



## A STUDY ON CRANIOMETRIC ANALYSIS OF ADULT HUMAN SKULLS IN TELANGANA POPULATION

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### ABSTRACT

Craniometry is the scientific measurement of various dimensions of bones of the skull useful for anthropometry and forensic practice in segregation of age, gender, stature, race, etc. of unknown persons. The present study was conducted in Osmania Medical College, Hyderabad, Telangana, India consisting of fifty (31 male and 19 female) dry adult human skulls of Telangana population collected from the Department of Anatomy and Forensic of three different Medical Colleges of Hyderabad. Cranial indices are useful for deciding racial and gender differences. The aim of the study was to determine sexual dimorphism of skull by using craniometric data. Therefore, measurements of maximum cranial length, breadth and height were taken using sliding Vernier Calipers and cranial indices of all the skulls were determined. The mean cranial length in male and female skulls was 17.66cm, in male it was 17.92cm and in female 17.1cm. The mean cranial breadth in male and female was 13.2cm, in male and female 13.4cm and 12.9cm respectively. The mean cranial index of male and female skulls examined was 75.21% in male 75.32% and in female 75.42%. The results in the present study showed no difference in cranial indices of male and female skulls which indicates less sexual dimorphism. In the present study, depending on the mean cranial index, n = 21 (42%) skulls belong to dolicocephalic, n = 24 (48%) to mesocephalic, n = 5 (10%) to brachycranial and no skull belong to hyperbrachycephalic. The result of this study will be of importance in forensic medicine, anthropology and in genetics. It has further application in clinical specialities such as plastic surgeries and oral surgery with craniofacial deformities.

**KEYWORDS:** *cranial index, cranial volume, craniometry, dolicocephalic, mesocephalic, skull*



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## INTRODUCTION

The anthropologists, in early days were relying only on external characteristics of the body for their studies. But, later they started examining valuable information about racial and psychological characters. This is done by both metric and non-metric study of the skulls. Metric study is also called craniometry which is recording of various linear measurements and different indices. Non-metric is the observation of the incidence of minor morphological variations of human skull. So the studies of metric and non-metric variants make it possible to differentiate characteristic features of races and also study their common features. Craniometry is the scientific measurement of the dimensions of the skull useful for anthropometry and forensic practice<sup>1</sup>. In forensic studies craniometry is being used to identify age, sex, stature, race, etc., of the individual from skeletal remains and to analyze evaluation of human species in archeology<sup>2</sup>. Cephalic dimensions and cranial indices are considered as the simplest and most efficient way to indicate racial and gender differences<sup>3</sup>.<sup>4</sup>. Almost all bones of the human skeleton show some degree of sexual dimorphism. Sex of an individual can be determined accurately in 80% of cases with the help of metric analysis of skull alone and using pelvis and skull together in 98% of the cases<sup>5</sup>. As studies on sexual dimorphism of cranium are very few therefore, we have undertaken this study to analyse and classify the skulls collected from Dept. of Anatomy, Osmania Medical College, Hyderabad, from Telangana, India. This craniometric data is helpful in forensic medicine,

anthropology in identification of race, sex, stature and region of unknown persons.

## MATERIALS AND METHODS

The present study was undertaken in the Department of Anatomy, Osmania Medical College, Hyderabad, Telangana, India. A total of fifty adult skulls (19 female, 31 male) were collected from the Departments of Anatomy and Forensic Medicine of various Medical Colleges of Hyderabad viz., Osmania Medical College, Gandhi Medical College and Deccan Medical College. Ethical clearance was taken from the institutional Ethical Review Committee before the initiation of the study. The measurements were taken after placing the skull in Frankfurt's horizontal plane. Instruments used were Vernier sliding caliper and spreading calipers. The measurements<sup>6</sup> taken were maximum cranial length (glabella to opisthion length GOL), maximum cranial breadth (right angles to the median sagittal plane), cranial height / basion -bregma height (basion to bregma BBH). Using these parameters cranial volume, cranial index was calculated according to the standard formulas<sup>7</sup>. Maximum, minimum and mean values of the above parameters and indices in male and female skulls were calculated. A comparative study of these values was done with those of the previous studies by various authors who worked on the skulls of different regions of India, over a period of hundred years.

Cranial index was calculated using the formula

$$\text{Cranial index} = \frac{\text{maximum cranial breadth}}{\text{maximum cranial length}} \times 100$$

Cranial volume was calculated using Lee-Pearson<sup>8</sup> formula

$$\begin{aligned} \text{Cranial volume (in males)} &= 359.34 + 0.000365 \times L \times B \times H \\ \text{Cranial volume (in females)} &= 296.40 + 0.000375 \times L \times B \times H \end{aligned}$$

Where L, B and H are cranial length, breadth and height respectively.

