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Anthropometric Predictors for Sexual Dimorphism of Skulls of South Indian Origin

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Abstract- Identification of an individual is important in any Medicolegal investigation. The primary factors that helpful in the identification include age, sex and stature.1 Skull is important in this regard as it resits adverse environmental conditions over time .2 The present study aims to determine sexual dimorphism in 80 skulls of south Indian origin. Parameters used are maximum cranial length, maximum cranial breadth, facial height, bizygomatic diameter, nasal height and nasal width. Cranial, upper facial and nasal indices were calculated.

Craniometrical measurements were expressed in descriptive statistics i.e. mean and SD are calculated. The p value of nasal height, nasal width and mastoid process length of both sides showed significant difference.

Index Terms- Sexual dimorphism, Skulls , Anthropometry

I. INTRODUCTION

In the field of forensic medicine, normally the available materials after sufficiently long period of death will be utilized to determine various body characteristics such as age, sex, etc for identification of individual. Gender has long been determined from skull, pelvis and the long bones with epiphysis and metaphysic in unknown skeletons. Anthropometry is an important part of physical\ biological anthropology. Forensic anthropometry is as scientific specialization emerged from the discipline of anthropology dealing with identification of human remains with the help of metric techniques.[3]

The use of anthropometry may arise under several sets of circumstances ie natural, intentional and accidental (air crash, train accidents, flood , fire etc) of the dead body. [4] Sex of an individual can be identified accurately in 80% of cases using skull alone and 98% cases using pelvis and skull together. [5]

The aim of this study to determine sexual dimorphism of skull by multivariate analysis of anthropometric data which will be helpful in anthropometric and medicolegal studies.

II. MATERIALS AND METHOD

The present study was undertaken in the Department of Anatomy, JSS Medical college, Mysore. Ethical clearance was taken from the institutional ethical review committee before the initiation of the study. the dry macerated skulls of age group 50-60yrs of known sex 41Males and 39 female skulls were studied. The measurements were taken after placing the skull in Frankfurt's horizontal plane. Instruments used are vernier sliding caliper and spreading caliper.

Fig 1: Max cranial length- glabella to occipital point

Fig 2: maximum bizygomatic diameter

Fig 3: mastoid process length – upper border of external acoustic meatus to tip of mastoid process

Anthropometric parameters used for the study are :

1. Max cranial length
2. Max cranial breadth
3. Cranial index breadth x100 length
4. Facial height
5. Bizygomatic diameter
6. Upper facial index bizygomatic diameter x100 facial height
7. Nasal height
8. Nasal width
9. Nasal index width x 100 height
10. Mastoid process length- right and left side

III. Statistical Analysis

The data entry and analyses were done using SPSS version 17. Craniometrical measurements were expressed in descriptive statistics i.e. mean and SD are calculated. The differences in mean and SD of males and females are analysed using unpaired t test. Variables which were found statistically significant in the univariate analyses were subjected to conditional forward stepwise multiple logistic regression, independent predictors of sex determination were assessed. P value of $\leq$ 0.05 was considered statistically significant.

IV. Results

Table 1 clearly depicts the measured anthropometric variants in the study as a predictor of sexual dimorphism in the skulls. Mean and standard deviations of all anthropometric measurements and indices were tabulated. Among those, nasal height, nasal width and right mastoid process length were found to be statistically significant predictors of sex determination of skulls. Mean and SD of nasal height among males and females were 4.79±0.57 and 4.54±0.35 respectively and the differences in the mean among males and females with respect to nasal height was found to be statistically significant (p=0.004). Similiarly, Mean and SD of nasal width among males and females were 2.36±0.26 and 2.23±0.24 respectively and the differences in the mean among males and females with respect to nasal width was found to be statistically significant (p=0.026). Mean and SD of right Mastoid process length among males and females were 3.53±0.42 and 3.42±0.30 respectively and the differences in the mean among males and females with respect to right Mastoid process length was found to be statistically significant (p=0.041).

