Photogrammetric Based Analysis of Facial and Nasal Indices: A Cross-sectional Study among the Igbo Ethnic Group of Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Facial and nasal indices have great value in forensic identification and all specialty concerns with the treatment of the face. The study aims to evaluate the facial and nasal index of the Igbo ethnic group of Nigeria.

Methods: 300 (150 males and 150 females) subjects of Igbo origin volunteered for the study. Each subject's frontal and profile view photographs were taken in the Natural Head Position and analyzed using Pro-Image Facial Software Version 2 to evaluate the facial width, facial height, nasal width, and nasal height. Facial and nasal indices were calculated and used to obtain the facial, and nasal types. Data were analyzed with IBM SPSS (version 25).

Results: The study showed that the mean values of the facial and nasal indices for females were 70.35±6.61 and 105.48±12.97 while males had 68.47±6.04, and 86.21±10.82 respectively. 96.2% and 94.7% of males and females have hyperleptoprosopic facial type; platyrrhine type of nose was dominant in both sexes. There was a significant sex difference in the facial index (P =0.048), nasal index (P=0.0001), facial type (P=0.022), and nasal type (P=0.0001).

Conclusion: The sex variations observed in facial index, nasal index, and facial and nasal types among the Igbo ethnic group of Nigeria would serve as a reference to clinical anatomists and forensic anthropologists.

Keywords: Forensic identification; nasal index; Igbo; facial index and Nigeria; forensic anthropologists.

ABBREVIATIONS

GB   : Glabella
MT   : Menton
ZY   : Zygomatic
AL   : Ala of the Nose
N   : Nasion
SN   : Subnasal

1. INTRODUCTION

Anthropometric study via photogrammetry has been appreciated in various disciplines such as forensics, anthropology, clinical, and even population studies [1]. These have quantified some body parameters to evaluate different proportions of the body. The facial index bears a direct relationship with the facial height and width of an individual and is important in facial reconstruction and identification [2]. Anatomists, plastic surgeons, maxillofacial surgeons, and anthropologists utilize this index even in the age estimation of an individual [3]. It is a further criterion that has been used for the classification of human face into hypereuryprosopic face (vast face, range:<79.9), euryprosopic face (broad face, range: 80-84.9), mesoprosopic face (round face, range: 85-89.9), leptoprosopic face (long face, range: 90-94.9) and hyperleptoprosopic face (very long face, range: >95 [4]. Nevertheless, as earlier quoted by Kanan et al., [5], Two persons are never alike in their measurable characters. Hence, the study of intra- and interpopulation variations among

different morphological characters has long been an interest. The study further evaluates the nasal index of the Igbo's.

The knowledge of nasal index is also employed in forensic science and physical anthropology [6] and has also served as criteria for nasal classification into Leptorrhine with a Nasal Index of 69.90 or less, Mesorrhine with a Nasal index between 70 and 84.90 and Platyrrhine (broad nose) with a nasal index of 85 and above [7].

Different areas of Nigeria have different facial, and nasal types. According to Torres-Rrestrepo et al. [8], the leptoprosopic face is said to be the most common in the African population, among Igbos, Ewunonu et al. [9] have also reported the dominance of leptoprosopic face; however, Eliakim-Ikechukwu et al. [10] revealed that hypereuryprosopic type of face was predominant among the Igbo and Yoruba ethnic groups of Nigeria. There have also been variations of nasal type among different populations [7, 11, 12].

These variations in anthropometric parameters in different ethnicities and races have motivated this study's interest bearing in mind that various factors could contribute to the variation over time. These factors include; environmental changes, diet, genetics, and even lifestyle. However, for the findings and deduction about a

population to remain current and relevant, there is a need for continuous evaluation of the anthropometric parameters towards a populational study. The study aims to evaluate the facial and nasal index of the Igbo ethnic group of Nigeria.

2. MATERIALS AND METHODS

2.1 Study Design

The study adopted a cross-sectional descriptive study design to generate values of the facial and nasal, indices 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 Cochran formula of the descriptive survey [13, 14].

