

Anthropological Variations of the Inner and Outer Canthal Distance of the Igbos of South-Eastern Nigeria

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ABSTRACT

This study is concerned with generating a database for outer and inner canthal dimensions for the Igbos of south-eastern Nigeria. The study was determined in 3000 normal subjects comprising 1500 males and 1500 females of ages 7-40 years. Six hundred subjects were selected from each of the five south-eastern states of Nigeria where the Igbos are dominant 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) and children (7-15 years). Measurement was done directly on subjects with a non-stretchable plastic ruler. The mean inner canthal distance for Igbo males are $3.54 \pm .49$ cm, $3.85 \pm .37$ cm and $4.04 \pm .29$ cm while females recorded $3.58 \pm .39$ cm, $3.82 \pm .29$ cm and $3.91 \pm .21$ cm, in children, young adults and adults respectively. The overall inner canthal distance value irrespective of age (7-40 years) in male was $3.81 \pm .44$ cm while in female it was $3.74 \pm .34$ cm; this value was significantly higher in male than in female. The mean outer canthal distance for Igbo male was found to be $10.27 \pm .66$ cm, $11.21 \pm .48$ cm and $11.61 \pm .43$ cm and for female, $10.33 \pm .58$ cm, $11.08 \pm .36$ cm and $11.33 \pm .27$ cm were recorded for children, young adults and adults respectively. There was significant sexual dimorphism observed in adults only ($P < 0.05$). Comparisons of these values to the reported values of other ethnic groups in Nigeria shows that ethnic variations exist for both inner and outer canthal measurements. This work has generated normative values of inner canthal distance and outer canthal distance for the Igbos of south-eastern Nigeria. This would be of benefit not only to the maxillofacial and plastic surgeons, but also to the anthropologist and dysmorphologist.

Keywords: Inner canthal distance, outer canthal distance, measurements, Igbos, Nigeria.

Inner canthal and outer canthal dimensions are important parameters in the assessment of most craniofacial abnormalities, systemic syndromes and it is a data mostly needed in surgical treatments of post-traumatic telecanthus (Farkas *et al* 2003). Clinicians employ canthal measurements in evaluating the degree of hypertelorism. Bisson and Grobbelaar (2004) expressed measurements of the lips as a ratio of intercanthal distance. At times, dentist also use the knowledge of inner canthal distance to predict the maxillary central incisor width by multiplying it by a decreasing functional value of the geometric progression term and then dividing it by a factor of two (Abdullah 2002).

In constructive surgery and orthodontic treatment there is need for accurate knowledge of the values of these distances so that deformities of the face which in most cases are often congenital, or due to trauma resulting from burns, neoplasm or any pathology involving the facial skeleton can be corrected (Vegter 1994). Several studies have shown that average values of these dimensions are race, age and gender sensitive (Laestadius *et al* 1969, Juberg *et al* 1975, Zuhail 1994, Ozturk *et al* 2006). It is necessary therefore to compare the normal value of the canthal distances in other to match groups with age, sex and race. It has also been shown that canthal

dimension values may vary with altitude (Bali *et al* 2005). By implication, it may not be unlikely that it vary with climatic condition(s) or ecological habitat of one human population to another.

A study aimed at generating a database for outer and inner canthal dimensions in the Ijaw ethnic group of southern Nigeria was carried out by Oyinbo *et al* (2008). This study revealed that the inner canthal measurement in young adult Ijaw males and females were 42 ± 5 mm and 39 ± 3 mm respectively while the outer canthal was 111 ± 14 mm for males and 120 ± 7 mm for females. Sexual dimorphism was found to be significant ($P < 0.05$). Umar (2005) conducted an orbital measurement among the plateau state indigenes of Nigeria and compared it with that of the Hausas. Out of the measured parameters, he revealed that the outer canthal distances and palpebral fissure length showed significant difference between the two tribes.

The normal values for intercanthal distances have also been investigated by Singh and Banerjee (1983) in an Indian population in order to establish normal values for these parameters. They reported that in males the mean values of the inner and outer canthal distances were $3.15 + 0.2445$ and $8.44 + 0.3172$ cm respectively while in females they recorded $3.09 + 0.2862$ and $8.17 + 0.3310$ cm

respectively. Anthropometrical variations in inner and outer canthal distances were reported in Turkish subjects by Evereklioglu *et al* (2002). This study found the outer canthal distance of young adult male to be larger than those of young adult female, and for the group as a whole, the differences were significant ($p < .001$). On the other hand, inner canthal distance of male is larger than that for female in all age groups but only significant in the 16- to 25-year-old age group ($p < .001$). Different methods of measurement have been employed by different investigators (Feingold and Bossert 1974, Osuobeni 1994, Abdllah 2002), but the direct measurement of inner canthal distance and outer canthal distance is however the preferred method for routine works (Evereklioglu *et al* 2002).

