

Anthropometric Variation Pattern of Canthal Distances with Advancing Age Among the Igbos of South-Eastern Nigerian

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Abstract: The objectives of the present study is to document the anthropometric variation pattern of the inner and outer canthal distances with advancing age among the Igbos of south eastern Nigeria. A total number of two thousand seven hundred subjects within age range of 7-40 years were measured (male = 1350 and female = 1350). The subjects were then grouped into nine groups. Each group was made up of 150 each of male and female subjects. These groups included subject within the following age range: 7-9, 10-12, 13-15, 16-18, 19-21, 22-24, 25-27, 28-30 and 31-40. A non-stretchable plastic ruler was used for the measurement of canthal distances. For subjects between 7-9 and 13-15 years old age groups, the inner canthal distance lengthened by 6.2 mm in males and 41 mm in females while the outer canthal distance increased by 9.2 mm in males and in females 9.5 mm. For ages between 16-18 and 22-25 years old groups, the inner canthal distance gradually lengthened further by 6 mm in males while in females it gradually shortened by 10 mm while in the outer canthal distance value the male value shortened by 3 mm while female value further lengthened slightly by 13 mm. For ages between 25-27 and 31-40 years old, the inner canthal distance gradually shortened by 7 mm in females while in males its values did not change while in the outer canthal distance value the male value shortened by 3.8 mm while female value remained the same. In this study, we concluded that aging affects the growth rate of the canthal distances with a higher growth rate noted in the 7 to 15 years old subjects. These data would be of benefit to the anthropologist, orthodontist and dysmorphologist.

Keywords: Igbos, inner canthal, Nigeria, outer canthal distances

INTRODUCTION

Anthropometric data concerning the changes of the facial features which occur in people throughout life provide useful information about the later stages of growth and development. Facial growth during adolescence was studied in detail by Bishara *et al.* (1995) and Athanasiou *et al.* (1992). Behrents (1986) and Bishara *et al.* (1994) independently studied the cross-sectional changes that occur in the craniofacial region. They reported that slow but cumulative growth in the late teens and early adulthood alters the facial morphology and the frontal facial profile.

Studies on craniofacial growth in individuals are based on cross-sectional data, where it is believed that the changes seen among people of different ages are representative of how individuals grow across time. Cross-sectional studies involving measuring subjects only once are actually seen as growth surveys, which unfortunately contain little information about growth since each person is only measured once, but the measurements recorded are quit informative.

Canthal dimensions are important anthropometric data of clinical significance. Inner canthal and outer canthal dimensions are important measurements in the evaluation of several systemic syndromes and

craniofacial abnormalities and in surgical treatments of post-traumatic telecanthus (Farkas *et al.*, 1992a). Dysmorphologist employs canthal measurements in evaluating the degree of hypertelorism. Accurate values of these distances are essential guide to both constructive surgery and orthodontic treatment.

It is also known that in a given individual, canthal values vary with age and tend to become constant in the mid to late twenties (Fledelius and Stubgaard, 1986). Although this is contrary to the reported studies of Farkas *et al.* (1992b) who revealed that the intercanthal width and biocular width (bi-Exocanthion) of North American Caucasians subjects reached adult size by 8 years in females and 11 years in males and the biocular width by 13 years in females and 15 years in males. Rapid growth rate was observed between 3 and 4 years in the inter canthal distances of both sexes. Hence this shows the importance of comparing normal values with age, sex and races for a particular group.

Anthropometrical variations in inner and outer canthal distances were reported in Turkish subjects by Evereklioglu *et al.* (2002). The outer canthal width showed significantly greater increments with advancing age from 7 through 25 years and the values were 7.5 mm for male and 5.3 mm for female.

A study aimed at generating a database for outer and inner canthal dimensions in the Igbos of South eastern Nigeria was carried out by Esomonu *et al.* (2011). This study revealed that the mean inner canthal distance for Igbo males are 3.54 ± 0.49 , 3.85 ± 0.37 and 4.04 ± 0.29 cm while females recorded 3.58 ± 0.39 , 3.82 ± 0.29 and 3.91 ± 0.21 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 ± 0.44 cm while in female it was 3.74 ± 0.34 cm; this value was significantly higher in male than in female ($p < 0.05$).

The objectives of the present study is to document the anthropometric variation pattern of the inner and outer canthal distances with advancing age and to determine the extent of sexual dimorphism of these facial dimensions among the various age groups in the Igbos of south eastern Nigeria.

The normative canthal values provided will serve as guide in medical intervention for conditions that may concern the facial canthus among the Igbo ethnic group. The canthal index recorded will also be of immense use to plastic surgeons and dysmorphologists towards achieving the best esthetic and functional result inherent to the Igbos.

