



## Inter: Ethnic comparison of canthal dimensions between ibibios and ijaws in Nigeria

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### Abstract

Canthal index is an important component of craniofacial anthropometry with no universal normative value. It varies greatly among individuals and most especially across ethnic groups. This study was aimed at comparing the canthal index between the Ibibio and Ijaw populations of Nigeria. Four hundred (400) adult participants with ages ranging from 19-31 years were included in the study. Two hundred (200) participants consisting of 100 males and 100 females were randomly selected from the Ibibio and Ijaw ethnic groups of Akwalbom and Bayelsa states, respectively, in Nigeria. A digital Vernier caliper was used to measure the inner and outer canthal distances and the canthal index was calculated from the values obtained. The results showed that Ibibio males and females had inner canthal distance of  $3.49 \pm 0.05$ cm and  $3.36 \pm 0.03$ cm; outer canthal distance of  $10.34 \pm 0.22$ cm and  $10.06 \pm 0.15$ cm, and mean canthal index of  $33.77 \pm 0.83$  and  $33.42 \pm 0.54$ , respectively. The Ijaw males and females had inner canthal distance of  $3.85 \pm 0.12$ cm and  $3.69 \pm 0.16$ cm; outer canthal distance of  $11.09 \pm 0.16$ cm and  $10.92 \pm 0.42$ cm, and mean canthal index of  $34.73 \pm 1.02$  and  $33.71 \pm 0.73$ , respectively. Using z-test ( $p < 0.05$ ), it was observed that the canthal index of the Ijaw males and females was significantly larger than that of the Ibibio males and females. Within the ethnic groups, sexual dimorphism was expressed for inner and outer canthal distances as well as the canthal index. The findings of this study will be of significance in physical anthropology and clinical medicine most especially in craniofacial surgery.

**Keywords:** outer canthal distance, inner canthal distance, canthal index, ibibio, ijaw, Nigeria

### Introduction

Canthal index is one very variable craniofacial parameter as there is no universal normative value (Yasas *et al.*, 2013<sup>[20]</sup>; Majumdar *et al.*, 2015<sup>[8]</sup>; Usman and Shugaba, 2015)<sup>[19]</sup>. Even among different ethnic groups of the same country, there are marked differences. Consequently, occurrence of ocular malformations such as telecanthus or hyper telorism is thus measured against the inner canthal distance compared with the outer canthal distance of that ethnic group (Ligha and Fawehinmi, 2011<sup>[6, 7]</sup>; Yasas *et al.* 2013)<sup>[20]</sup>. Thus, diagnosis of quantitative anomalies such as hyper telorism requires an objective definition of abnormal phenotype and a good knowledge of the normal variation of the trait in a given ethnic background at a certain age (Azeem *et al.*, 2010)<sup>[3]</sup>. Canthal index is a facial biometric parameter that is useful in medical genetics such as enhancing the clinician's accurate description of their diagnosis since many syndromes presented at birth usually involve the head and face (Nzeako *et al.*, 2017)<sup>[9]</sup>. In addition, knowledge of inner and outer canthal distances is important in orthodontics, for example, in the manufacture of spectacles, goggles, etc. by formulating standardized sizes (Oladipo *et al.*, 2010<sup>[15]</sup>; Anibor *et al.*, 2014<sup>[2]</sup>; Nzeako *et al.*, 2017)<sup>[9]</sup>. It could also guide surgeons in facial reconstruction of craniofacial abnormalities or surgical treatment of post-traumatic telecanthus (Yasas *et al.*, 2013)<sup>[20]</sup>. It has become common knowledge due to the vast researches carried out that people with different genetic backgrounds have different craniofacial morphology because they are subjected to significantly different environmental influences (Elzaki *et al.*, 2015<sup>[5]</sup>; Oladipo *et al.*, 2017)<sup>[11]</sup>. Therefore, findings from one

