

# Facial Analysis of the Igbo Ethnic Group of Nigeria for the Evaluation of Sexual Dimorphism

## ABSTRACT

**Background:** Facial analysis defines the measurement of soft tissue in the face used in forensics, anthropology, artistic design, and facial reconstruction. The study aims to evaluate the sexual differences in facial parameters among the Igbo ethnic group of Nigeria.

**Methods:** 400 (200 males and 200 females) subjects of Igbo origin volunteered for the study. Each subject's frontal view photographs were taken in the Natural Head Position (NHP) and analyzed using Pro-Image Facial Software Version 2 to evaluate the nasal width, nasal height, mouth width, facial width, facial height, inner canthal distance, and outer canthal distance. Data obtained were analyzed with IBM SPSS (version 23) and independent T-test as an inferential statistic

**Results:** The result showed that NW was ( $M=5.16\pm 0.65$ ,  $F=5.34\pm 0.53$ ,  $t=-2.91$ ,  $p=0.00$ ), NH was ( $M=5.61\pm 0.62$ ,  $F=5.26\pm 0.57$ ,  $t=5.92$ ,  $p=0.00$ ), MW was ( $M=6.64\pm 0.7$ ,  $F=6.54\pm 0.71$ ,  $t=1.46$ ,  $p=0.14$ ), FW was ( $M=16.17\pm 1.31$ ,  $F=15.07\pm 2.04$ ,  $t=6.39$ ,  $p=0.00$ ), FH was ( $M=16.63\pm 1.11$ ,  $F=16.08\pm 1.31$ ,  $t=4.36$ ,  $p=0.00$ ), En was ( $M=4.62\pm 0.46$ ,  $F=4.31\pm 0.47$ ,  $t=6.75$ ,  $p=0.00$ ) and Ex was ( $M=12.23\pm 0.86$ ,  $F=12.16\pm 1.01$ ,  $t=0.82$ ,  $p=0.41$ ).

**Conclusion:** The nasal width and Height, facial width and height, and inner canthal distance show gender differences among the Igbo ethnic group of Nigeria. This study will have a practical application in Forensics, Anthropology, Artistic and Industrial design, and to medical professionals involved in facial reconstruction.

**Keywords:** facial analysis, soft tissue, Forensics, Anthropology, Igbo, Nigeria

## 1.0 Introduction

Facial analysis defines the measurement of soft tissue in the face used in various disciplines such as forensics, facial reconstruction, anthropology, and population studies [1]. The soft cutaneous tissue of the face such as mouth width, nasal height and width, canthal distances, and facial width and height has been a point of interest because the role of the hard tissue (skeletal structures) is an accepted fact that influences facial form but the soft tissue bears the covering which forms the external surface of the face that is made up of integument, adipose tissue, connective tissue, and muscles [2]. This constituent of the soft tissue does not always distribute itself in a uniform orderly manner in every individual and has led to greater variations in the amount and distribution. However, studies show that the predisposition of this constituent of the soft tissue and facial features in general is influenced by genetic, diet, and environmental factors which in turn has made it difficult to establish a defined difference in sex in a population [3].

In Forensics and anthropology, there is a need to establish the sexual differences in the facial parameters to aid in identification and classification when necessary [4]. However, reference data abound in our communities, but diet and environmental changes have been observed to alter the facial morphology of an individual [4,5] therefore, it is necessary to evaluate facial anthropometry continuously to remain current and have relevant data of the population. The need to establish sexual differences in facial parameters is not limited to Forensics and anthropology alone rather it will be valuable in artistic design such as face masks, nose braces [6], and so on, to pinpoint the areas of consideration also it will be value to all medical professionals involved in facial reconstruction. The importance of sexual differences in facial parameters in understanding ethnic diversity cannot be overemphasized [7].

Previous studies among Nigerian populations on nasal width, nasal height, mouth width, facial width, facial height inner and outer canthal distance have shown variations in their findings over time. [12, 15, 22, 24, 25, 26, 30, 32, 33, 35]. These variations have motivated the interest of this study to aim at evaluating the sexual differences in facial parameters among the Igbo ethnic group of Nigeria.

The Igbo ethnic group is one of the largest and most culturally diverse ethnic groups in Nigeria [8]. They primarily inhabit the southeastern region of Nigeria, which includes states such as Anambra, Enugu, Imo, Abia, and Ebonyi [9]. The Igbo people have a rich cultural heritage, with a language called Igbo (or Ibo) as their primary means of communication. Igbo society is known

for its strong sense of community and family ties [10]. Their social structure is often organized around extended families and clans, with a focus on communal values and traditional customs. The impacts of climate change in the region are diverse and can have far-reaching consequences for the environment, agriculture, and overall livelihoods of the Igbo people [11].

