

Original Research Article

Photogrammetric Based Analysis of Facial and Nasal Indices: A Cross sectional Study among the Igbo ethnic group of Nigeria

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 was 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 sexual difference in the facial index ($P = 0.048$), nasal index ($P = 0.00$), facial type ($P = 0.022$), and nasal type ($P = 0.00$).

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.

ABBREVIATION

Glabella (gb), Menton (mt), postcranium (op), Zygomatic (Zy), ala of the nose (al), nasion (n), subnasal (sn)

Keywords: Forensic identification, Nasal index, Igbo, Facial index and Nigeria, nasal index, forensic anthropologists.

UNDER PEER REVIEW

1.0 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. The leptoprosopic face is the most common in the African population, according to Torres-Rrestrepo et al. [8]. Among Igbos, Ewunonu et al. [9] have also shown a leptoprosopic face; however, Eliakim-Ikechukwu et al. [10] have shown hypereuryprosopic faces among Igbos and Yorubas. 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. 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.

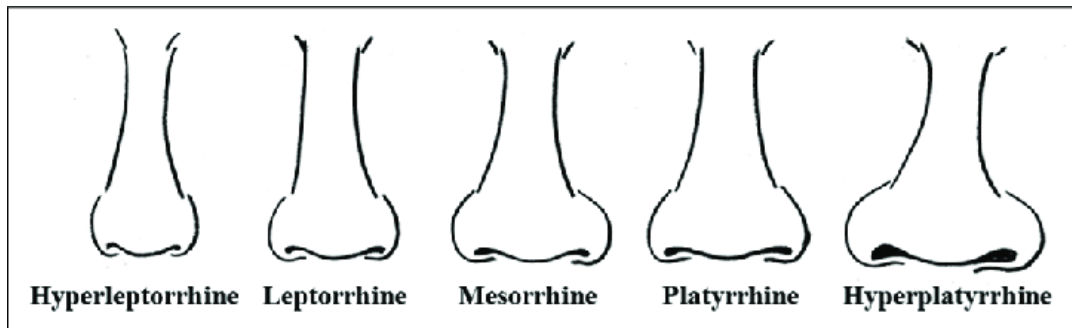


Figure 1, Nasal type

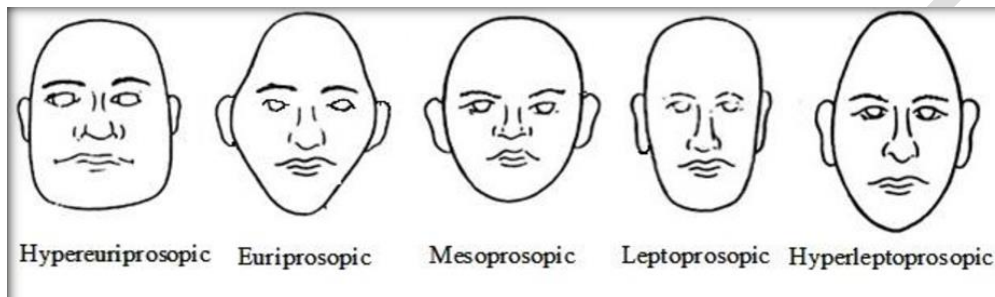


Figure 2, Facial type

2.0 MATERIALS AND METHOD

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].

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

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

$$\text{Sample Size} = \frac{1.96^2 \times 0.28(1-0.28)}{0.05^2} = 296.75$$

For this study, the sample size was rounded up to 300.

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. 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-op), nasal width (al-al), nasal height (n-sn), The facial, nasal and cephalic index was calculated as

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

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

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.

Table 1, Banister's Classification of Facial Types

Face shape	Facial index
Hyperuryprosopic (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

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

3.0 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).

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

Table 4, Association of indices based on sex

	Sex	Mean	St.D	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, NS= not significant (p<0.05)

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%)			

Table 6 Distribution of nasal type based on sex

		leptorrhine	mesorrhine	platyrrhine	χ^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%)			

4.0 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 sexual 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 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, however, their claims must have arisen from several related kinds of literature. 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].

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.

5.0 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.

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-demographical 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.

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.

REFERENCE

1. Ambali MP, Roy PP, Mohite SS. Anthropometric Analysis of India's Nasal Index. *Pakistan Heart Journal*. 2023 Mar 1;56(1):427-31.
2. Sarkodie FK, Abaidoo CS, Tetteh J, Adjei-Antwi C, Okwan DK. Facial indices and morphology: A study among Bono and Ewe adult population in the Bono region, Ghana. *Scientific African*. 2022 Mar 1;15:e01092.
3. Thurzo A, Kosnáčová HS, Kurilová V, Kosmel' S, Beňuš R, Moravanský N, Kováč P, Kuracinová KM, Palkovič M, Varga I. Use of advanced artificial intelligence in forensic medicine, forensic anthropology, and clinical anatomy. *InHealthcare* 2021 Nov 12 (Vol. 9, No. 11, p. 1545). MDPI.
4. Okwesili OR, Obikili EN, Achebe JU. Facial index among Igbo children and adolescents in Enugu. *Biomed Res*. 2019;30.
5. Kanan U, Gandotra A, Desai A, Andani R. Variation in the facial index of Gujarati males photometric study. *Int J Med Health Sci*. 2012 Oct;1(4):27-31.
6. Kapoor P, Chowdhry A, Popli DB. Orthodontists in forensic facial approximation (FFA): current inter-disciplinary perspective. *Egyptian Journal of Forensic Sciences*. 2021 Dec;11(1):1-3.
7. Esomonu UG, Ude RA, Lukpata PU, Nandi EM. Anthropometric study of the nasal index of Bekwara ethnic group of cross river state, Nigeria. *International Research Journal of Applied and Basic Sciences*. 2013;5(10):1262-5.