ethnic group cannot be applied to another due to the observed differences in craniofacial norms for different human populations, gender and ages (Elzaki *et al.*, 2015)<sup>[5]</sup>. Ultimately, a clear knowledge of craniofacial dimensions such as canthal index would give more valuable description of dysmorphic physical findings, because medical conditions such as low set ears, widely spaced eyes and nipples are no longer accepted unless accurate measurements accompany such claims (Omotande, 1990)<sup>[16]</sup>. Previous studies on various ethnic groups in Nigeria reported that Urhobo males have a canthal index of 24.38 and the females have a canthal index of 29.38 while the canthal index of Itsekiri males and females were 26.03 and 27.07, respectively (Oladipo *et al.*, 2009). According to Oladipo *et al.* (2011)<sup>[11]</sup>, inner canthal distance of the Ibibio males and females were 3.52cm and 3.36cm, respectively while the outer canthal index were 11.15 for male Ibibios and 10.73 for the females. The mean canthal index for both males and females were reported to be 31.64 and 31.47 respectively. Similar research on Ikwerre school children in Nigeria found that the mean inner and outer canthal index for males were 3.39 and 9.11 with a mean canthal index of 37.00 whereas mean values for female participants were found to be 3.38cm for inner canthal index (Oladipo *et al.*, (2013)<sup>[12]</sup>. These values as reported were seen to be sexually dimorphic. Canthal index and its associated measurements have been reported to increase with increasing age, however this increase gradually becomes stable from the early twenties to mid-twenties (Azeem *et al.*, 2010<sup>[3]</sup>; Anibor *et al.*, 2014<sup>[2]</sup>; Oladipo *et al.*, 2017)<sup>[14]</sup>. Also, males have been reported to have a higher canthal index

than females. These variations of canthal index within and between different populations have been attributed to environmental and genetic factors (Jaja *et al.*, 2011<sup>[6]</sup>; Anibor *et al.*, 2014<sup>[2]</sup>; Eboh *et al.*, 2015)<sup>[4]</sup>. The reported variations in the inner and outer canthal distances as well as the changes in the canthal index in relation to age, sex and among different populations necessitated the current investigation into the inter-ethnic comparison of the canthal index between the Ibibio and the Ijaw sub-populations in the south-south geo-political zone of Nigeria.

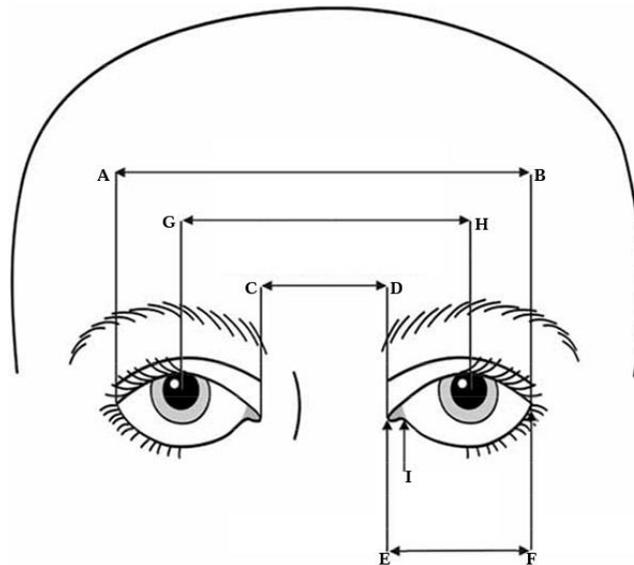
### Materials and Methods

The study consisted of 400 randomly selected participants between the ages of 19 and 31 years. Out of this total number of participants 200 were from each ethnic community to represent the Ibibio and the Ijaw sub-populations in Nigeria. Male and female volunteers were chosen in equal sample size of 100 each and these were noted to be direct descendants from parents and grandparents who were also of the same ethnic group. The study and measurement techniques were clearly explained to the participants and informed consent was obtained before measurements were taken. Individuals with craniofacial defects were excluded from the study. The inner and outer canthal distances were measured using a digital Vernier caliper (a product