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

Where, $Z_{1-\alpha/2}$ = Standard normal variate (at 5% type 1 error) = 1.96
p = expected proportion of respondents (28%)
d = absolute error = 0.05

$$Sample\ Size = \frac{1.96^2 \times 0.28(1-0.28)}{0.05^2} = 296.75$$
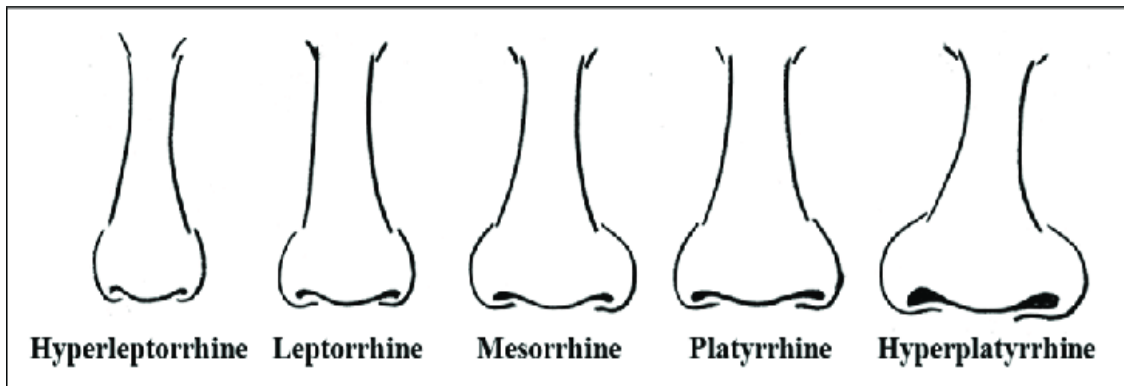
For this study, the sample size was rounded up to 300.
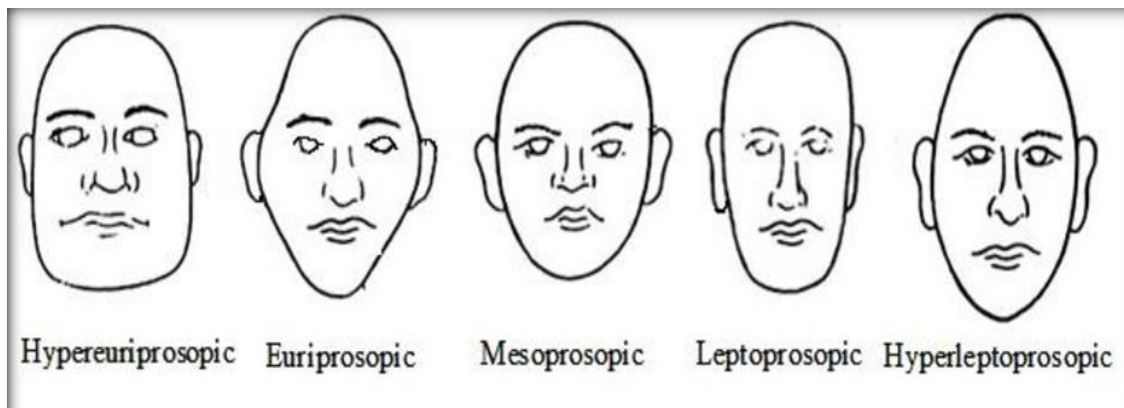

Fig. 1. Nasal type

Fig. 2. Facial type

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 25years to 35years were selected and they must not have any facial deformity or have undergone any facial or head surgery. Subjects who did not meet these stated criteria were excluded from the study.

2.4 Photographic Setup

A photographic stand was set with a digital camera placed on a tripod stand for easy adjustment concerning the respondent's height. A 1-centimeter calibrated graph board was placed behind the tripod stand and a mirror was also placed opposite the calibrated graph board to ensure the respondent had an eye-to-eye mirror Image. This is to ensure they are positioned in their Natural Head position (NHP). All respondents were photographed in a calm state with their heads in the natural head position (NHP), with no facial gestures, and the images were saved to a hard drive for picture analysis.

