Angular photogrammetric analysis of the facial profile of the adults of Bini ethnicity of Nigeria

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Abstract

Context: The face is the most important aspect of human identification. It also functions as the centre of attraction and appearance. **Aim:** The aim of this study was to characterize the facial profiles of Bini using angular photogrammetric analyses. **Materials and Methods:** A total number of four hundred Bini volunteers between the age range 18 to 30 years comprising two hundred males and two hundred females were recruited for this study. The photographs were taken with the subject keeping their heads in natural head at a distance of 150 cm from the camera in a well illuminated room in candescent light. All photographs were exported to Adobe Photoshop CS 5 Extended. The angle studied were nasofacial, nasofrontal, nasolabial and nasomental angles. Statistical analysis was done by using program Statistical Package for Social Sciences (SPSS), version 16.0 (SPSS, Inc., Chicago, Illinois, USA). Comparisons were made of all the facial angles studied between males and females using the students' *t*-test. **Results:** There was statistically significant sexual dimorphism in three of the angles measured. The nasofrontal angle was significantly higher ($P < 0.05$) in females (133.80 ± 0.40) than in males (128.00 ± 0.60). The nasofacial angle was significantly higher ($P < 0.05$) in males (35.580 ± 0.0) than in females (34.30 ± 0.20). The nasomental angle was significantly higher ($P < 0.05$) in females (128.10 + 0.30) than in males (126.90 ± 0.40). There was no statistically significant difference ($P > 0.05$) between the nasolabial angle of the males (76.20 ± 0.80) and that of the females (75.90 ± 0.70). **Conclusion:** This study has shown as in most other populations that the angular variables in tissue profile are sexually dimorphic among the Bini.

Key words: Angular, Bini, facial, Nigeria, photogrammetry

INTRODUCTION

The face is the most important aspect in human identification. It also functions as the center of attraction and of the appearance. However, the attractiveness of an individual is highly subjective, being dependent on many factors being involved, some of which are culture, personality, ethnic background, and age.[1]

The shape of the face is a result of the underlying skeleton and soft tissues. The variability and beautifulness of the face are expressed in the different sizes and shapes of the individual features of parts of the face and different facial angles.[2]

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Comprehensive soft-tissue analysis of the face is vital, as the soft-tissue profile may differ between different age groups, sexes, and ethnic groups. Various methods have been used to evaluate facial characteristics, such as craniofacial anthropometry,[3] photogrammetry,[4-10] cephalometric radiography,[11] stereophotogrammetry[12] as well as computed tomography and laser scanning.[13]

Studies have been carried out using photogrammetry to determine the facial traits of several ethnic groups of Nigeria.[8,14-16] However, there has not been any study in the literature on the angular facial profile among the Bini ethnic group of Nigeria. Therefore, the aim of this study was to characterize the facial profiles of Bini adults using angular photogrammetric analyses. The angles studied were the nasofacial, nasofrontal, nasolabial, and nasomental angles.

Several medical specialties, such as orthognathic and plastic surgery, orthodontics, and dental prosthesis, address facial features, hence there is a need for clinicians working in the maxillofacial discipline to know the standard of the face of a specified ethnic group, which may then guide the repair of affected areas in their patients. This research work would also be useful to anatomists, physical anthropologists, genetic counselors, forensic scientists, and beauticians.

MATERIALS AND METHODS

This cross-sectional study was conducted with approval from the Ethical Committee of the College of Medical Sciences, University of Benin before the commencement of the study. It was conducted at the University of Benin, Benin City, Edo State, Nigeria with the undergraduate students who were of Bini ethnicity. Bini ethnicity was determined on the basis of the criterion that their parents and paternal and maternal grandparents were all of Bini origin. Four hundred (400) subjects in total within the age range 18-30 years, comprising 200 males and 200 females, were recruited for this study. The selected sample consisted of Bini subjects, with fully developed adult dentition and facial profile. Subjects with previous plastic/constructive surgery of the face, trauma of the face, or a history of craniofacial syndrome were excluded from the study. Informed consent was obtained from each of the subjects.

The photographic setup consisted of a tripod that held a digital camera (Nikon COOLPIX, model S9100, manufactured by Nikon Inc., USA). It was ensured that the tripod was stable and easily adjustable so as to maintain the optic axis of the lens at a horizontal level with the head of the subject when capturing photographs. The photographs were captured at a standard resolution of 12.1 megapixels. The subjects were positioned on a line marked on the floor, at a distance of 150 cm from the camera, in a well-illuminated room with incandescent light. Their heads were in a natural position, with the gaze parallel to the floor.[4] The camera was raised to the ear level of the participant to provide good quality of image and to prevent distortion of the face.[17] The photographs were shot with a white background and an even distribution of light to minimize shadows and to reduce noise.

