Original Article

Photogrammetric Analysis of Nasofacial Angle Among the Urhobo Subjects

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Abstract

Background: All known anthropometric angles are evidently characterized by the feature of structural and functional variation according to gender, ethnic, and ecological influences. Knowledge of craniometric variation in the nasofacial angle among the Urhobo subjects appears limited, prompting the conduct of this study. **Aim:** The aim of the current anthropometric study was to evaluate a sample population of Urhobo subjects, by photogrammetric techniques, to establish the normal value of their nasofacial angle, and its associated variation. **Materials and Methods:** The noninvasive technique of angular photogrammetry was adopted for this investigation. This method incorporates the use of angular analysis of standardized left lateral facial cephalograms of 1000 Urhobo subjects, between 18 and 60 years of age. Selected craniofacial landmarks include the glabella, nasion, and nasal dorsum. **Results:** Descriptive analysis of data obtained from sampled Urhobo subjects revealed a mean nasofacial angle of 39.81° ± 4.81° and 39.45° ± 4.04° for males and females, respectively. Obtained means were not gender-specific on *t*-test analysis. **Conclusion:** While research findings did not demonstrate statistically significant gender differences, the obtained results would still have beneficial forensic and archaeological applications in reaching conclusions regarding subject identity, particularly in scientific expeditions in the politically volatile study area.

Keywords: Nasofacial angle, photogrammetric analysis, Urhobo

Introduction

Like change, the only constant finding in the science of anthropometry is the feature of structural and functional variation within and between all studied structures. On account of the depth of these variations, the statement is often made that no two human structures are exactly the same, not even genetically identical monozygotic twins.[1-4] Measurement and evaluation of the degree of intra-ethnic inter-gender variation in the craniofacial quantity of nasofacial angle among adult Urhobo subjects form the principal focus and aim of the present study. The primary objective of the current investigation is to determine the normative and mean values of the nasofacial angle among the said study population and attempt an inferential statistical analysis of such obtained values for gender dimorphism. Comparative analysis of obtained data against reference figures published for other ecological, ethnic, and racial groups will also be considered. The results obtained from the current angular craniofacial anthropometric study and related investigations will find significant relevance in forensic studies designed to evaluate human remains in terms of gender determination, age estimation, and identification of the possible cause of death. In reconstructive facial surgery, most particularly in cosmetic rhinoplasty with esthetic nose enhancement, data obtained from this study would have significant importance in surgical resolution of blunt/penetrating nasal trauma, congenital defects, and even a failed primary rhinoplasty.[5]

Members of the Urhobo ethnic group constitute the largest ethnicity in Delta State, Nigeria, with a 2006 population census figure of 4,098,391. Mainly farmers and fishermen by occupation, Urhobo subjects dwell in the heart of the Southern Nigerian Niger Delta region where Aweto[6] reported their geographical location in a territory bounded by latitudes 6°

Access this article online

Quick Response Code:

Website: www.njmonline.org

DOI: 10.4103/NJM.NJM_51_20

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How to cite this article: Mamerhi ET. Photogrammetric analysis of nasofacial angle among the Urhobo subjects. Niger J Med 2020;29:433-6.

Submitted: 30-Dec-2019 **Revised:** 29-Mar-2020
Accepted: 26-Apr-2020 **Published:** 18-Sep-2020

and 5°, 15° North and Longitudes 5°, 40°, and 6°, 25° East in Delta State of Nigeria.

Materials and Methods

Study design

The descriptive cross-sectional observational method of quantitative study design was adopted for the current research investigation. Left lateral cephalogrammetric profiles of a sample population of one thousand adult Urhobo subjects were obtained and evaluated for variation in the nasofacial angle. This 4-year study was conducted between October 2011 and October 2015. All the selected 1000 study subjects were recruited into the sample population only after satisfying the following inclusion criteria:

i. Pure breed second-generation Urhobo indigenes, who are resident in Urhobo regions of Delta State for a period spanning 5–10 years. Urhobo subjects of ambiguous ethnic origin were therefore excluded from the sample frame
ii. Adult Urhobo subjects in the age range of 18–65 years
iii. Negative past medical history of congenital or acquired craniofacial deformities, including surgery to the nose.