2.5 Photographic Analysis

The study made use of a digitalized photo analyzer, the WinImager developed by Oghenemavwe et al. [15] to measure the cutaneous points and determine the value of various landmarks of the face such as facial width (zy-zy) and facial height (gb-mt), nasal width (al-al), nasal height (n-sn), The facial, nasal and cephalic index was calculated as

$$facial\ index = \frac{face\ width\ (zy-zy)}{face\ height\ (gb-mt)} \times \frac{100}{1}$$

$$nasal\ index = \frac{nasal\ width\ (al-al)}{nasal\ height\ (n-sn)} \times \frac{100}{1}$$

The facial and nasal types were obtained from the indices adopting Banister's and Martin and Saller's [16] classification of facial and nasal types.

2.6 Reliability Test

The reliability of the instrument was examined by the researcher using two methods; first in the field by collecting data from the subject directly and on photographs afterward a paired T-test was run to compare both data and the result showed no significant differences. Secondly, the researchers used Cronbach alpha to evaluate the reliability of the result and the result showed accepted and reliable.

2.7 Statistical Analysis

The data were subjected to statistical analysis using the International Business Machines Statistical Package for Social Science (IBM SPSS version 25) for statistical analysis. Independent t-test was used as an inferential statistic to test for significance between sex on numerical data (the indices) and chi-square was also used as an inferential statistic to test for significance association

Table 1. Banister's classification of facial types

Face Shape	Facial Index
Hypereuryprosopic (vast face)	<79.
Euryprosopic (broad face)	80–84.9
Mesoprosopic (round face)	85–89.9
Leptoprosopic (long face)	90–94.9
Hyperleptoprosopic (very long face)	>95

Table 2. Martin and saller classification

Nasal Shape	Size of Nose	Nasal Index
Hyperleptorrhine	Long narrow nose	40–54.9
Leptorrhine	Moderately narrow nose	Less than 70
Mesorrhine	Moderate or medium size	70–84.9
Platyrrhine	Moderately wide nose	85–99.9
Hyperplatyrrhine	Vast nose	100 or more

between sex and categorical data (the facial, and nasal type). A probability less than 0.05 (P<0.05) was considered statistically significant.

3. RESULTS

Table 3 shows the descriptive statistics of the facial and nasal parameters of the Igbo ethnic group of Nigeria and the result revealed that facial width had a mean value of 16.45±1.47, face height was 16.36±1.94, facial index was 100.19±11.83, nose width 5.17±0.53, nose height was 5.56±0.66 and nasal index was 94.26±14.12.

Table 4 evaluates the facial and nasal indices based on sex, the findings revealed that males had a facial index of 103.13±9.35 and females 96.10±13.65. And 86.21±10.82 was observed in the nasal index of males, and females was 105.48±12.97. The comparison with sex has further shown that there are statistically significant differences observed in facial and nasal indices.

Our study revealed that hyperleptoprosopic was the predominant facial type in both males and females and showed no sex difference (Table 5). The males and females were observed to have broad noses (platyrrhine) and were significant with sex (Table 6).

4. DISCUSSION

Our study presents that 103.13±9.35 and 86.21±10.82 were males' facial and nasal index respectively while females were 96.10±13.65 and 105.48±12.97, representing facial and nasal index respectively, the facial and nasal index showed sex differences among Igbo ethnic group. The differences observed in the facial and nasal index of the Igbo could be attributed to multiple factors including the growth pattern observed in males and females.

The epiphyses of the female are said to fuse first compared to males which indirectly shows that males have a higher chance of bone growth for extra years compared to females. However, hormonal influences could also contribute to the difference because during puberty, males undergo a surge increase in testosterone which influences bone growth. Cultural practices could also play a vital role attributing to the differences observed in facial and nasal index. Igbo people are well known for their post-natal cultural practices of molding the face and its features in the early post-natal period. Our findings on sex differences in nasal index agree with Esomonu et al. [7] that nasal index had a statistical sex difference among the Bekware ethnic group of Cross Rivers State of Nigeria and Mohammed et al. [11] also state that nasal index was significant with sex among the Hausa ethnic group of Nigeria. A study of the nasal index in the southern part of Nigeria by Oladipo et al. [17], and Staka et al. [18] among the Kosovo Albanian Population also revealed that the nasal index shows a significant sex difference. However, Oladipo et al. [19] study on nasal index among the Okrika ethnic group contradicts our findings. They reported no sex differences observed in nasal index. Our finding on nasal index further suggests that the female nose is quite broad compared to the males.