## **2.0 Materials and Method**

### **2.1 Study Design**

The study adopted a cross-sectional descriptive study design to generate values of the nasal width, nasal height, mouth width, facial width, facial height, inner canthal distance, and outer canthal distance of males and females of the Igbo ethnic group of Nigeria using anthropometric standards via photogrammetry. The study population comprised subjects drawn from Abia, Anambra, Enugu, Ebonyi, and Imo State of Nigeria, and Imo State University was used as the Study area.

### **2.2 Sample Techniques and Sample Size**

A multistage random sampling technique was adopted in the study to ensure that every respondent has an equal chance of being selected and the sample size was calculated using the Taro Yamane formula of the descriptive survey.

### **2.3 Study Criteria**

The study was limited to only subjects whose parents and grandparents are of Igbo origin and currently residing in Igbo land. Subjects who fit into the designed age interval of 18-41 years were selected and they must not have any facial deformity or have undergone any facial surgery. Subjects who did not meet these stated criteria were excluded from the study.

### **2.4 Photographic setup**

A descriptive questionnaire was administered to all respondents to obtain their socio-demographic variables. For facial capture, a digital camera (Nikon COOLPIX S2800, 20.1 megapixels, x5 zoom) was mounted on a tripod platform 120cm distant from a graphic board. To guarantee that the head was in a natural head position (NHP), a mirror was placed opposite the graphic board where the tripod was in between. All respondents were photographed in a calm

state with their heads in the natural head position (NHP), and the images were saved to a hard drive for picture analysis.

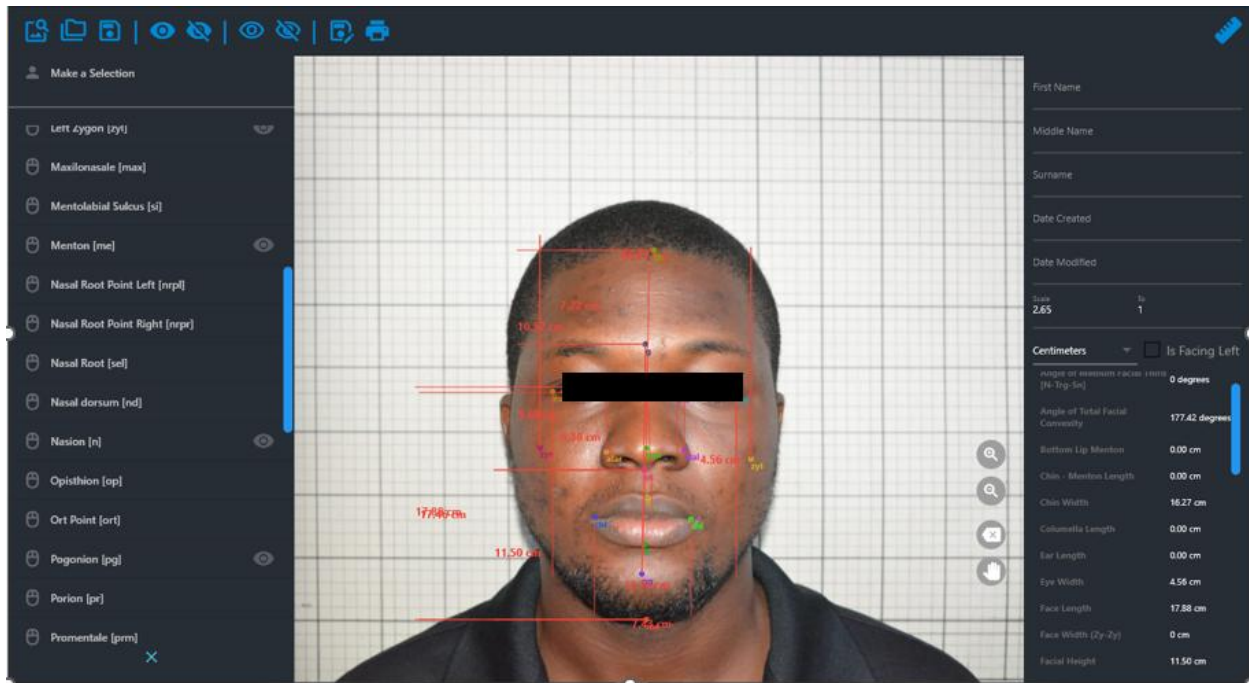


**Photographic set-up**

### **Figure 1. Photographic set-up**

#### **2.5 Photographic analysis**

The study made use of a digitalized photo analyzer, the WinImager developed by **Loveday et al. [36]** to measure the soft cutaneous points of the face and determine the value of various landmarks such as nasal width, nasal height, mouth width, facial width, facial height, inner canthal distance and outer canthal distance.