In most clinical conditions involving Africans, reference to non African standard for canthal values does arise because of the non availability of African standard values therefore this present study is concerned with generating a database for inner and outer canthal distances of the Igbos of south-eastern Nigeria since very few documented study had singled out the Igbos in respect of canthal dimensions.

MATERIAL AND METHODS

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; No Oculofacial trauma, No Craniofacial congenital anomaly; No known clinically manifestation of telecanthus or epicanthus, Both parents must come from same state.

The choice of the lower end of the age range was based on the fact that younger children might not cooperate fully with the examiner. The upper end of the age range was chosen based on the assumption that any increase in the measured parameters with age would have stopped by age 40.

After informed consent had been obtained, the Inner canthal distance and Outer canthal distance were measured.

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), and children (7-15 years).

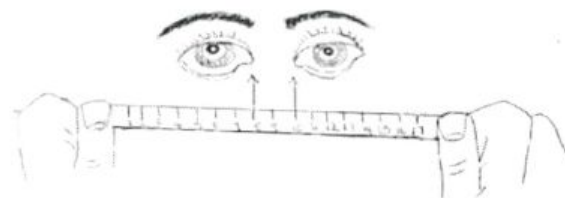


Fig 1: Showing measurement of the Inner canthal distance- the distance between the medial angles of the palpebral fissures of the eyes.

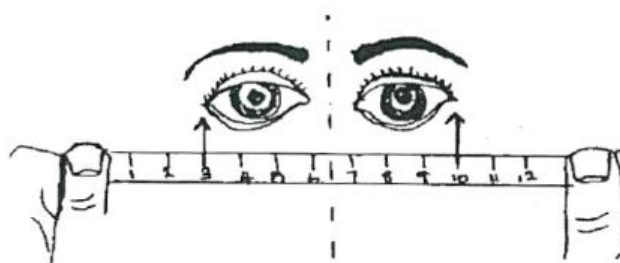


Fig 2: Showing measurement of the outer canthal distance- the distance between the lateral angles of the palpebral fissures of the eyes.

Measurement of the canthal distances

A non-stretchable plastic ruler was used for the measurement of intercanthal distances. The inner canthal distance was measured by having the subject look straight at the examiner while the millimeter ruler was held tightly against the bridge of the subject's nose. The subject was instructed to look upward for the outer canthal distance, thus maximizing the contrast between the sclera and the skin. Inner and outer canthal distances were measured between the medial and lateral angles of the palpebral fissures, respectively (Figure 1 and 2). This was the method previously applied by Laestadius *et al* (1969).

RESULTS

Mean values, standard deviation, two-tailed significance for the values of inner canthal distance and outer canthal distance, for male and female subjects among the five states and the summation of the values for the Igbo population were carried out using the SPSS version 16 software package.

Measurements of the inner and outer canthal distances were compared between males and

females and presented in table 1 and 2 respectively. All measurements were taken in centimeters. Some of the variables have equivalent proportions between the sexes while others appear to be sexually dimorphic relative to the age group.

The techniques for measurements of inner and outer canthal distances are simple and universally standard to perform. The mean values of the canthal parameters investigated were compared statistically. The mean inner canthal distance for Igbo males are 3.54±.49cm, 3.85±.37cm and 4.04±.29cm while females recorded 3.58±.39cm, 3.82±.29cm and 3.91±.21cm, in children, young adults and adults respectively (table 1). The inner canthal distance value ranges between 2.4cm to 4.8cm in male, while female value ranges between 2.4cm to 4.7cm. The overall inner canthal distance value irrespective of age (7-40 years) in males was 3.81±.44cm while in females it was 3.74±.34cm this value was significantly higher in males than in females.

The difference in the inner canthal distance between males and females was only significant in adults (table 1), In Anambra,

Ebonyi, Enugu and Imo states, significant sexual dimorphism were observed in adult age group (table 1). In each of these instances, the proportion of the inner canthal distance was greater in male than in female.

The mean outer canthal distance for Igbo males are 10.27±.66cm, 11.21±.48cm and 11.61±.43cm and for females 10.33±.58cm, 11.08±.36cm and 11.33±.27cm were recorded for children, young adults and adults respectively (table 2). When the values of males were compared with the values of females, there was significant sexual dimorphism observed in adults only (table 2). In Abia state significant sexual dimorphism were seen in adults (table 2). In Anambra, Ebonyi and Enugu states the values showed significant sexual dimorphism in young adults and in adults group (table 2), while in Imo state, significant sexual dimorphism was noted in all the age groups (table 2). In all significant sexual dimorphism noted, the mean values for male was higher than the values recorded for females except in Imo state where the female value was higher in children (table 2).