Igbo land is located in southeastern Nigeria, with a total land area of about 15,800 square miles (about 41,000 km²). The CIA World Factbook 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 are found mainly in Abia, Anambra, Ebonyi, Enugu and Imo states.

SUBJECTS AND METHODS

Sample size: The Igbo population used in the study was selected from Abia, Anambra, Imo, Enugu and Ebonyi states, which are the five states of Nigeria where the Igbo ethnic group is dominant. In this study, the subjects were invited to participate if they met the following criteria:

Age 7 through 40 years; Normal craniofacial configuration; No known history of neurologic disease; No Oculofacial trauma; No known clinically manifestation of telecanthus or epicanthus; Both parents must come from any of the five states.

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 following measurements were made: Inner canthal distance and Outer canthal distance.

A total number of two thousand seven hundred subjects were measured (male = 1350 and female = 1350). Four hundred and fifty subjects were selected from each of the five states to make up the 2700 subjects. The subjects were then grouped into nine groups; each group was made up of 300 subjects. These groups included subject within the following age range: 7 through 9 years; 10 through 12 years; 13 through 15 years; 16 through 18 years; 19 through 21 years; 22 through 24 years; 25 through 27 years; 28 through 30 years; and 31 through 40 years. This was essential so as

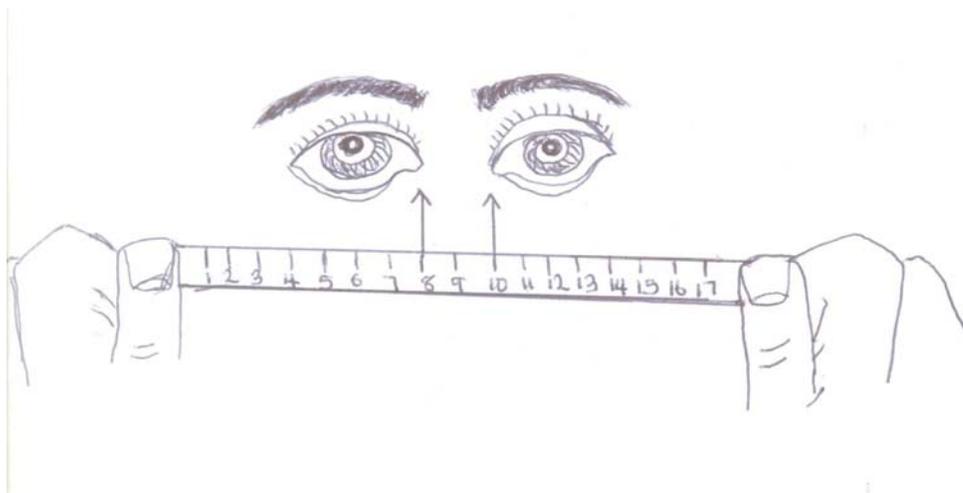


Fig. 1: Inner canthal distance-the distance between the medial angles of the palpebral fissures of the eyes

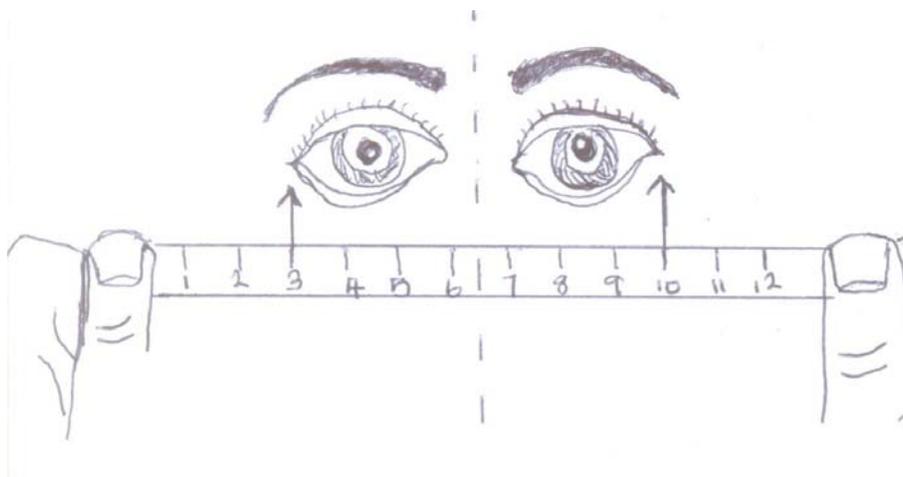


Fig. 2: Outer canthal distance-the distance between the lateral angles of the palpebral fissures of the eyes

to statistically assess the anthropometric variation patterns of each parameter with advancing age.

Canthal distance measurement: 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 (Fig. 1 and 2).