**Figure 2. Diagram showing photographic analysis**

## 2.6 Statistical analysis

The data were subjected to statistical analysis using the International Business Machines Statistical Package for Social Science (IBM SPSS version 23) for statistical analysis. Independent t-test was used as an inferential statistic to test for significance between sex. A probability less than 0.05 ( $P < 0.05$ ) was considered statistically significant.

## 3.0 Results

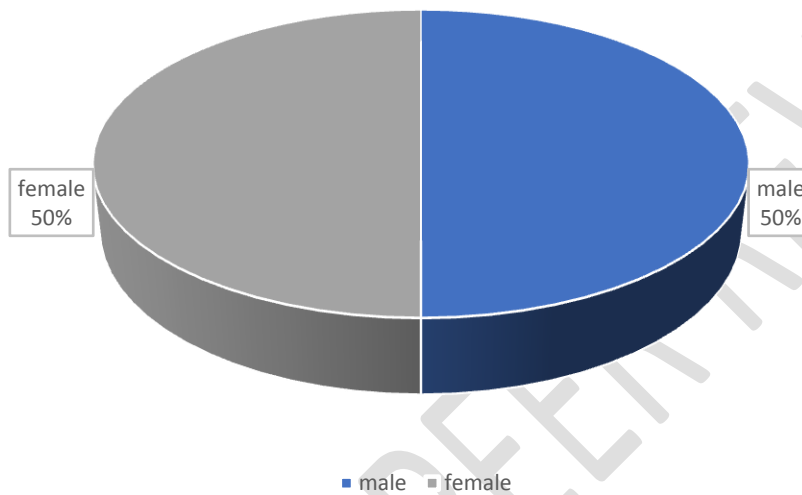
The study comprised four hundred respondents (200 males and 200 females) within the age interval of 18-40 years from the Igbo ethnic group of Nigeria. (figure1, 2).

**Table 1**, provides the descriptive statistics of the Igbo ethnic group of Nigeria, the mean $\pm$ SD for the age was 25.72 $\pm$ 3.26, nasal width was 5.25 $\pm$ 0.59, nasal height was 5.44 $\pm$ 0.62, mouth width was 6.59 $\pm$ 0.71, facial width was 15.62 $\pm$ 1.80, facial height was 16.62 $\pm$ 1.24, inner canthal distance was 4. $\pm$ 0.49, and outer canthal distance was 12.19 $\pm$ 0.93.

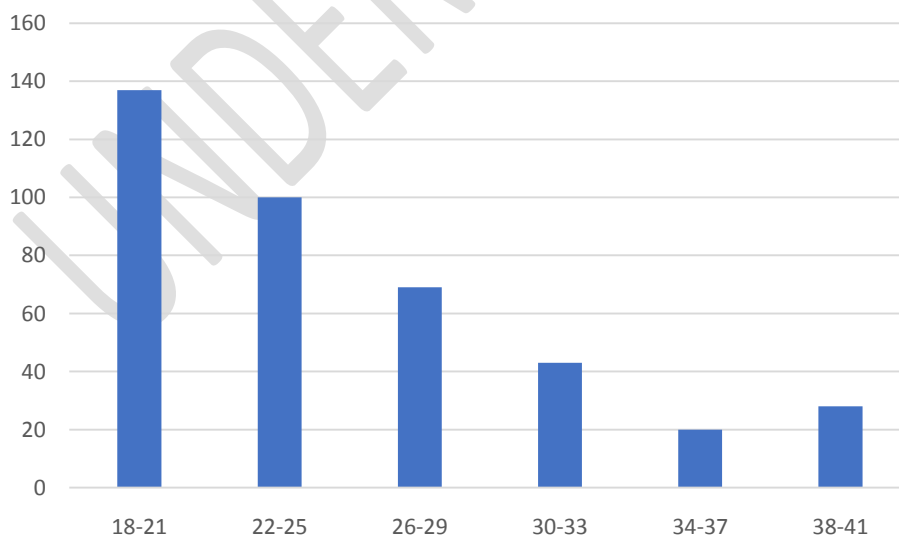
Sexual differences of some facial linear variables of the Igbo were presented in **Table2**.