Table 1: Comparison of males and female skulls using anthropometric measurements and indices:

	Parameters	Male		Female		P Value
		Mean	SD	Mean	SD	
1	Cranial breadth	13.29	1.93	13.28	1.45	0.990
2	Antero – posterior length	16.81	1.61	16.77	1.73	0.904
3	Cranial index	78.40	7.13	79.13	5.87	0.622
4	Facial height	6.09	0.47	6.02	0.40	0.516
5	Bizygomatic breadth	12.73	1.56	12.61	1.45	0.732
6	Upper facial index	48.13	7.08	47.85	6.06	0.850
7	Nasal height	4.79	0.57	4.54	0.35	**0.004**
8	Nasal width	2.36	0.26	2.23	0.24	**0.026**
9	Nasal index	49.38	7.50	49.24	6.37	0.930
10	Mastoid process length- right	3.53	0.42	3.42	0.30	**0.041**
11	Mastoid process length- left	3.54	0.42	3.36	0.34	**0.041**

Table 2 depicts the results of multivariate analysis to find out the independent predictors of sexual dimorphism. On stepwise conditional forward multiple logistic regression, nasal height (p=0.044) and mastoid process length left (p=0.006) were found to be independent predictors of sex determination among

skulls of south Indian origin with b co-efficients of -1.053 and -2.202 respectively.

Table 2: Multivariate analysis of predictors of sex determination of skulls

	β co-efficient	SE	Wald	OR	P value
Nasal height	-1.053	0.601	3.071	0.349	0.044
Nasal width	-1.944	1.039	3.499	0.143	0.061
Mastoid process length-right	1.819	1.397	1.696	6.166	0.193
Mastoid process length-left	-2.202	1.256	3.075	0.111	0.032
Constant	10.616	3.855	7.583	40779.549	0.006

V. Discussion

In the present study p value of nasal height, nasal width and mastoid process length of both the sides showed difference compared to other parameters. Harihara studied Japanese skulls by discriminant analysis using measurements like max.length of skull, max breadth of skull, height of skull with 89.7% accuracy.[6]

Deshmukh and deveshi studied parameters like maximum cranial length, maximum cranial breadth, cranial height, maximum cranial circumference, maximum bizygomatic diameter, basion- nasion length, biasterionic breadth, bregma lambda length, mastoid length, palatal breadth. They were found to be significant with p value < 0.05 and also revealed 90% accuracy of male crania and 85.29% accuracy of female crania.[7]

Sanjai sangvichien etal studied 30 measurements on 101 skulls and showed 26 of 30 measurements and 5 of 14 indices showed a statistically significant difference between males and females. Multiple logistic regression analysis to predict gender on 4 skull measurements ie nasion – basion length, maximum breadth of cranium, facial length and bizygomatic breadth of face.[8]

In another study by Sudke Geetanjali B and Diwan Chhaya V studied 73 skulls using parameters like maximum cranial length, maximum cranial breadth, orbital height, orbital breadth, nasal height, nasal breadth, bizygomatic diameter, nasion-prosthion length. It showed percentage of skulls identified was 95.5% for males and 86.2% for females..[9]

Giles et al and kajanoja had done the statistical analysis using the anthropometric parameters as glabella – occipital length, max width, basion bregma height, max bizygomatic diameter, prosthion nasion height, basion prosthion, nasal breadth. And obtained the accuracy level of 82--89% and 79.4% by applying discriminant functional analysis.[10]

VI. Conclusion

Sex could be determined very well from the cranium using Anthropometry. The parameters like nasal height, nasal width and mastoid process length can be used as predictors to determine gender. The gender differences in cranial morphology emphasize the significance of applying data to an individual subject in a given population. Such knowledge is not only applicable to forensic scientists but also in plastic surgery and oral surgery with craniofacial deformity.

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