Table1: Comparison of inner canthal distance in male and female subjects in different age groups in the Igbo Ethnic group of Nigeria

AGE (YRS)	SEX	ABIA	ANAMBRA	EBONYI	ENUGU	IMO	IGBOS
7-15	MALE	3.58±.47	3.49±.53	3.55±.50	3.52±.51	3.56±.44	3.54±.49
	FEMALE	3.58±.40	3.55±.38	3.54±.36	3.60±.40	3.62±.41	3.58±.39
16-25	MALE	3.85±.37	3.79±.36	3.88±.34	3.84±.37	3.88±.42	3.85±.37
	FEMALE	3.81±.30	3.82±.27	3.81±.26	3.82±.31	3.83±.34	3.82±.29
26-40	MALE	4.09±.24	3.98±.34 ^A	4.05±.21 ^B	3.98±.27 ^C	4.07±.27 ^D	4.04±.29 ^F
	FEMALE	3.92±.22	3.88±.20 ^A	3.95±.24 ^B	3.91±.19 ^C	3.90±.20 ^D	3.91±.21 ^F
7-40	MALE	3.85±.43	3.75±.47	3.82±.44	3.77±.44	3.83±.44	3.81±.44 ^E
	FEMALE	3.77±.35	3.75±.33	3.76±.33	3.77±.34	3.78±.35	3.74±.34 ^E

Values with similar alphabetical superscript are significant at P<0.05

Table2: Comparison of inner canthal distance in male and female subjects in different age groups in the Igbo Ethnic group of Nigeria

AGE (YRS)	SEX	ABIA	ANAMBRA	EBONYI	ENUGU	IMO	IGBOS
7-15	MALE	10.34±.62	10.22±.65	10.24±.64	10.29±.71	10.28±.66 ^K	10.27±.66
	FEMALE	10.26±.62	10.30±.63	10.32±.56	10.31±.58	10.45±.50 ^K	10.33±.58
16-25	MALE	11.21±.49	11.20±.43 ^C	11.20±.50 ^F	11.20±.48 ^I	11.26±.49 ^L	11.21±.48
	FEMALE	11.11±.37	11.08±.33 ^C	11.03±.36 ^F	11.08±.38 ^I	11.11±.34 ^L	11.08±.36
26-40	MALE	11.61±.38 ^A	11.56±.45 ^D	11.59±.41 ^G	11.64±.45 ^J	11.64±.45 ^M	11.61±.43 ^O
	FEMALE	11.32±.25 ^A	11.39±.24 ^D	11.31±.28 ^G	11.30±.27 ^J	11.31±.29 ^M	11.33±.27 ^O
7-40	MALE	11.07±.73 ^B	10.97±.76	10.99±.77 ^E	11.03±.78 ^H	11.05±.78	11.03±.76 ^P
	FEMALE	10.90±.62 ^B	10.91±.63	10.88±.59 ^E	10.89±.60 ^H	10.95±.53	10.90±.60 ^P

Values with similar alphabetical superscript are significant at $P < 0.05$

DISCUSSION

This study is focused on anthropometrical measurement of the canthal parameters of the Igbos of south-eastern Nigeria. The research was tilted towards identifying the average inner and outer canthal distances that are inherent to the Igbo ethnic group. These data invariably can assist in the diagnosis of genetic pathology like ocular adnexal changes and somatometric traits of the face such as epicanthus, telecanthus, widely spaced eyebrows, and blepharophimosis which most times do present a false error in the detection of certain craniofacial syndromes (DeMyer 1967, Pryor 1969, Farkas et al 1992a, 1992b).

The obtained data were separated according to state and sex. As noted in the tables sexual dimorphism was found to be statistically significant ($P < 0.05$) mainly in the outer canthal distance.

This study revealed that the inner canthal value of young adult and adult males are larger than that for young adult and adult females but only significant in the adult age group ($P < 0.05$). The average total increment for inner canthal width achieved between children and adults is 5.0 mm in males and 3.3 mm in females. Abia state recorded the highest value in inner canthal distance for adult males (4.09cm) and also in children with a value of 3.58cm (table 1). In young adults, Ebonyi and Imo states had the highest value which is 3.88cm (table 1) while Anambra state recorded the lowest values in all the major age group, having 3.49cm, 3.79cm and 3.98cm for children, young adults and adults respectively (table 1). The highest value in female inner inter canthal distance was observed in Ebonyi state with 3.95cm (table 1) while Anambra adult female has the lowest value of 3.88cm (table 1). Imo state recorded

