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Original Article

Photogrammetric Evaluation of Some Normative Facial Indices of Young Adults of Igbo Ethnic Group, Nigeria

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Abstract

BACKGROUND AND AIM: Evaluation of facial indices (nasal, canthal, and facial index) has always been of great interest because of its use in forensic science, plastic surgery, orofacial surgery, and population studies. The study aims to evaluate the normative facial indices of young adults of the Igbo ethnic group of Nigeria.

METHOD: The study adopted a descriptive cross-sectional study design where 300 respondents participated in the study (150 males and 150 females) between the ages of 18 - 37 years with BMI of 18 – 29 were randomly selected. Subjects whose BMI fell within the category of slightly underweight (≤18.4) and slightly overweight (>24.9) according to conventional BMI classification, looked seemingly healthy and were included in the study. Minimum sample size was determined using the Cochran's formula. Linear facial parameters and facial indices were calculated using the standard formula, and data obtained were analyzed using IBM SPSS version 23. Continuous variables were presented as mean±SD. Age was grouped into 18-21, 22-25, 26-29, 30-33 and 34-37. Data was presented as mean ± standard deviation. Independent T-test was used to test for significance in the variables between genders, one way ANOVA was used to test for significance in age and variables. A probability less than 0.05 (P<0.05) was considered statistically significant.

RESULTS: Facial indices (canthal, nasal and facial index) were 37.67±5.14, 78.85±15.08 and 54.65±5.01 respectively among the males while among the females; 0.23±7.47, 61.26±12.44 and 46.22±14.04 respectively. The study parameters were found to be higher in males (p<0.05). The study analyzed respondents aged 18-21, 22-25, 26-29, 30-33 and 34-37 and found no significant association between canthal, nasal, and facial index and age. The Canthal index was higher in 22-25 years. nasal index values were higher in 34-37 years and facial index in ages 26-29 years.

CONCLUSION: Facial indices show significant sex differences and would serve as a reference to clinical anatomists and forensic anthropologists.

Keywords:
Facial indices; forensic science; Igbo; plastic surgery; orofacial surgery; population

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INTRODUCTION

Photogrammetry is a scientific method of obtaining reliable information and precise measurement of objects including humans through photographs (Yakar *et al*., 2022). The head and face measures termed craniofacial measurements have been an integral part of craniofacial surgery and syndromology. It is a physical and clinical anthropological approach that involves taking exact and systematic measurements of the human skull which also include measurement of inner canthal distance, outer canthal distance, nasal height, nasal width, facial height, and facial width. This linear facial measurement could be used to deduce some facial indices (facial, nasal, and canthal index) (Alshehhi *et al*., 2023).

The term canthus refers to either corner of the eyes. The medial section of the superior and inferior eyelids forms the inner canthus (medial or nasal canthus), while the lateral part of the superior and inferior eyelids forms the outer canthus (lateral or temporal canthus). The inner intercanthal distance (ICD) is the distance between the canthus of the eyes, whereas the outer canthal distance (OCD) is the distance between the canthus of the eyes (Alshehhi *et al*., 2023). Age, gender, race, and ethnicity all have an impact on canthal measures (Ma *et al*., 2019). Normal values of inner and outer canthal distances, canthal index serves as useful parameters

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in the evaluation and treatment of congenital or post traumatic deformities of the cephalic and facial regions such as telecanthus, occular hypotelorism and craniosynostosis (Radha and Srinivasan, 2021).

Nasal index in different races demonstrates its importance to climate, such that a narrow nose is observed in cold and dry conditions, but a flat or wide nose is observed in moist and warm locations, as a result of natural selection in human evolution (Phuong *et al*., 2020). Ethnic influences can cause noses to seem distinctive and come in a variety of shapes and sizes. The nasal index is a very valuable anthropometric characteristic that is acknowledged in nasal surgical and medical management. The nasal index (NI) is an important anthropometric characteristic for determining the race and gender of a person whose identification is unknown (Shrestha *et al*., 2019).