The mean $\pm$ SD of nasal width showed a significant differences (M=5.16 $\pm$ 0.65, F=5.34 $\pm$ 0.53, t=-

2.91,  $p=0.00$ ), nasal height was also significant with gender ( $M=5.61\pm0.62$ ,  $F=5.26\pm0.57$ ,  $t=5.92$ ,  $p=0.00$ ), mouth width ( $M=6.64\pm0.7$ ,  $F=6.54\pm0.71$ ,  $t=1.46$ ,  $p=0.14$ ) it shows no gender difference but facial width ( $M=16.17\pm1.31$ ,  $F=15.07\pm2.04$ ,  $t=6.39$ ,  $p=0.00$ ), facial height ( $M=16.63\pm1.11$ ,  $F=16.08\pm1.31$ ,  $t=4.36$ ,  $p=0.00$ ), both facial width and facial height was statistically significant with gender. The inner canthal distance was evaluated ( $M=4.62\pm0.46$ ,  $F=4.31\pm0.47$ ,  $t=6.75$ ,  $p=0.00$ ) and was also significant so as outer canthal distance ( $M=12.23\pm0.86$ ,  $F=12.16\pm1.01$ ,  $t=0.82$ ,  $p=0.41$ ) and was non-significant with gender.



**Figure 3. Sex**



**Figure 4**The age interval

**Table 1** Descriptive Statistics for Igbo

Parameters	N	min	max	Mean	SEM	Std. Deviation
age	400	18.00	40.00	25.72	0.16	3.26
NW (cm)	400	3.86	6.92	5.25	0.03	0.59
NH (cm)	400	3.54	7.68	5.44	0.03	0.62
MW (cm)	400	3.78	9.37	6.59	0.04	0.71
FW (cm)	400	10.38	21.40	15.62	0.09	1.80
FH (cm)	400	11.80	21.36	16.36	0.06	1.24
En (cm)	400	3.04	6.10	4.47	0.02	0.49
Ex (cm)	400	10.18	15.24	12.19	0.05	0.93

*NW= nasal width, NH= nasal height, MW= mouth width, FW= facial width, FH= facial height, En= inner canthal distance, Ex= outer canthal distance,*

**Table 2, Compares the mean of Igbo facial linear measurements based on sex**

Parameters	male	female	t-score	p-value	Inference
NW (cm)	5.16±0.65	5.34±0.53	-2.91	0.00	S
NH (cm)	5.61±0.62	5.26±0.57	5.92	0.00	S
MW (cm)	6.64±0.70	6.54±0.71	1.46	0.14	NS
FW (cm)	16.17±1.31	15.07±2.04	6.39	0.00	S
FH (cm)	16.63±1.11	16.08±1.31	4.56	0.00	S
En (cm)	4.62±0.46	4.31±0.47	6.75	0.00	S
Ex (cm)	12.23±0.86	12.16±1.01	0.82	0.41	NS

*NW= nasal width, NH= nasal height, MW= mouth width, FW= facial width, FH= facial height, En= inner canthal distance, Ex= outer canthal distance, NS=Non-significant, S= significant,  $p<0.05$*

#### 4.0 Discussion

The present study evaluates the sexual differences of facial linear parameters among the Igbo ethnic group of Nigeria, where nasal width was 5.16±0.65 in males and females was 5.34±0.54. the nasal height in males was 5.61±0.62 and in females was 5.26±0.57. Our results have shown that males have a larger nasal height and a smaller nasal width compared to females, though it has been hypothesized that males have a larger nose because males tend to have more lean muscle mass than females which means males need more oxygen to encourage muscle growth and maintenance but in contrary, the size and shape of a nose vary among individuals and is influenced by various factors like;genetics, evolutionary and environmental factors. The hormonal factor is another key role that affects the size and shape of the human body, especially for females. The present findings have shown that nasal width and height had sexual differences among the Igbo ethnic group of Nigeria which is consistent with Mohammed et al., [12] in their study of nasal index among the Hausa ethnic group of Nigeria, that there are sexual differences in nasal width and height. Oladipo et al., [13] study in southern Nigeria stated that nasal width and height showed significant gender differences. The study by Agburun et al., [14] among the Ikwerres of Rivers State, Nigeria, also reported that there are sexual differences in nasal width and height among the Ikwerres population though Esomonu et al., [15] study among the Bekwara

ethnic group of Cross River State findings is inconsistent with the present study but our study has shown consistency with [16, 17, 18, 19].