the highest value in young adults and children with 3.83cm and 3.62cm respectively (Table 1) while the lowest values in young adults were observed in Abia state and Ebonyi state, though Ebonyi state also presented the lowest value in children (3.54cm). For the overall group in this study, the mean inner canthal distance was $3.81 \pm .44$ cm for males and $3.74 \pm .34$ cm for females. Male values were significantly higher than the female value. The Igbo ethnic group and the Ijaw ethnic group of Nigeria share almost similar measurement in inner canthal value as evident in the works of Oyinbo et al (2008) who measured the inner canthal distance of the Ijaws of Southern Nigeria of ages 22-40 years and revealed that the inner canthal measurement in adult Ijaw males and females were 4.2 ± 0.5 cm and 3.9 ± 0.3 cm respectively. Other works on Nigerian ethnic groups reported lower values for inner canthal distance. Oladipo et al., (2009), reported that Urhobo males and females had inner canthal distances of 3.40cm and 3.00cm respectively while Itsekiri males and females had inner canthal distances of 3.50cm and 3.30cm respectively but like in this study significant sexual dimorphism was also expressed. Anas and Esomonu (2010) also reported lower values in Hausa ethnic group of Nigeria (3.34cm and 2.89cm), they revealed that significant sexual dimorphism exist also in the Hausa ethnic group. Anas (2009) studied the inner canthal distance of the Yoruba ethnic group and reported 3.68cm and 3.67cm for males and females respectively but found no statistical difference between male and female. In a study of a mixed population, Feingold and Bossert (1974) found the overall inner canthal distance to be 3.5cm. The overall result for the adults of Igbo ethnic group was higher than all these studies

The present study disclosed that outer canthal distance of male is significantly wider than that for female ($p < .05$) in adults. The outer canthal distance showed significantly greater increments with advancing age from childhood to adulthood and the values were 1.34cm for males and 1.0cm for females. For the overall group in this study, the mean outer canthal distance was $11.03 \pm .76$ cm for males and 10.90 ± 2.38 mm for females. The values were significantly higher in males ($P < 0.05$). The value reported in this study is lower than the reported values for Urhobo male, (13.10cm) and female, (12.10cm) and for itsekiri male, (12.9cm) and female, (11.4cm) ethnic groups of Nigeria by Oladipo et al., (2009). The reported values of the Ijaws were also higher than the reported values of the Igbos but unlike the reported value of the Igbos the Ijaw female value (12.0cm) is higher than the male value (11.1cm) (Onyibo et al, 2008). The Hausa outer canthal values as presented by Anas and Esomonu (2010) also revealed higher significant values in females but the values of the present study are higher than the reported values for the Hausa ethnic group. Anas (2009) also revealed that Yoruba ethnic group has outer canthal value 10.2cm and 10.09cm for male and female respectively these values are also lower than the values reported for the Igbos in the present study but higher value was also noted in Yoruba male.

Anthropometrical variations in outer canthal distances were reported in Turkish subjects by Evereklioglu et al (2002). In their study, they found the outer canthal distance of young adult male to be larger than those of young adult female, and for the group as a whole, the differences were also significant ($p < .001$). This trend was also observed among the Igbo ethnic group. The normal values for outer canthal distance investigated by Singh and Banerjee (1983) in an Indian population revealed that males had mean value of 8.44cm while in females they recorded 8.17cm respectively these values are much lower than the reported values for the Igbo ethnic group. Kaimbo and Kayembe (1994) reported values of outer inter canthal distance for Zairian subjects, aged from 2 1/2 to 18 years are almost similar with the reported values for the Igbos. The mean outer canthal for the Zairians was revealed to be 10.04cm for the first age group (2 1/2 to 6 years), 10.65cm for the second age group (7 to 10 years), 11.17cm for the third age group (11 to 14 years) and 11.85cm for the fourth age group (15 to 18 years).

These variations are not unusual; several studies have already shown that ethnic variations do exist in human anthropometry (Juberg et al 1975,

Laestadius et al 1969, Zuhail 1994). The reasons for these variations were not revealed in this study, but it may not be unconnected with the genetic contents and prevailing environmental conditions of the various ethnic groups (Oyinbo et al 2008). The works of Juberg et al (1975) shows that method of measurement is one of the important factors that account for the variations observed in human anthropometry. Although various methods of measurement have been employed by different investigators, nonetheless the simplest and more effective method for measurement of inner canthal and outer canthal distances for routine work as long as racial or ethnic standard values are needed is simple measurement using a millimeter ruler across the bridge of the nose (Cohen et al 2002).

This work in a minute way has demonstrated that ethnically Nigeria is a heterogeneous population. The work has equally generated normative values for inner canthal distance and outer canthal distance of the Igbos of south-eastern Nigeria and it would be of benefit not only to the maxillofacial and plastic surgeons, but also to the orthodontist and dysmorphologist.

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