The facial index is calculated by multiplying the length of the face by the width of the face by 100. In comparative anthropology, it is frequently employed. Identification and racial morphological classification rely heavily on facial features (Nagpal *et al*., 2019). When used in conjunction with hand print patterns, facial indices serve as identifying tools for forensic and biometric reasons such as health insurance, voter identification cards, driver's licenses, and passports, among others. (The Facial Index (FI) is one of the commonest and reliable indices used in identification of the five types of faces namely; Hypereuryprosopic (FI: ≤ 79.9), Euryprosopic(FI: 80.0–84.9), Mesoprosopic (FI: 85.0–89.9), Leptoprosopic (FI: 90.0–94.9) and Hyperleptoprosopic (FI: ≥ 95.0). (Gallardo *et a*l., 2008; Trivedi *et al*., 2017; Novita, 2006; Dodangheh *et al*., 2018).

The anthropometry of facial indices abounds in our community but this study was inspired by the differences in body measurements across ethnicities and races, recognizing that these variations can change over time due to factors like environment, diet, genetics, and lifestyle. To keep findings about any population relevant, it is essential to continually assess these measurements in population studies. This study aimed at examining the facial indices of the Igbo ethnic group in Nigeria.

MATERIALS AND METHODS

Study design

The study adopted a cross-sectional descriptive study design to generate values of the facial indices of males and females of the Igbo ethnic group of Nigeria using photogrammetry and made use of a total number 300 subjects (150 males and 150 females) whose age ranged between 18 - 37 years. 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. Multi-stage random sampling techniques were used in the study and sample size was determined using the Cochran formula;

$$Sample\ size = \frac{Z_{1-\propto/2^2}\ p(1-p)}{d^2}$$

Where, $Z_{1-\propto/2}$ = Standard normal variate (at 5% type 1 error) = 1.96

p = expected proportion of respondents (130%)

d = absolute error = 0.05

$$Sample\ Size = \frac{1.96^2 \times 1.3(1-0.85)}{0.05^2} = 299.64$$

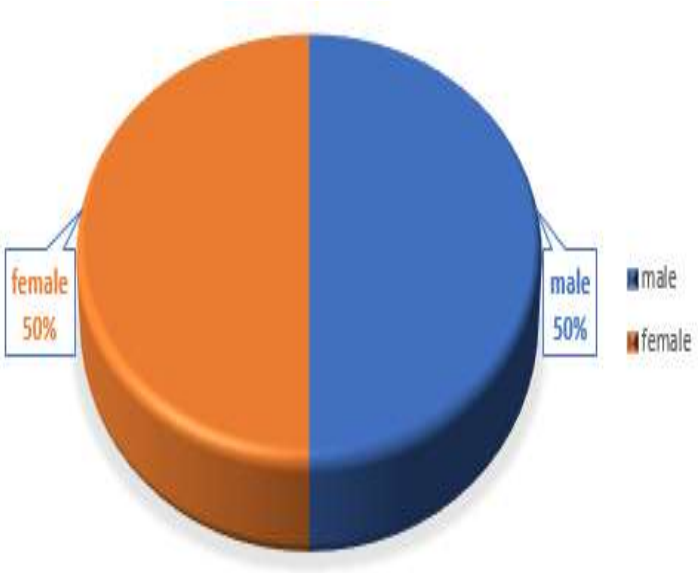

Fig. 1. Gender distribution

Study Criteria

The study was limited to only Igbo whose parents and grandparents are of Igbo origin within the designated age interval of 18-37 years. Subjects with any facial deformity or that had previously undergone any facial surgery were excluded from the study. Subjects whose BMI fell within the category of slightly underweight (≤18.4) and slightly overweight (>24.9) according to conventional BMI classification, looked seemingly healthy and were included in the study. Therefore, respondents within BMI range of 18 - 29 were selected.

Materials/ photographic setup

A descriptive questionnaire was administered to all respondents to obtain their age and parentage. For facial capture, a digital camera (Nikon COOLPIX S2800, 20.1 megapixels, x5 zoom) was mounted on a tripod platform 120 cm distant from a graphic board. The scales on the graphic board enabled measurement (Fig. 2). 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.