The relationship between facial width and height was also considered in the study and it shows further that there was a difference in the male and female facial index, though it was contradicted by Sudikshya et al. [20] who's in their report stated that facial index has no difference in male and female but our findings agree with Yesmin et al. [21] among the Malay population, Dodangheh et al. [22] among medical students and Okwesili et al. [23] among the Igbo population, that there were differences in male and female facial index.

The present study further evaluates the facial and nasal types prevalent among the Igbo ethnic group of Nigeria. It revealed that 82% of the females had a hyperleptoprosopic type of face and 58.5% of males were observed with hyperleptoprosopic facial type, though Okwesili et al., [23] have stated that leptoprosopic facial type is predominant in Africans, Our findings agree with their study and also the findings of Ese et al. [24] but Our findings contradict Kumar and Lone, [25] among Haryanvi adults, they reported that mesoprosopic was predominant and in the Malay population, Yesmin et al. [21] also reported a similar result.

Among the Igbo, a broad nose (platyrrhine) was observed more and it was followed by a mesorrhine type of nose (44.3%). A study by Jonasson and Willis, [26] has shown that the size and shape of the nose most often time is influenced by climatic conditions and sex. Another anthropometric study has quantified the shape of the nose in various ethnicities and races. The findings of the study agree with Oladipo et al. [19].

Table 3. Descriptive Statistics of the facial and nasal parameters among the Igbo ethnic group of Nigeria

	minimum	maximum	mean	SEM	Std. Dev
Face width	12.98	21.40	16.45	0.10	1.47
Face height	10.49	21.19	16.36	0.14	1.94
Face index	52.41	128.41	100.19	0.87	11.83
Nose width	4.02	6.78	5.16	0.03	0.53
Nose height	4.12	7.63	5.56	0.04	0.66
Nasal index	65.07	135.88	94.26	1.12	15.12

SEM=Standard Error of Mean

Table 4. Association of indices based on sex

	Sex	Mean	SD	SEM	T-test	p-value	Inference
Facial index	Male	103.13	9.3519	0.908	4.126	0.00	S
	Female	96.1024	13.652	1.5660			
Nasal index	Male	86.2158	10.82660	1.05157	-10.893	0.00	S
	Female	105.4841	12.97367	1.48818			

S=significant (p<0.05), NS= not significant (p>0.05), SD=Standard Deviation, SEM=Standard Error of Mean

Table 5. Distribution of facial type based on sex

	Euriprosopic	Hyperleptoprosopic	Hypereuryprosopic	Leptoprosopic	Mesoprosopic	X^2	p-value	Inference
Female	0 (0.0%)	54 (71.1%)	5 (6.6%)	7 (9.2%)	10 (13.2%)	11.40	0.022	S
Male	1 (0.9%)	87 (82.1%)	0 (0.0%)	12 (11.3%)	6 (5.7%)			

X^2=chi-square, S=significant (p<0.05)

Table 6. Distribution of nasal type based on sex

		Leptorrhine	Mesorrhine	Platyrrhine	X^2	p-value	Inference
Sex	**Female**	1(1.3%)	0(0.0%)	75 (98.7%)	48.243	0.00	S
	Male	4(3.8%)	47(44.3%)	55(51.9%)			

X^2=chi-square, S=significant (p<0.05)

The above-discussed study has shown some similarities and differences with another related study on the evaluation of facial and nasal indices of the Igbo ethnic group of Nigeria. The difference could be attributed to ethnicity, environmental factors, races, or methods used in the study.

5. CONCLUSION

The study has shown that there are sex differences in the facial index, nasal index, facial type, and nasal type among the Igbo ethnic group of Nigeria, and will be of importance to clinical anatomists and forensic anthropologists.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during the writing or editing of manuscripts.

CONSENT

A consent form followed by a descriptive questionnaire was issued to all respondents and only those who consented to the research were personally interviewed to gather their socio-demographic data and also to evaluate if they met the inclusive criteria.

ETHICAL APPROVAL

The study was approved by the Faculty Research Committee of Basic Medical Sciences, University of Port Harcourt, Nigeria.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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