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Original article

Sex determination using facial linear dimensions and angles among Hausa population of Kano State, Nigeria

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ABSTRACT

The aim of the study was to determine sexual dimorphism as well as to predict sex using facial linear dimensions and angles among Hausas of Kano state Nigeria. A total of 283 subjects comprising 147 males and 136 females age range 18–25 years participated. Photographs methods were used to capture the face. Independent sample *t*-test was used to test for sex differences in the variables. Binary logistic regression was applied to obtain a predicting equation (BLR model) for sex. The predicted probabilities of BLR were analyzed using receiver operating characteristic curve. The results showed that all the facial linear dimensions showed significance sexual dimorphism except interocular distance, upper facial width, philtrum length, lower vermilion width, left and right orbital width. With regards to sex prediction, upper facial height was the single best predictor of sex with an accuracy of 76.2% and 24–33% contribution to the prediction. However, the percentage accuracy increased to 91% when six variables were pooled together in the equations. For facial angles, only nasion and aperture modified angle did not show significant gender differences. However, in the variables with significant sexual dimorphism only nasomental angle showed a significant level of sex prediction with an accuracy of 70.3%. In conclusion, sex discrimination using facial linear dimensions and angles was well established in this study. The sex of an individual of Hausa ethnic group can be determined using facial linear dimensions. Dispite sexual dimorphsm shown by facial angles, only nasomental angle was good discriminator of sex.

1. Introduction

The facial anatomy of different ethnic groups must be well understood to achieve maximum facial aesthetic results after plastic/orthognathic surgery. The knowledge of the most striking facial characteristic of each ethnic group is a key to successful corrective surgery or analysis of postoperative as well as characterization of individuals in the context of Human Biology. In the field of facial anthropometry, Farkas and coworkers had compiled the single most comprehensive survey of ethnic groups from multiple regions around the world.[1] Despite this comprehensive approach, the global range of variation for each facial measurements was not well documented.[2,3]

Beyond the linear distances, the surface projection of certain facial features was also appreciated in the literature among different populations. The facial angles were the common parameters used in this regards. The angular measurement of the face has also been used to provide an insight into the variability that exists in the ideal facial profile.[4]

Both facial linear distances and angles have been utilized across different populations for personal identity and can serve as a way of revealing information with respect to biological profiles like ancestry, sex, the age of an individual. Due to vast ethnic variation in the facial profiles[5,6] and ethnic-specific facial model (for Hausas) is needed in order to accommodate the application of this model in the field of human identification and characterization. For forensic purposes relatively few studies have considered facial assessment, although a promising result has been obtained especially in the field of age estimation of the living[7,8], defining sexual dimorphism[9], and traits specific to ethnic groups.[6,10–12]

In summary, it was generally accepted that facial traits may be extremely useful if used with caution for aging, sexing, determin-

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ing ancestry and even in the initial phases of personal identification within the forensic domain.

1.1. Aim of the work

The aim of the study was to determine sexual dimorphism and predict sex using facial linear dimensions and angles among Hausa population of Kano sate Nigeria.

2. Materials and methods

2.1. Study area

The study was conducted among one of the original Hausa states, Kano state of Nigeria (see Fig. 1). Kano is the most populous state in Nigeria, with a population of 9,383,682 million people . The urban area of the state covers 137 km^2 and comprises of six local government areas (LGAs), Kano Municipal, Fagge, Dala, Gwale, Tarauni and Nassarawa with a population of 2,163,225 at the 2006 Nigerian census. The principal inhabitants of the city are Hausa people.[13]

2.2. Subjects

A total of 283 subjects comprising 147 males and 136 females participated in the study. Any subject who was Hausa up to the level of grandfather, apparently healthy whose face was free from physical deformity or pathological changes, and within the age range of 18–25 years was considered, this was to control the effect of aging on the facial measurements. Male with excessive facial hair, which obscures some of the facial landmarks, and craniofacial anomalies were excluded from the study. Any subjects outside these inclusion criteria were also excluded from the study. Before the commencement of the research, ethical approval was sought from ethical committee of Kano state Hospitals Management Board. Informed consent was sought from the participants and persons whose photograph appears in the study.