of Voolita-Guangzhou Technology Co. Ltd., Guangdong, China). Inner canthal distance was measured as the distance from one endocanthion to another. Outer canthal distance was taken as the distance from one exo canthion to another (Fig. 1). The participant was made to sit upright in a chair with the head at the same level as the examiner. The participant was also made to look straight at the examiner before the inner canthal distance measurement was made. The outer canthal distance measurement required the subject to maintain the head straight but with the eyes looking upward. This was done to maximize the contrast between the sclera of the eye and the skin (Oladipo *et al.*, 2011<sup>[13]</sup>; Osunwoke *et al.*, 2012<sup>[18]</sup>; Adhikari *et al.* 2016<sup>[11]</sup>; Nzeako *et al.*, 2017)<sup>[9]</sup>. To minimize errors, the average of two measurements for each parameter from a participant was used for analysis.

Canthal index was calculated as: 
$$\frac{\text{inner canthal distance}}{\text{outer canthal distance}} \times 100$$

The data obtained were analyzed using Excel Data Analysis Tool pak (2010 version). Descriptive statistics, including mean  $\pm$  standard deviation were calculated. Z-test was applied to test for the significance of differences in the means, with p-value of less than or equal to 0.05 considered to be statistically significant.



**Fig 1:** Schematic drawing with some facial parameters. A-B= Outer Canthal Distance; C-D= Inner Canthal Distance; E= Inner Canthus; F= Outer Canthus; E-F= Palpebral Fissure length; G-H= Inter pupillary Distance; I= Lacrimal Punctum (Source: National Human Genome Research Institute, 2009).

### Results

The results of the study are presented in the tables 1-3. Table 1 summarizes the descriptive statistics of the mean values of the inner canthal distance (ICD), outer canthal distance (OCD), and Canthal Index (CI). The average age of the participants in the study was about 24 years. The Ibibio males had a mean inner canthal distance of  $3.49 \pm 0.05$  cm; mean outer canthal distance of  $10.34 \pm 0.22$  cm, with CI of 33.77. The Ijaw males had a mean ICD of  $3.85 \pm 0.12$  cm; the mean OCD of  $11.09 \pm 0.16$  cm with the CI at 34.73. The mean values for the ICD, OCD and CI derived from the females from the two ethnic groups were similar but relatively lower than those of the males (Table 1). Tables 2 and 3 compared

the results between male and female participants of both populations, respectively using Z-test analysis. It was found that a significant difference exists in the measured variables between males or females from the two study populations. The Ijaw males and females also had significantly higher values in the measured parameters and as well as the canthal index when compared to the Ibibio males and females.

The results from analyses of the mean values from male and female participants of each population are shown in table 4. The analysis showed that the both the Ijaw males and females had Z-values of inner and outer canthal distances that were closer to the critical value of 1.96 compared to the values from the Ibibio

males and females. Table 5 compared the values gotten from the present study with those reported by other researchers in different populations across Nigeria. The results inner and outer canthal

distances and canthal index were all within the same range except in the two studies where the sample population included children as low as three years of age.

**Table 1:** Summary of the mean ± standard deviation of the inner canthal distance, outer canthal distance and canthal index for Ibibio and Ijaw volunteers in Nigeria

Ethnic group	Sample size	Sex	Mean age (years)	Inner Canthal Distance (cm)	Outer Canthal Distance (cm)	Canthal Index
Ibibio	100	Male	24.45	3.49±0.05	10.3±0.22	33.77±0.83
	100	Female	24.12	3.36±0.03	10.06±0.15	33.42±0.54
Ijaw	100	Male	24.05	3.85±0.12	11.09±0.16	34.73±1.02
	100	Female	24.46	3.69±0.16	10.92±0.42	33.71±0.73