RESULTS

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. Mean, SD, Student t-test and one way analysis of variance for the values of inner canthal distance and outer canthal distance for male and female subjects among the Igbo population were carried out. We researched on 2700 subjects aged between 7 and 40 years. The subjects were divided into 3 year age cohort and each cohort had 225 men and 225 women with the exception of the last group which has 10 year old cohort each of males and females. The change of means with advancing age for the measured dimensions is presented in Table 1 Inter canthal distances measurements were compared between males and females. All measurements are given in centimeters. Some of the variables have equivalent proportions between the sexes

Table 1: Anthropometry variation pattern with advancing age of the canthal parameter in male and female subjects in different age groups in Igbos of South Eastern Nigeria

Age (years)	Sex	Inner canthal distance	Outer canthal distance
7-9	Male	3.20±0.38 ^A	9.79±0.39
	Female	3.39±0.37 ^A	9.87±0.47
10-12	Male	3.60±0.46	10.31±0.54
	Female	3.55±0.31	10.29±0.38
13-15	Male	3.82±0.41	10.71±0.63
	Female	3.80±0.37	10.82±0.44
16-18	Male	3.81±0.44	11.15±0.47
	Female	3.82±0.30	11.08±0.30
19-21	Male	3.83±0.41	11.15±0.55 ^F
	Female	3.86±0.27	10.91±0.36 ^F
22-24	Male	3.87±0.24 ^B	11.18±0.20
	Female	3.72±0.31 ^B	11.21±0.34
25-27	Male	4.03±0.35	11.75±0.56 ^G
	Female	3.97±0.24	11.22±0.30 ^G
28-30	Male	4.06±0.24 ^C	11.40±0.33
	Female	3.89±0.25 ^C	11.30±0.28
31-40	Male	4.03±0.29 ^D	11.37±0.31 ^H
	Female	3.90±0.13 ^D	11.22±0.20 ^H
7-40	Male	3.81±0.44 ^E	11.03±0.76 ^I
	Female	3.74±0.34 ^E	10.90±0.60 ^I

Values with similar alphabetical superscript are significant at p<0.05

while others appear to be sexually dimorphic relative to the age group. Statistical analysis was carried out using SPSS version 16.

The overall inner canthal distance value irrespective of age (7-40 years) in males was 3.81±0.44 cm while in females it was 3.74±0.34 cm. this value was significantly higher in males than in females (Table 1). An increasing value of inner inter canthal value with advancing age was observed which is statistically significant (p<0.05). The inner canthal distance increased significantly in males from 3.20±0.38 cm at age group 7-9 years old to 4.06±0.56

cm at 28-30 years old (Table 1) while in females similar pattern of increase was noted but maximum value of 3.97 ± 0.25 cm for the inner canthal distance was observed at age group 25-27 years old (Table 1). The difference between males and females values at each age group stage was significant in groups 7-9, 22-24, 28-30 and 31-40 years (Table 1). In each of these instances, the proportion of the inner canthal distance was greater in males than in females except in the 7-9 years age group.

The outer canthal distance increased significantly in males from 9.79 ± 0.39 cm at subgroup 7-9 years old to 11.75 ± 0.56 cm at 25-27 years old (Table 1). Similar pattern of increase was noted in females but the value increased from 9.87 ± 0.47 cm to a maximum value of 11.30 ± 0.28 cm for the outer canthal distance which was observed at age group 28-30 years old (Table 1). For the overall group in this study irrespective of age the mean outer canthal distance was significantly higher in males than in females ($p < 0.05$). When the values of males were compared with the values of females from similar age group, there was significant sexual dimorphism observed in age groups 19-21, 25-27 and 31-40 years. In all the significant increased values recorded, the mean values for males are higher than the values recorded for females.

DISCUSSION

This study is focused on the anthropometrical measurements of the inter canthal distances of the Igbo of south eastern Nigerian. Subjects chosen were those that have no apparent abnormal morphological features and no genetic defects affecting the facial region. The research was tilted towards identifying the effect of age on the average canthal distances of the Igbo ethnic group. These data are useful in the diagnosis of most anomalies like ocular adnexal changes and somatometric traits of the face such as epicanthus, telecanthus, widely spaced eyebrows and blepharophimosis which affects the facial region.

In this study, we revealed that aging affects the rate of growth of the inter canthal distances. For subjects between 7-9 and 13-15 years old age groups, the inner canthal distance lengthened by 6.2 mm in males and in females 4.1 mm while the outer canthal distance increased by 9.2 mm in males and in females 9.5 mm. For ages between 16-18 and 22-24 years old group, the inner canthal distance gradually lengthened further by 0.6 mm in males while in females it gradually shortened by 1.0 mm while in the outer canthal distance value the male value shortened by 0.3 mm while female value

further lengthened slightly by 1.3 mm. For ages between 25-27 and 31-40 years old, the inner canthal distance gradually shortened by 0.7 mm in females while in males the values did not change while in the outer canthal distance value the male value shortened by 3.8 mm while female value remain the same.