8. Torres-Restrepo AM, Quintero-Monsalve AM, Giraldo-Mira JF, Rueda ZV, Velez-Trujillo N, Botero-Mariaca P. Agreement between cranial and facial classification through clinical observation and anthropometric measurement of Envigado school children. *BMC Oral Health* 2014;14:50.
9. Ewunonu EO, Anibeze CIP. Anthropometric study of facial morphology in a South-Eastern Nigerian population. *Hum Bio Rev* 2013;2:314-323.
10. Eliakim-Ikechukwu C, Onuh E, Bassey T, Mesembe OE Cephalofacial indices of the Ibo and Yoruba ethnic groups in southern Nigeria. *J Biol Agric Healthc* 2012;2:144-148.
11. Mohammed I, Mokhtari T, Ijaz S, Omotosho AD, Ngaski AA, Milanifard M, Hassanzadeh G. Anthropometric study of the nasal index in Hausa ethnic population of northwestern Nigeria. *Journal of Contemporary Medical Sciences*. 2018 Jan 1;4(1).
12. Oladipo GS, Olabiyi AO, Oremosu AA, Noronha CC. Nasal indices among major ethnic groups in Southern Nigeria. *Sci Res Essay*. 2007 Jan 1;2(1):20-2.
13. Adheke OM, Asiwe N, Uahomo PO, Ezerioha CE, Wariboko LI, Irozulike FC, Opara AI. Assessment of Determinants for Choosing Medical Sciences as a Career Path amongst Medical Students of University of Port-Harcourt, Nigeria. *Journal of Complementary and Alternative Medical Research*. 2023 Jun 3;22(2):30-6.
14. Asiwe N, Irozulike FC, Wariboko LI and Adheke OM, Health Assessment of the Ikwerres and Okrikas Ethnic Group of Rivers State, Nigeria: Using Body Mass Index and Waist-to-Hip Ratio, *Journal of Complementary and Alternative Medical Research*. 2023 Jul 31;23(2):27-35.
15. Loveday OE, Babatunde F, Isobo U, Sunday O, Ijeoma O. Photogrammetric analysis of soft tissue profile of the face of Igbos in Port Harcourt. *Asian J Med Sci*. 2011 Dec 25;3(6):228-33
16. Martin R, K Saller, *Lehrbuch der Anthropologie*. Gustav Fischer Verlag, Stuttgart 1957.
17. Oladipo GS, Olabiyi AO, Oremosu AA, Noronha CC. Nasal indices among major ethnic groups in Southern Nigeria. *Sci Res Essay*. 2007 Jan 1;2(1):20-2.
18. Staka G, Dragidella F, Disha M. Anthropometric study of nasal index of the Kosovo Albanian population. *Antrocom Online Journal of Anthropology*. 2012;8(2):457-62.

19. Oladipo GS, Eroje MA, Fahwehinmi HB. Anthropometric comparison of nasal indices between Andoni and Okrika tribes of Rivers State, Nigeria. *International Journal of Medicine and Medical Sciences*. 2009 Apr;1(4):135-7.
20. Sudikshya KC, Shrestha S, Bhattarai L. Nasal parameters and facial index in medical undergraduates: a cross-sectional study. *Journal of Lumbini Medical College*. 2019 Dec 30;7(2):81-7.
21. Yesmin T, Thwin SS, Afrin Urmi S, Wai MM, Zaini PF, Azwan K. A study of facial index among Malay population. *Journal of Anthropology*. 2014;2014.
22. Dodangheh M, Mokhtari T, Mojaverrostami S, Nemati M, Zarbakhsh S, Arabkheradmand A, Gh H. Anthropometric study of the facial index in the population of medical students in Tehran University of Medical Sciences. *GMJ*. 2023;3(1).
23. Okwesili OR, Obikili EN, Achebe JU. Facial index among Igbo children and adolescents in Enugu. *Biomed Res*. 2019;30.
24. Ese A, Okiemute EM, Peace I, Charity O. Facial types and morphology: A study among Ika subjects in Delta State, Nigeria.
25. Kumar M, Lone MM. The study of facial index among Haryanvi adults. *Int J Sci Res*. 2013 Sep;2(9):51-3.
26. Jonasson KA, Willis CK. Changes in the body condition of hibernating bats support the thrifty female hypothesis and predict consequences for populations with white-nose syndrome. *PLoS one*. 2011 Jun 22;6(6):e21061..