**Table 2:** Z-test results comparing the Ibibio and Ijaw males

Variables	Population		Z-calculated
	Ibibio	Ijaw	
ICD	3.49±0.05cm	3.85±0.12cm	28.0*
OCD	10.34±0.22cm	11.09±0.16cm	27.8*
CI	33.77±0.83	34.73±1.02	7.3*

\*Values are significant at p=0.05; critical value 1.96

**Table 3:** Z-test results comparing the Ibibio and Ijaw females

Variables	Population		Z-calculated
	Ibibio	Ijaw	
ICD	3.36±0.03cm	3.39±0.16cm	19.20*
OCD	10.06±0.15cm	10.92±0.42cm	19.13*
CI	33.42±0.54	33.71±0.73	3.21*

\*Values are significant at p=0.05; critical value 1.96

**Table 4:** Z-test results showing statistical relationship between males and females

Population	Variables	Gender		Z-calculated
		Male	Female	
Ibibio Ijaw	ICD	3.49±0.05cm 3.85±0.12cm	3.36±0.03cm 3.39±0.16cm	23.80* 7.64*
Ibibio Ijaw	OCD	10.34±0.22cm 11.09±0.16cm	10.06±0.15cm 10.92±0.42cm	10.44* 3.71*
Ibibio Ijaw	CI	33.77±0.83 34.73±1.02	33.42±0.54 33.71±0.73	3.53* 8.11*

\*Values are significant at p=0.05; critical value 1.96.

**Table 5:** Comparison of inner canthal distances, outer canthal distance and canthal index of this study with other populations

Author	Population	Age (Years)	Sample Size	Gender	ICD (cm)	OCD (cm)	CI
Oladipo <i>et al.</i> , 2018 <sup>[10]</sup>	Ogoni	18-70	382	Male Female	3.56±0.30 3.47±0.26	12.53±0.49 12.39±0.55	28.41±1.79 28.15±1.83
Oladipo <i>et al.</i> , 2017 <sup>[11]</sup>	Ijaw	3-18*	801	Male Female	2.80±0.24 2.75±0.32	9.26±0.73 9.15±0.68	30.32±0.31 30.01±1.07
Nzeako <i>et al.</i> , 2017 <sup>[9]</sup>	Delta	21-35	1000	Male Female	3.41±0.4 3.36±0.4	11.29±0.9 11.06±0.9	30.93±3.30 30.37±2.88
Anibor <i>et al.</i> , 2014 <sup>[2]</sup>	Isoko	12-35	600	Male Female	3.70±0.19 3.46±2.24	10.61±0.37 10.71±0.29	35.58±0.96 34.64±0.83
Osunwoke <i>et al.</i> , 2012 <sup>[18]</sup>	Ijaw	3-21*	1000	Male Female	2.83±0.42 2.81±0.28	9.25±0.63 9.19±0.58	30.94±2.23 30.59±1.12
Oladipo <i>et al.</i> , 2011 <sup>[13]</sup>	Ibibio	18-58	800	Male Female	3.52±0.27 3.36±0.30	11.15±0.51 10.73±0.63	31.64±2.57 31.47±4.52
Oladipo <i>et al.</i> , 2010 <sup>[15]</sup>	Bayelsa	18-65	1000	Male Female	3.89±0.26 3.73±0.26	10.76±0.38 10.45±0.32	35.92±1.70 35.59±1.73
Osunwoke <i>et al.</i> , 2010 <sup>[17]</sup>	Igbo	23-42	1000	Male Female	3.67±0.37 3.68±0.49	10.20±0.44 10.20±0.45	36.72±3.65 36.75±4.90
Present study, 2019	Ibibio	19-30	200	Male Female	3.49±0.05 3.36±0.03	10.34±0.22 10.06±0.15	33.77±0.83 33.42±0.54
Present study, 2019	Ibibio	19-31	200	Male Female	3.85±0.12 3.69±0.16	11.09±0.16 10.92±0.42	34.73±1.02 33.71±0.73

ICD = Inner Canthal Distance, OCD = Outer Canthal Distance, CI = Canthal Index.