All photographs were exported to Adobe Photoshop CS5 Extended (Adobe Systems Inc., USA). Anatomical points of reference of the face were digitally marked on the photographs of all the subjects. All the required measurements were made using Adobe Photoshop by a single operator to minimize the margin of error. The angles were measured in degrees (°) and rounded off to one decimal place.

The following landmarks were located on the photographs [Figure 1] to obtain all the measurements: Glabella (G), nasion (N), pronasal (Prn), columella (Cm), subnasal (Sn), labial superior (Ls), and pogonion (Pg).

The following linear parameters and angles on the photos were obtained from the landmarks [Figure 2]:

- Nasofacial angle: Inferior angle formed by intersection between the glabella-pogonion (G-Pg) line and the nasion-pronasal line (N-Prn).
- Nasofrontal angle (G-N-Prn): Angle between glabella-nasion line (G-N) and nasion-pronasal line (N-Prn).
- Nasomental angle (N-Prn-Pg): Angle between nasion-pronasal line (N-Prn) and pronasal-pogonion line (Prn-Pg).
- Nasolabial angle (Cm-Sn-Ls): Angle between columella-subnasal line (Cm-Sn) and subnasal-labial superior line (Sn-Ls).

Statistical analysis

Computer-assisted analysis of the right lateral facial photographs was done by using the program Statistical Package for Social Sciences (SPSS), version 16.0 (SPSS Inc., Chicago, IL, USA) and presented in a table. Comparisons

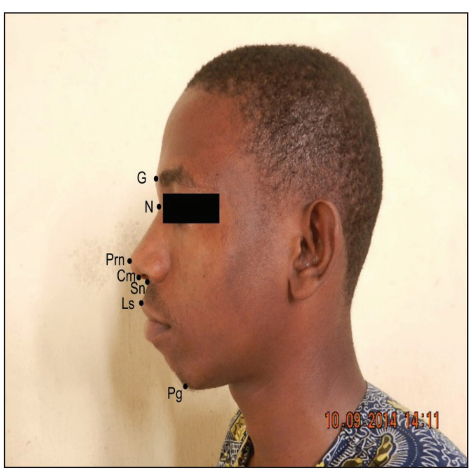

Figure 1: Landmarks used in the investigation

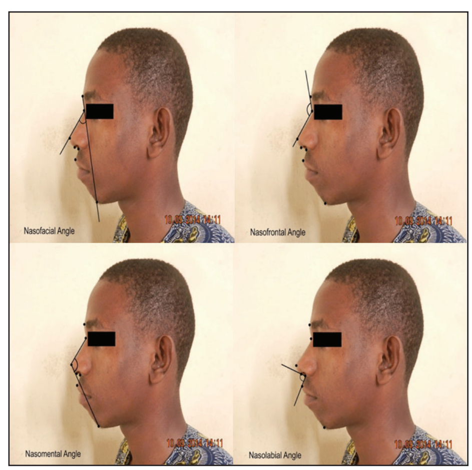

Figure 2: Facial angles obtained from the photographs

were made of all the facial angles studied between males and females using the Student's *t*-test (two-tailed distribution of two samples, assuming equal variance). The differences were considered statistically significant at 95% confidence level (that is, when $P < 0.05$).

RESULTS

Descriptive statistical analysis including mean ± standard error and range for the photogrammetric angular measurements together with the results of the Student's *t*-test comparing male and female measurements is shown in Table 1.

There was statistically significant sexual dimorphism in three of the angles measured. The nasofrontal angle was significantly higher ($P < 0.05$) in females (133.8° ± 0.4°) than in males (128.0° ± 0.6°). The nasofacial angle was significantly higher ($P < 0.05$) in males (35.58° ± 0.°) than in females (34.3° ± 0.2°). The nasomental angle was significantly higher ($P < 0.05$) in females (128.1° ± 0.3°) than in males (126.9° ± 0.4°). There was no statistically significant difference ($P > 0.05$) between the nasolabial angle of the males (76.2° ± 0.8°) and that of the females (75.9° ± 0.7°).

DISCUSSION

The knowledge of soft-tissue anthropometric profiles can never be overemphasized in the discipline of medicine, especially in the specialties such as orthognathic and plastic surgery, orthodontics, and dental prosthesis. Therefore, research work of this type is essential for clinicians such as those working in the maxillofacial discipline, as knowledge of the standard anthropometric features of the face of a specific ethnic group would guide the repair of affected areas in their patients.

The purpose of the present study was to investigate the angular parameters that define the soft-tissue profile of the Bini ethnic group. Photogrammetry has an edge over other methods in facial profile analysis, particularly in the area of angular measurement, as angular measurements are not affected by photographic enlargement, the procedure is noninvasive and could be used to investigate pre- and postoperative changes in the face, and it provides a permanent record of patients.[12] Photogrammetric analysis does not require expensive or complex equipment, compared with other methods, and offers digital results that are easily evaluated using computer software. Further, the procedure does not expose the subjects to radiation. It is, therefore, ethically more acceptable to develop population norms through population-based photogrammetric studies.