Plate 1: Photographic set-up/photography

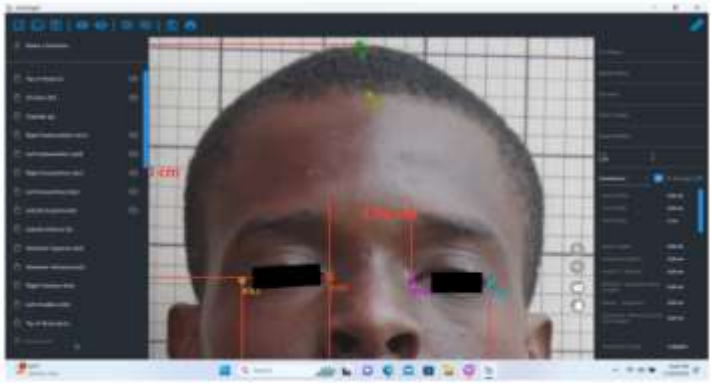

Fig. 2: Digitalisation - Measurement of facial parameters by computer analysis using WinImager® software

Photographic analysis

Photographs were transferred to a computer, and with the appropriate landmarks (Figs. 2), measurements were extracted with the aid of the software-tool for facial analysis, the WinImager version 2 developed by Oghenemavwe et al. (2010). The images captured by the digital camera were evaluated with the aid of the software tool transferred to spread sheet and databases on the computer screen generated values which were used as the result. The endo-canthal distance, exo-canthal distance, nasal width, nasal height, facial width and facial height were used to determine the canthal, nasal and facial indices thus:

$$canthal\ index = \frac{endocanthal\ distance}{exocanthal\ distance} x \frac{100}{1}$$

$$nasal\ index = \frac{nasal\ width}{nasal\ height} \times \frac{100}{1}$$

$$facial\ index = \frac{face\ width}{face\ height} x \frac{100}{1}$$

Statistical analysis

The data were subjected to statistical analysis using the International Business Machines Statistical Package for Social Science (IBM SPSS version 26) for statistical analysis. The result was presented as mean ± standard deviation. Independent T-test was used to test for significance in the variables between genders, one way ANOVA was used to test for significance in age and variables. A probability less than 0.05 ($P<0.05$) was considered statistically significant.

RESULTS

Table 1, illustrates the descriptive statistics of the anthropometric parameters, endocanthal distance was 3.48±0.57cm, exocanthal distance 9.02±1.01cm, canthal index, was 38.68±6.27, nasal width 3.57±0.06cm, nasal height 5.08±0.92cm, nasal index 72.17±16.49, face width 9.93±1.95cm, face height 18.41±2.27cm and face index 53.43±7.51.

In Table 2, the study explores the association of face indices with gender, our findings show that the canthal, nasal, and facial index were 37.67±5.14, 78.85±15.08 and 54.65±5.01 respectively among the males while the female was 40.23±7.47, 61.26±12.44, and 46.22±14.04 respectively. There was a significant difference ($p<0.05$) in the face indices.

Table 1. Descriptive statistics of anthropometric variables for both sexes

	Range		Mean
	Min.	Max.	
endocanthal distance (cm)	2.28	6.17	3.48±0.57
exocanthal distance (cm)	6.32	12.25	9.02±1.01
canthal index	26.76	85.21	38.68±6.27
nasal width (cm)	2.00	5.16	3.57±0.64
nasal height (cm)	3.29	8.06	5.08±0.92
nasal index	38.76	99.63	72.17±16.49
Facial width (cm)	10.19	13.65	9.93±.95
facial height (cm)	11.19	23.35	18.41±2.27
facial index	19.57	76.68	53.45±7.51

Table 2. Comparison of Anthropometric Variables based on sex

	sex	Mean±SD	T score	P value	inference
canthal index	male	37.67±5.14	-2.78	0.006	S
	female	40.23±7.47			
nasal index	male	78.85±15.08	7.58	0.00	S
	female	61.26±12.44			
facial index	male	54.65±5.01	3.89	0.00	S
	female	46.22±14.04			