\* Sample population with age range including children aged three years.

**Discussion**

The results obtained from the study showed that there are statistically significant differences in the inner canthal distance, outer canthal distance, and canthal index between the Ibibio and Ijaws of south-southern Nigeria, with the later having higher mean values for both the males and females. These observed variations could be due to genetic influence and environmental factors. The mean values obtained for inner and outer canthal distances and canthal index of the Ibibio are comparable to the values obtained by Oladipo *et al.* (2011) <sup>[13]</sup>. Who reported the

inner canthal distance of 3.52±0.27 cm and 3.36±0.30 cm; outer canthal distance of 11.15± 0.51cm and 10.73±0.63cm and the canthal index of 31.64 and 31.47 for the male and female Ibibios, respectively.

The inner canthal values recorded from the Ibibio males and females at 3.49±0.05cm and 3.36±0.03cm are similar with those of another South-southern Nigerian population reported by Nzeako *et al.* (2017) <sup>[9]</sup>, with a mean inner canthal distance of 3.41±0.4cm and 3.36±0.4, from the males and females respectively. However, both the outer canthal distance and

canthal index from these two Nigerian ethnic groups are dissimilar. This implies that although certain parameters may seem equal in two different subpopulations, it is always safer or accurate to bring in all parameters into analysis and comparison before a conclusion is drawn, especially if the values will be applied in various fields of anthropology.

Further analysis shows that the mean values of the inner and outer canthal distances of the Ijaws are closely related to those reported by Oladipo *et al.* (2010) <sup>[15]</sup>, where the inner canthal distance of male and female were  $3.89 \pm 0.26$  cm and  $3.73 \pm 0.26$  cm; outer canthal distance of  $10.76 \pm 0.38$  and  $10.45 \pm 0.32$  cm, respectively among the same Ijaw ethnic group. It is worthy of note that these values given by Oladipo *et al.* (2010) <sup>[15]</sup>, are higher than what were reported by Oladipo *et al.* (2017) <sup>[11]</sup>, and Osunwoke *et al.* (2012) <sup>[18]</sup> from the same Ijaw ethnic group. This could be as a result of differences in the ages of the sample population utilized for each study.

When the values are tested for males and females of the same subpopulation, it is observed that sexual dimorphism is expressed. In both the Ibibio and Ijaw ethnic groups the males have higher values for the inner and outer canthal distances as well as in the canthal index. Anibor *et al.* (2014) <sup>[2]</sup>, and Oladipo *et al.* (2013) <sup>[12]</sup>, in their studies also report that males generally have higher canthal values.

It is observed from the present study that the canthal index alone is not an absolute representation of ocular dimensions of a given population without the associated inner and outer canthal distances. This is because, though the inner canthal and outer canthal distances may be different from different populations, the canthal index may remain the same. This implies that if only canthal index is reported for a given population, there is the tendency for them to have closely related values which will give the impression that the facial dimensions are either the same or similar. The final conclusion may not be the case when both inner and outer canthal measurements are reported along with the value for the canthal index for each population.

The results from this study shows that an individual having a relatively 'broad face' does not automatically translate to high canthal index neither does a person having a 'narrow face' translate that such an individual has a low canthal index. Thus, appropriate measurements should accompany such claims at all times. In addition, there is no sequence of values that are obtained in that the values of a particular individual did not necessarily affect the next subject even though both may be from the same ancestry or of geographical location. Thus, the values derived from a particular person cannot be used to estimate that of the other though they may be siblings.

In conclusion, it can be stated that the adults of the Ijaw and Ibibio ethnic groups in South-southern Nigeria have significantly different dimensions of the inner and outer canthal distances, and canthal index. In addition, the Ijaws tended to have higher values of these measurements when compared to the Ibibio people.

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