brachycephalic head type was noted in the females of all state.

The cephalic index (CI) was also determined for the Ibibios by Oladipo *et al* (2010). The data obtained showed that the mean value of the CI is 79.85±4.05 for males and 78.36±6.12 for female. The CI shows that Ibibio males and females belong to the mesocephalic group. This result is consistent with the mesocephalic head shape observed in Igbo males although Ibibio female head type is different from that of the Igbo female.

Danbronu *et al* (2008) reported that cephalic index showed no association to boys weight, height and girls height but it showed significant difference to girls weight. They explained that, this could be due to the roles female hormones play in deposition of fat in the body (Livshits et al 2002, Jones 1996, Hauspie 1996). This finding according to them also provides a basis why mean cephalic index of girls was relatively larger than that of boys as witnessed in the presen study.

This seeming discrepancy in changes of heac form in different populations may be attributed tc differences in the dominant direction of growtl vectors. Other factors that may contribute to these differences are nutritional status in early life whicl may accelerate brain growth in the dominan direction. Genetic factors may act in determining the dominant direction of the growth vectors (Hossain *e al* 2005, Kretschmann *et a* 1979).

In conclusion, statistically significan differences between the treated groups, according tc sex, were found in most of the measured variables Such proportional difference did influence cephalic índex. According to the cephalic Índex, male value revealed that mesocephalic type were dominant ir children and adults while brachycephalic type wa dominant in young adults. In females the dominan head type is byachycephally in all age groups Comparing previous records of the female cephalic index with recent work proves tendency towards "brachycephalisation". The data collected will be o utmost importance in forensic medicine anthropology and in genetics.

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