2.3. Methodology

2.3.1. Facial photographing

To obtain the photographs (frontal and lateral) individuals were asked to sit and look directly at the camera in front of them,[14] keeping an upright and normal posture, with both arms free along the body. The head position corresponds to the Broca's natural head Position.[15] Behind the subjects, a white screen was placed to standardize the background. The camera was placed on a tripod stand (WT3570, China) to standardize the distance (100 cm) between it and the subject as well as adjust the camera according to sitting height of the subject. In addition, the tripod stands helped to avoid undesirable movements of operator and camera while taking photographs.[16] Before capturing the face, the operator ensured that glasses had been removed, the participant's forehead, neck, and ears were clearly visible during the process.[17] After the images were captured, those images were downloaded to a personal computer and stored in jpeg format for processing and analyses.

For measurements error analyses, a direct facial anthropometry was adopted,[18] this involved asking the participant to sit in with his head in natural head position. A digital vernier caliper (Neiko 01407A, China) was then used to measure the facial linear dimensions whereas a hinge was used to measure the facial angles of face indirectly and goniometer was used to determine the measure-

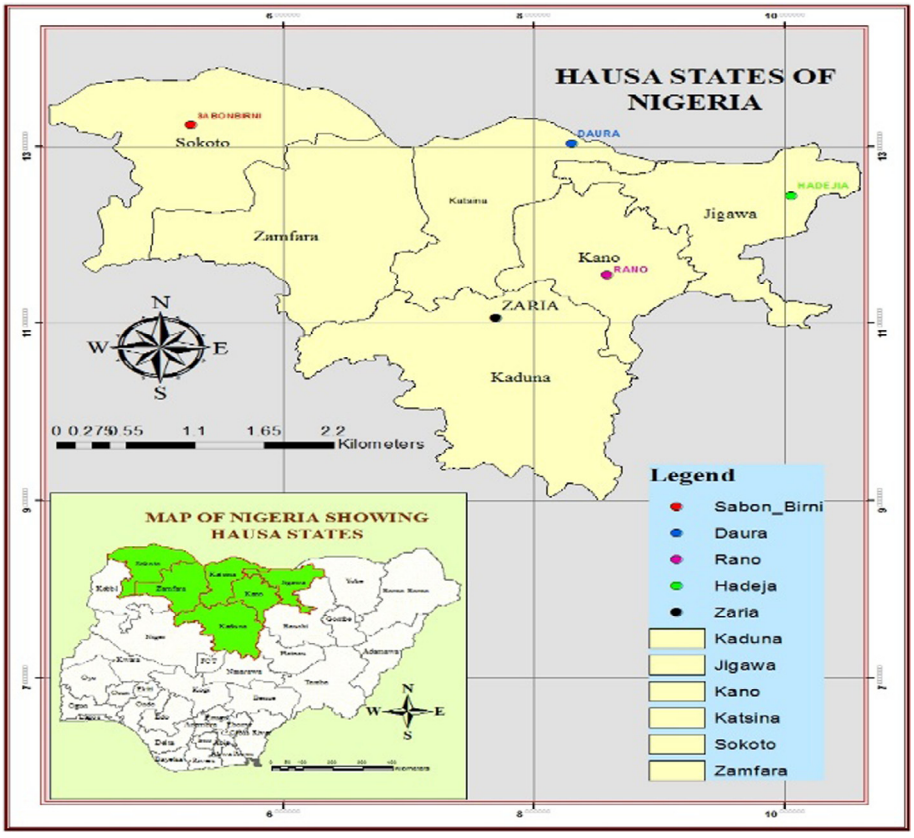

Figure 1. Map of seven Hausa state indication location of the study (Kano).