In orthodontics, assessing the width of the mouth is crucial for diagnosing and treating issues related to malocclusion [20]. The present study evaluates the mouth width of the Igbo ethnic group of Nigeria and the result showed that males had a mean of  $6.64 \pm 0.70$  while females had  $6.54 \pm 0.71$  and the comparison shows no gender difference among the Igbo of Nigeria. The finding of the study disagrees with Benwoke et al., [21], Uche et al., [22] among Nigerians of Delta State extraction, and Houlton et al., [23] among southern Africans, that there are significant gender differences. The lack of a statistically significant difference in mouth width between males and females within the Igbo ethnic group suggests that, based on the sample studied, this particular facial characteristic does not exhibit gender-based distinctions. It's also important to note that the absence of statistical differences does not imply that there are no individual variations but rather the study focuses on the Igbo ethnic group of Nigeria.

The present study evaluates the facial width and height. The results showed that males have a larger facial height and width compared to females and the comparison has shown that there is a sexual difference. The findings agree with the notion that males have a higher facial height and width compared to females which first, is influenced by hormonal action that occurs during puberty. Males typically undergo a surge in testosterone during puberty which is possible to influence facial bone growth. On the other hand, genetic coding inherited from parents can also play a significant role and developmental factors such as nutrition, environment, and lifestyle attributes in facial growth. The present study agrees with Adelaja et al., [24] on the evaluation of facial index among the Igbo. In their report, they stated that there are sexual differences in facial width and height. Okwesili et al., [25] among the Igbo also reported sexual differences though Ese, [26] among the Ika ethnic group of Delta State reported that there is no gender difference in facial height, she further stated that facial width had a significant gender difference. Human may vary in their measurement due to many factors that can alter the human morphology. Jeremic et al., [27] study in central Serbia, and Yesmin et al., [28] among the Malay population have also reported in their works that there are significant sexual differences in facial width and height. Even a study carried out among university students of

Tehran University India by Dodangheh et al., [29] also reported that there are sexual differences in facial width and height.

The normative values of inner and outer canthal distance are very important for the successful reconstruction of the canthal area. The present study presents that the inner canthal distance of Igbomales was  $4.62 \pm 0.46$  and for females was  $4.31 \pm 0.47$  while the outer canthal distance for males was  $12.23 \pm 0.86$  and for females was  $12.16 \pm 1.01$ . The study further showed that inner canthal distance had a significant gender difference among the Igbo but outer canthal distance showed no gender difference. **males may have facial features that are perceived as more robust or larger compared to females due to hormonal and genetic factors. These differences can include a broader jaw, a more prominent brow ridge, and a larger nose** The finding of this study agrees with Oladipo et al., [30] study on the canthal index among the Ibibios, they reported that inner canthal distance showed gender difference and outer canthal distance showed no gender difference. Jaja et al., [31] in their study also reported that inner canthal distance is significant while outer canthal distance showed no gender difference among young Nigerians. A study carried out in India also agrees with the present study that inner canthal distance showed significant gender difference and outer canthal was insignificant. Even a study among the Isoko in Delta State, Nigeria also agrees with the present study that inner canthal distance had a significant gender difference and outer canthal had no gender difference. Though the present disagrees with a study by Eboh et al., [32] among the Urhobos, Nigeria. They reported that outer canthal distance had a significant gender difference. Osunwoke et al., [33] among Igbo also contradict the present study, they reported that inner canthal distance showed no gender difference, in 2012, Osunwoke et al., [34] study on inner and outer canthal distance among the Ijaws, their findings disagreed with the present study because they reported that outer canthal distance showed a significant gender difference. Oladipo et al., [35] also disagree with this study, they reported a significant gender difference among Ikwerre, Rivers State, Nigeria. The findings of this study further suggest that males have a higher inner canthal distance than females but there is no difference in outer canthal distance.

The above-discussed study has shown some similarities and differences in facial parameters among different ethnic groups and the difference could be attributed to ethnicity, race, methodology, and environmental factors.

## **5.0 Conclusion:**

The study has shown gender differences in nasal width and height, facial width and height, and inner canthal distances. The findings of the study will have a practical application in Forensics, Anthropology, Artistic and Industrial design, and to medical professionals involved in facial reconstruction.

## **CONSENT**

A written consent was issued to every subject to declare their consent to participate in this study as per University Standards.

## **ETHICAL APPROVAL**

The study was approved by the ethical research committee of the University of Port-Harcourt, Port-Harcourt, Nigeria.

## **ACKNOWLEDGEMENT**

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## **COMPETING INTERESTS**

The authors have declared that no competing interests exist.

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