"S" significant (P< 0.05)

DISCUSSION

Facial anthropometry is the study that deals with the measurement of the proportion, size as well as the shape of face of a human being, it has verse used by various disciplines such as forensics, facial surgeons, and physical anthropologists for identification, facial reconstruction, or industrial purpose (Sui *et al*., 2023). The present study evaluates the nasal, canthal, and facial index of young adults of the Igbos ethnic group of Nigeria. Our study showed that the male's nasal index was 78.85±15.08cm while the female's was 61.26±12.44cm and displayed gender difference in nasal index among the Igbos. This difference may stem from natural anatomical and physiological variations between genders. Generally, men tend to have broader noses and larger nasal openings, which aligns with findings in other populations. These variations can also be influenced by genetic, hormonal, and developmental factors that give men slightly larger facial structures, possibly supporting respiratory needs. Additionally, lifestyle and environmental factors unique to the Igbo population could also play a role in these nasal differences between genders. Our finding agrees with Oladipo *et al*. (2009) on nasal index among Adoni and Okrika ethnic groups of Rivers State also agrees with Oladipo *et al*.(2007) among major ethnic groups in Southern Nigeria. Esomonu *et al*. (2013) and Mohammed *et al*.(2018) among Bekwara ethnic, and Hausa ethnic, Nigeria respectively that there is a gender difference in the nasal index through Oladipo *et al*. (2009), Oladipo *et al*. (2007) and Esomonu *et al*. (2013) have reported in their study that platyrrhine type of nose was prevalence based on nasal index (nasal index above 85) but our study has contradicted with their finding that mesorrhine type of nose was predominate (nasal index within 70-84.90) and Staka et al. (2012) also agreed. Our findings also disagree with Sarun *et al*. (2014) of Tharu and Mongoloid population of Nepal and Ogah *et al*. (2014) that reported no gender difference in nasal index.

The canthal index in the present study shows that male has 37.67±5.14 while females have 40.23±7.47 and there was a significant gender difference among the Igbos ethnic group. Our findings agree with Oladipo *et al*. (2011), Anibor *et al*. (2014) among the Isoko population, Shah *et al*. (2014) among the Nepalese undergraduate, Eboh *et al*. (2015) among the Urhobo population that there was significant gender difference of canthal index though our findings disagree with Radha *et al*. (2021) that reported that there was no gender difference in canthal index.

Our study further explores the facial index of the Igbos ethnic group of Nigeria and it shows that the males had a mean value of 54.65±5.01, female 46.22±14.04 and it was significant with gender. The finding of the study agrees with Han et al. (2013) among the Korean population, Yesmin et al. (2014) in the Malaysian population and Jeremić et al. (2013) among the central Serbia population their facial index is significant with gender differences though our findings contradict with a report from Shetti et al. (2011) that facial index had no gender difference.

The study evaluated the association of age and face indices and revealed that there was no age difference in nasal, canthal and facial index among the Igbo ethnic group because these facial features tend to settle into stable proportions once a person reaches maturity. After facial structures are fully developed, they generally stay consistent in size and shape throughout adulthood, with only minor changes as people age. This stability aligns with similar studies, indicating that age has little impact on these specific measurements in adults. Oladipo et al. (2007) and Esomonu et al. (2013) in their study reported that there was no age difference on the face index. Their finding aligns with the current study and further suggests that as growth proceeds, the proportions of the face increase in the same manner having an insignificant ratio with age.

The above-discussed study showed some similarities and differences in nasal, canthal and facial index among the Igbo ethnic group with related studies and the difference could be attributed to ethnicity, nationality, methodology, races and environmental factors. The facial index of the Igbo based on our findings could be said to be hypereuriprosopic (<79.9).

Conclusion: The evaluation of normative facial indices has shown that there are significant gender differences in nasal, canthal and facial index among the Igbo ethnic group of Nigeria. The age was considered non-significant with nasal, canthal and facial index among the Igbo population.

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