



ORIGINAL ARTICLE

Determination of sex using cephalo-facial dimensions by discriminant function and logistic regression equations



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Abstract: The aim is to bring together the new anthropological techniques and knowledge about populations that are least known. The present study was performed on 901 healthy Gujarati volunteers (676 males, 225 females) within the age group of 21–50 years with the aim to examine whether any correlation exists between cephalofacial measures naming maximum head length, maximum head breadth, bizygomatic breadth, bigonial diameter, morphological facial length, physiognomic facial length, biocular breadth and total cephalofacial height and sex determination. Also, discriminant function and logistic regression methods were verified to check the best accuracy level for sex determination. Mean values of cephalofacial dimensions were higher in males than in females. Best reliable results were obtained by using logistic regression equations in males (92%) and discriminant function in females (80.9%). Our study conclusively establishes the existence of a definite statistically significant sexual dimorphism in Gujarati population using cephalo-facial dimensions.

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1. Introduction

Anthropometry is an essential tool of biological anthropology which involves a series of standardized measuring tech-

niques that express quantitatively the dimensions of the human body. Somatometry is one of the disciplines of anthropometry which deals with the measurement of the living body and cadaver including the head and face. Krogman¹ in his monumental publication (later on revised with Iscan et al.²) “The Human Skeleton in Forensic Medicine” points out that the use of anthropometry may arise under several sets of circumstances i.e. natural, intentional and accidental (war dead cases, air crash, road and train accidents, earth quake, flood, fire; deliberate mutilation,

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disfigurement, pounding, gouging etc. of the dead body). Determination of sex is of fundamental importance both for personal identification in forensic science as well as for population data studies. Sex is generally inferred from facial morphology which is highly reliable. Many researchers have made use of somatometry widely in the estimation of sex from different body segments like the skull, long bones, pelvis, clavicle, phalanges, ribs etc. The most popular statistical model in sex determination is the recently developed discriminant function analysis which encouraged many forensic scientists to assess their anthropometric data accordingly.³ The present study aimed to examine sexual dimorphism and to produce a practical discriminant function or logistic regression for determining the sex in Gujarati group of people. Logistic regression was always performed along with the discriminant function. A total of eight standard cephalofacial measurements were taken from 676 males and 225 females of known sex and race of Gujarati people. To date, there are no metric cephalofacial criteria for Gujarati people. Therefore, the purpose of this study is to establish population specific standards for sex determination from the cephalofacial dimensions. The ultimate aim of determining sex in forensic science is to help the law enforcement agencies in achieving 'personal identity' in the medicolegal cases like mutilated and decomposed body parts. In many cases cephalofacial dimensions are the only means of evidence for forensic examination. Such studies are also useful in forensic medicine, plastic and oral surgeries, clinical and research purpose and facial reconstruction.

2. Material and methods

The present study was carried out in the Ahmedabad district of Gujarat. A total number of 901 subjects of Gujarati origin were included in the study. The subjects were within the age limit of 21–50 years. Subjects were purely of Gujarati ethnic origin and were selected at random from different parts of Ahmedabad. Gujarat is situated on the west coast of India. Gujarati subjects were born, bred and live in the Ahmedabad district of Gujarat state. Gujarat is home to the Gujarati-speaking people of India. It has a population in excess of 50 million. Ahmedabad is the largest city in Gujarat. The subjects included in the study were healthy individuals free from any deformity. Anthropometric measurements like maximum head length, maximum head breadth, bizygomatic breadth, bigonial diameter, morphological facial length, physiognomic facial length, total cephalofacial height and biocular breadth were taken independently on each individual. Besides the above measurements, name, sex, caste, native and occupation of each subject were also recorded. All the measurements were taken in a bright room. All measurements were taken using standard anthropometric procedure with the subject sitting in a chair in a relaxed condition and head in the anatomical position. Cephalofacial dimensions are taken by spreading a calliper in centimeters according to the landmarks, techniques and procedures recommended by authors Singh and Bhasin (see Fig. 1).

Measurements	Abbreviate	Definitions
Maximum head length (g-op)	MHL	It measures the straight distance between glabella (g) and opisthocranion (op)
Maximum head Breadth (eu-eu)	MHB	It measures the straight distance between the two eurya (eu)
Bizygomatic breadth (zy-zy)	BZB	Direct distance between the two most lateral points on the zygomatic arches (zy-zy)
Bigonial breadth (go-go)	BGB	It measures the straight distance between the two gonion (go), rounded posteroinferior corner of the mandible between ramus and the body
Biocular breadth (ec-ec)	BOB	It measures the straight distance between the two external canthi (ectocanthion) i.e., outer corners of the eye
Total head height (v-gn)	THH	It measures the projective distance between vertex (v) and gnathion (gn)
Physiognomic facial height (tr-gn)	PFH	It measures the straight distance between trichion (tr) and gnathion (gn)
Morphological facial height (n-gn)	MFH	It measures the straight distance between nasion (n) and gnathion (gn)

Data were subjected to statistical analysis of mean, minimum, maximum and standard deviation of mean. These were subjected to SPSS discriminant function analysis and logistic regression.

3. Results

The types of data to be analyzed were 901 Gujarati whose cephalofacial measurements were taken directly. The samples were examined, separately and pooled. Table 1 displays the mean, minimum and maximum values with their respective standard deviation of eight cephalofacial parameters of the Gujarati.

Eight measurements derived from the data were used to produce a series of discriminant functions and logistic regression for sex determination.

Sex was also determined using discriminant function and logistic regression in the pooled sample of 901 Gujarati to check the accuracy (Table 4).

Further, the collected data were checked for their accuracy and reliability with the established equations of discriminant function and logistic regression. Table 5 illustrates the accuracy level of males and females when the values of cephalofacial measurements were placed in the formulated equations.

4. Discussions

Sex determination is very important for identification in forensic medicine, medico legal cases and forensic anthropologists.

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