The average maximum total increment for inner canthal width achieved between the 7-9 years old children and the 28-30 years adults where the maximum value was noted is 8.6 mm in males and 5.8 mm in the 25-27 years old adult females. The increment was higher in males than in females though females attained maximum value earlier than males. On the other hand, the outer canthal distance showed significantly greater increments with advancing age from 7-9 years through 25-27 years old and the values were 19.6 mm for males and in females 14.3 mm increment was observed although maximum value was noted in the 28-30 years old group. Evereklioglu *et al.* (2002) tried to evaluate norms and demonstrate anthropometric variations in inner and outer canthal distances with advancing age and sex in urban Turkish subjects. The average total increments for inner canthal width achieved between ages 7 and 25 years for the Turks were 2.8 mm in males and 2.2 mm in females. On the other hand, the outer canthal width showed significantly greater increments with advancing age from 7 through 25 years and the values were 7.5 mm for males and 5.3 mm for females, these values are lower than the reported values for the Igbo.

Farkas *et al.* (1992a) measured the intercanthal width (inner canthal distance) and biocular width (outer canthal distance) of 1,594 North American Caucasians. The subjects were between the ages of 1 and 18 years and equally divided between males and females. They recorded a total growth of 5.2 mm in intercanthal width and 12.5 mm in biocular width which was achieved between ages 1 and 18 years. At 1 year of age, they found out that the degree of development of the intercanthal width reached 84.1% and that of the biocular width reached 85.9% of adult dimensions in both sexes. According to their report, the levels of growth achieved by 5 years of age rose to 93.3% in the intercanthal width and 88.1% in the biocular width in both sexes but the intercanthal width showed little growth after 1 year of age; while in contrast, the biocular width showed significantly greater growth increments both before and after 5 years of age. According to them, rapid growth was observed between 3 and 4 years in the intercanthal width of both sexes but in the Igbo rapid growth was observed between 7-15 years old, although in these cross-sectional studies the age ranges varies. The growth observed in the outer

canthal distance for the Igbos is also higher than the biocular width reported by Farkas *et al.* (1992b) for the North American Caucasians.

The Inner canthal distance and Outer canthal distance of the Igbos decreased at the 31 to 40 years group in both male and female when compared to the 28-30 years old group. We attribute the decrease of the Inner canthal distance width to the progressive “drooping” of the eyelids with age (Ferrario *et al.*, 2001). We further assumed that this horizontal decrease in the Outer canthal distance actually reflects an oblique (downward-and-medial) “sagging” of the outer canthus with age (Jack Hou, 2006). Ferrario *et al.* (2001) also found a significant effect of age on the inclination of the eyes. Their study confirmed the downward-and-medial movements of the outer canthi which might have caused the reduction noted as the Igbos aged.

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 10.04 cm for the first age group (2 1/2 to 6 years), 10.65 cm for the second age group (7 to 10 years), 11.17 cm for the third age group (11 to 14 years) and 11.85 cm for the fourth age group (15 to 18 years). Their value is almost similar to the reported value for the Igbos in the study.

Goel *et al.* (1987) conducted an anthropometric assessment of inner canthal and outer orbital dimensions with the aim of establishing a normal range. The study comprises of 750 normal looking children of both sexes, of Meerut region who were divided into 15 groups. The first group had children up to 1 month, then 1 month-1 year, 1-2 years and so on to 13-14 years, respectively. Their inner canthal distance and Outer Orbital Distance (OOD) were measured with a modified vernier calliper and the normal range of each, for different age-groups were defined. They reported that the mean value of ICD and OOD observed during the first month of life were 2.14 and 7.04 cm, respectively and by 13-14 years of age the values were 3.14 and 11.11 cm, respectively. They reported that the mean levels of ICD and OOD are similar in males and females unlike in the Igbos.

It has been revealed that canthal values vary with age and tend to become constant in the mid to late twenties (Fledalius and Stubgaard, 1986). This was consistent with the reported values for the Igbos since the increase from the 7-9 years old to a maximum value at the 28-30 years old in males and in females it was noted in the 25-27 years old. Although this is contrary to the reported studies of Farkas *et al.* (1992a) who revealed that the intercanthal width and biocular width

(bi-Exocanthion) of North American Caucasians subjects reached adult size by 8 years in females and 11 years in males and the biocular width by 13 years in females and 15 years in males.

CONCLUSION

This study in a minute way has demonstrated that aging affects the growth rate of the canthal distances. It is obvious that as the Igbos advance in age, there was age-progressive increase in the growth rate of the canthal distances which gradually reduces as they attain adulthood. This study has also generated normative values for inner canthal distance and outer canthal distance of the Igbos of south-eastern Nigeria for the various age groups 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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