The standard protocol for an approach to subjects in cross-sectional studies was strictly adhered to, with precise but detailed subject enlightenment as regards the aim, objectives, and overall nature of the present investigation. Informed consent, written in the English language but explained in Urhobo dialect, was then signed or otherwise thumb printed by the study participants. Basic demographic biodata of subjects including gender, age, place of birth, local government area of origin, and local government area of residence (with the duration of residency) were also obtained among others.

Data collection

Collection of cephalometric data for nasofacial angle measurement commenced with fixation of subjects conveniently in the standard anatomical position with the head oriented along the orbitomeatal plane of 1884. A second-look physical examination of subjects for possible covert signs of facial deformities was then conducted followed by angular cephalometric landmarks selection, including, from above downward, the glabella (G), nasal dorsum (Nd), and pogonion (P). Participants nasofacial angle (G–P–Nd) was then measured as the angulation in degrees between the glabella–pogonion (G–P) line and another straight line traced anteroinferiorly along the nasal dorsum.

Data analysis

All collected nasofacial angle data were collated and subjected to analysis for descriptive and inferential statistics in collaboration with a team of certified statisticians. The William S Gosset *t*-test statistical tool in the IBM Statistical Package for the Social Sciences (International Business Machines Corporation (IBM), Armonk, New York, USA) was used to establish significant gender differences at $P \leq 0.05$.

Results

Descriptive statistical data, including obtained mean value, standard deviation, and range of nasofacial angle, are presented in Tables 1 and 2, for sampled male and female Urhobo subjects, respectively. Table 3 is a comparative presentation of the nasofacial angle published for other population groups.

Discussion

Variation is without doubt, the rule of nature. Whether functional or structural, anthropometric indices and angles will demonstrate variation according to such genetic and environmental factors like gender, geographical settings, age, race and ethnicity. The nasofacial angle, is no exception: It evaluates the magnitude and esthetic value of the angular relationship between the frontal bone at the glabella and the nasal bones at the radix and along the dorsum of the nose. Reported to range between 30° and 40° in the "ideal" Caucasian face,[11] the range of nasofacial angle in sampled Urhobo males varies from 27.00° to 50.00°, with a mean value of 39.81° ± 4.81°. Female Urhobo subjects presented a mean value of 39.45° ± 4.04°, with a minimum nasofacial angle of 31.00°

Table 1: Range, minimum, maximum, and mean values of the nasofacial angle, with standard deviation, among studied male Urhobo population (*n*=500)

Variable	Range	Minimum	Maximum	Mean with SD	*P*
Nasofacial angle	23	27º	50º	39.81º±4.80	0.198

Significant gender dimorphism selected at $P \leq 0.05$. SD: Standard deviation

Table 2: Descriptive statistics showing range, minimum, maximum, mean values, and standard deviation of nasofacial angle among sampled female Urhobo subjects (*n*=500)

Variable	Range	Minimum	Maximum	Mean with SD	*P*
Nasofacial angle	23	31º	54º	39.45º±4.04	0.198

Significant for gender dimorphism at $P \leq 0.05$. SD: Standard deviation

Table 3: Comparative data on nasofacial angle measurement in other population groups

Author (date)	Population/ethnic group	Nasofacial angle (sample size)
Anić-Milosević *et al.*,[7]	Croatian subjects	Males (58): 29.53º±2.51 Females (52): 30.36º±2.38
Reddy *et al.*,[8]	North Indians	Males: 34.38º±1.77 Females: 33.69º±1.37 (150 adults)
Jain *et al.*,[9]	Himachali Indian males	33.26º (100 adult males)
Andrews and Schoenrock[10]	North Americans	35.0º

and a maximum angle of 54.00°. A thorough appraisal of these figures revealed a slightly larger male-to-female mean values of nasofacial angle and may account for the relatively more pointed, protruded, and projected nose structure supposedly associated with Urhobo males. When the obtained mean values for each gender were compared statistically, significant sexual dimorphism was not observed in association with this variable at $P \leq 0.05$ (calculated P: 0.198).