Table 1: Data of craniofacial angle for males and females of the Bini population

Craniofacial angle	Sex	Mean ± se	Range	P
Nasofacial	Males	35.5±0.3	24.1-45.9	0.000*
	Females	34.3±0.2	25.5-43.3	
Nasofrontal	Males	128.0±0.6	106-149.6	0.000*
	Females	133.8±0.4	115.4-145.8	
Nasomental	Males	126.9+0.4	112.7-156.8	0.020*
	Females	128.1±0.3	117.3-141.7	
Nasolabial	Males	76.2±0.8	41.3-108.1	0.72
	Females	75.9±0.7	54.8-109.5	

*Statistically significant ($P < 0.05$)

The higher values in the table for the females in this study could be explained by the fact that, in general, the facial contours of female subjects were softer than those of males, especially in the area of the nose, lips, and chin.[6] The values of the nasofacial angle in this study (35.5° ± 0.3° in males and 34.3° ± 0.2° in females) are similar in comparison with those of the North Indians (34.38° ± 1.77° in males and 33.69° ± 1.37° in females),[9] but larger than those of Croatians (29.53° ± 2.51° in males and 30.36° ± 2.38° in females),[6] and smaller than those of the Khana people of Rivers State of Nigeria (33.54° ± 4.10° in males and 32.09° ± 3.61° in females)[16] and the Garo population of Bangladesh (40.27° ± 4.54° in males and 38.67° ± 4.05° in females).[2] A higher nasofacial angle suggests a greater projection of the nose.[10]

This study showed that the nasofacial angle (G-Pg/N-Prn) of the adult Bini males was significantly higher than that of the females. This is in agreement with studies by Osunwoke and Onyeriodo[16] among the Khana population of Nigeria and by Oghenemavwe *et al*.[14] among the Igbo population of Nigeria, but at variance with the study by Ferdousi *et al*.,[2] who found no statistically significant difference in nasofacial angles between males and females among the Garo population of Bangladesh.

This study showed that the nasofrontal angle (G-N-Prn) of the adult Bini females was significantly higher than that of the males. This is in agreement with the findings of Osunwoke and Onyeriodo[16] among the Khana People in Rivers State, Nigeria, those of Reddy *et al*.[9] among the North Indians, of Fernandez-Riveiro *et al*.[4] among the European Caucasians (Galicians) of Spain, Anic-Milosevic *et al*.[6] among Croatians, of Wamalwa *et al*.[10] for Kenyans, of Zaib *et al*.[18] for Pakistanis, and of Ferdousi *et al*.[2] among the Garo People of Bangladesh. However, Malkoç *et al*.[7] and Epker[19] found no sexual differences in this angle among the Turkish, while Anibor and Okumagba[8] found a higher value of nasofrontal angle in the males than in the females among the Urhobos of Nigeria. The sex difference in nasofrontal angle observed in the Bini population could be attributed to the prominence of the glabella in males.[2,20]

The average value of the nasomental angle (N-Prn-Pg) found in the Bini population was comparable with the

Itsekiri population of Nigeria[8] and with the North Indian population[9] but was higher than among the Igbo population[14] and the Urhobo population[15] of Nigeria. This study also showed that the nasomental angle was significantly higher in females than in males.

The application of nasolabial angle (Cm-Sn-Ls) is important in the evaluation of the relationship between the nasal base and the upper lip during orthodontic diagnosis and treatment planning. It is of great clinical relevance because its magnitude depends on the anteroposterior position and inclination of the upper anterior teeth. It can be altered in orthodontics or orthognathic surgery.[2,10]

The mean value of the nasolabial angle (Cm-Sn-Ls) found in the Bini population was much less compared to the Garo population of Bangladesh (91.28° ± 12.98° in males and 91.92° ± 8.90° in females) Ferdousi *et al*.,[2] the North Indian population (102.32° ± 4.69° in males and 101.50° ± 4.39° in females),[9] the Turkish population (101.09° ± 10.19° in males and 102.94° ± 10.43° in females),[7] the Pakistani population (95.83° + 6.13° in males and 92.00° + 7.37° in females),[18] the Khana population of Nigeria (86.21° + 16.61° in males and 91.73° + 14.85°)[16] as well as the white European population (105.2° ± 13.28° in males and 107.57° ± 8.5° in females).[4] Significant sexual dimorphism was not observed between the males and females.

CONCLUSION

In conclusion, variation in facial anthropometry with relation to race and ethnicity is well documented and accepted. The present study, therefore, presents the norm for the angular facial profile among the Bini population. This study has shown that, as in most other populations, the angular variables in tissue profile are sexually dimorphic among the Bini.

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