The current research finding of higher male than female mean values of nasofacial angle was observed in reports of craniofacial norms authored by Anibor and Okumagba[12] for a sample population of 100 adult Urhobo subjects (minimum, maximum, and mean values of 29.0°, 48.0°, and 39.6° ± 5.0°, and 28.0°, 45.0°, and 37.4° ± 4.9° for males and females, respectively). Angular craniometric findings in the present study are also in tune with that reported by Oghenemavwe *et al.*,[13] for a sample population of 120 adult Urhobo indigenes, with documented mean values of 40.77° ± 6.29° and 35.6° ± 7.46° for males and females, respectively. The obtained mean values in the current investigation as well as values documented in Anibor and Okumagba[12] angular profile for Urhobo subjects full within the 30°–40° normal limit set by Powell and Humphreys.[11] However, the nasofacial profile reported in the Oghenemavwe Urhobo series overshoots this range by a rather negligible value of 0.77°. Contrary to the finding of statistically insignificant sexual dimorphism in the present study, as well as the stated Anibor craniometric series, documented mean nasofacial angle in the Oghenemavwe series were reportedly gender-specific.

The striking similarity in the mean values of nasofacial angle – 37.8° ± 0.45° and 36.3° ± 0.37° in male and female Ibo subjects respectively – was reported by Eliakim-Ikechukwu *et al.*[14] on the evaluation of 276 Ibo subjects. Eliakim-Ikechukwu *et al.* 2013[14] reported that the Yoruba mean value of 35.5° ± 0.38° is the lowest value of the nasofacial angle published for any Nigerian ethnic group. Male Yoruba nasofacial angle value stated in this study series was 37.3° ± 0.69°. The obtained data in the Eliakim-Ikechukwu *et al.*'s, 2013,[14] study of adult Ibo and Yoruba subjects did not reflect statistically significant gender differences. Reputed for his single-gender (male only) anthropometric studies, Ukoha *et al.*[15] reported a mean value of 39.0° ± 5.79°, with a minimum and maximum value of 28.0° and 50.0°, respectively. As was observed in the current study, higher male-to-female mean values of nasofacial angle appear to be a constant finding in all previous Nigerian works of literature available on this variable. The greater projection and prominence of the pronasale in males are suggested to underlie this attribute.

Comparative analysis of mean values of nasofacial angles in the current study population and that reported for Caucasian population groups show that the Urhobo subjects have a considerably larger nasofacial angle than that reported for Croatians, North Indians, Himachali Indian, and North Americans. While Anić-Milosević *et. al.*[7] documented the mean nasofacial angles of 29.53° ± 2.51° and 30.36° ± 2.38° for 58 adult male and 52 female Croatian subjects, respectively, Reddy *et al.*'s, 2011,[8] computer-assisted analysis of 150 adults of North Indians generated male and female mean angles of 34.38° ± 1.77° and 33.69° ± 1.37°, respectively. The mean value given by Jain *et al.*,[9] for 100 adult Himachali Indian males of 33.26° is also comparatively low. The North American mean nasofacial angle (35.0°) is equally low relative to that obtained for the studied population.[10,16] Some authors have suggested a more anteriorly placed glabella and smaller lower face among the generality of Caucasian subjects as possible morphological factors underlying the etiology of the comparative anatomical finding herein of relatively low Caucasoid or European mean values of nasofacial angle.

Conclusion

The mean value of nasofacial angle among the investigated Urhobo sample population is 39.81° ± 4.43°, varying from 39.81° ± 4.81° in males to 39.45° ± 4.04° in females and being nongender specific. The principal conclusion to be drawn on the basis of this mass of nonlinear craniometric means is that the anthropometric variable in focus, the nasofacial angle, merely displays arithmetic gender variations, vacillating along ethnic lines, geographical factors, age, and even cultural influences. This angular measurement differences should be borne in mind when invasive medical interventions that alter normal nasofacial traits are being considered or conducted.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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