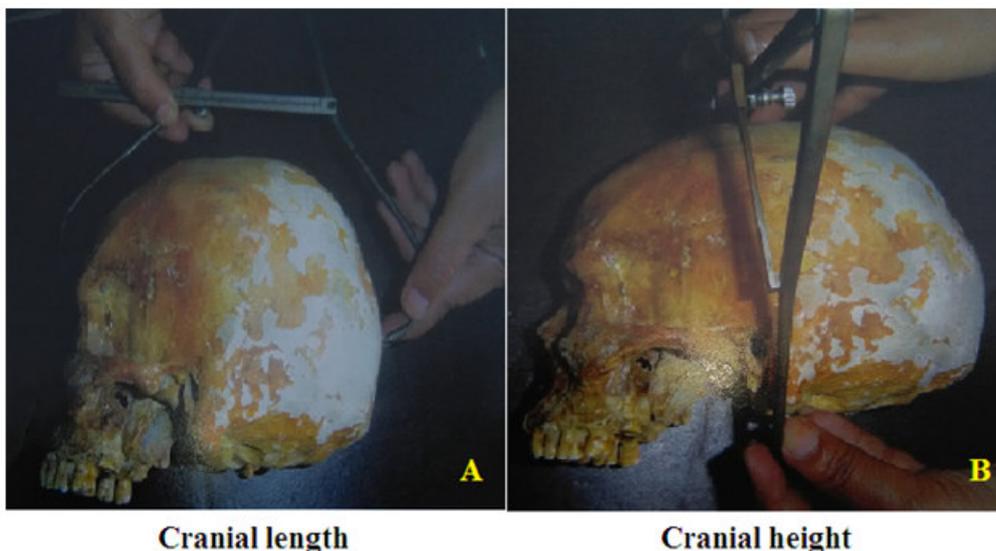
## RESULTS AND DISCUSSION

Various craniometric measurements like cranial length, breadth and height were recorded in fifty skulls consisting of 31 male and 19 female. These measurements were taken in millimeters and converted into centimeters and recorded. Cranial index and cranial volume were calculated using standard formulae as mentioned earlier. The minimum, maximum and mean of cranial length (Fig. 1A) and breadth (Fig. 1B) were noted and summarized in Table 1. The cranial length was measured with spreading calipers from glabella to opisthion. The mean cranial length was calculated using the formula  $\sum x/n$ . The mean cranial length in males and females was 17.66cm, in males it was 17.92cm and in

females 17.1cm (Table 1). Cranial length in male and female ranged from 15.8 cm (minimum) to 19.1cm (maximum), in males 17.1 to 19.1cm and in females 15.8 to 18.4cm. Comparative study of cranial length showed that the present study results are similar to the observations made in the studies by Turner<sup>9</sup> in Thug (17.9cm), Pariah (17.55cm), Tamil Sudra (17.40cm) skulls. The mean cranial breadth in males and females was 13.2cm, in males and females it was 13.4cm and 12.9cm respectively (Table 1). The cranial breadth in male and female skulls ranged from 12.2 to 15.0cm, in male 11.2 to 15.0cm and in female it was 10.4 to 13.9cm. Cranial breadth in this series are comparable to the findings made in the studies by Turner<sup>9</sup> in Thugs (13.06cm).

**Table 1**  
**Cranial length and breadth in male and female skulls of the present study**

Sex	No. of skulls	Cranial length (cm)			Cranial breadth (cm)		
		Maximum	Minimum	Mean	Maximum	Minimum	Mean
Male	31	19.1	17.1	17.92	15.0	11.2	13.4
Female	19	18.4	15.8	17.1	13.9	10.4	12.9
Total	50	19.1	15.8	17.61	15.0	12.2	13.2



**Figure 1**

**A- Cranial length, B- cranial breadth**

The mean cranial index of male and female skulls examined was 75.21%. The mean cranial index in males was 75.32% and in females 75.42% (Table 2). The cranial index in male skulls ranged from 59.77 (minimum) to 81.76% (maximum) and in females 69.66 to 78.82%. The present study results are similar to the studies made by earlier researchers. The results in the present study clearly indicate that difference in cranial indices of male and female skulls is insignificant similar to earlier studies<sup>10-12</sup>. The insignificant difference in the cranial indices of the male and female skulls confirms less sexual dimorphism in humans as compared to other primates<sup>11</sup>. Our results are contradictory to high level of sexual dimorphism observed<sup>13</sup> in Nigeria skulls. Based on cranial index the skulls were classified according to Ashley Montagu and listed in Table 2. In the present

study, depending on the mean cranial index (75.21%), n = 21 (42%) skulls belong to Dolicocephalic (long head), n = 24 (48%) to Mesocephalic (medium size head), n = 5 (10%) to Brachycranial (short head) and no skull (n = 0) belong to Hyperbrachycephalic (very short head) group. However, Dhall and Gopinath<sup>14</sup> in their study on 89 adult skulls belonging to the North Indian population found in 78 (87.64%) skulls dolicocephalic, 10 (11.24%) mesocephalic and 01 (1.12%) brachycephalic and concluded that most of the North Indian skulls belong to dolicocephalic group. Desai et al.<sup>15</sup> in their study on South Indian skulls reported most skulls belonged to mesocephalic type. However, in the present study 57.3% skull belongs to dolicocephalic group contradictory to the previous studies.

**Table 2**  
**Classification of skulls based on cranial indices in the present study**

Sex	No. of skulls	Cranial index (%)			No. of skulls	Cranial index (%)	Type of skulls
		Maximum	Minimum	Mean			
Male	31	81.76	59.77	75.32	21	Up to 74.9	Dolicephalic
Female	19	78.82	69.66	75.42	24	75.0-79.9	Mesocephalic
Total	50	81.76	59.77	75.21	5	80.0-84.9	Brachycephalic
					NIL	85.0-89.9	Hyperbrachycephalic

Earlier reports demonstrated that in Mongoloid race dolicocephaly was rare while brachycephaly was rare in Negroid race. Human knowledge of paleontology and available data suggest that early man was generally dolicocephalic. According to Cunningham<sup>16</sup> book of

Anatomy, dolicocephalic skulls were found in Australians, Zulus, Eskimos and Fijians. Mesocephalic skulls in European (mixed), Chinese, and Polynesians (mixed) and Brachycephalic skulls in Malays, Burmese, American Indian and Andamanese<sup>17</sup>.

**Cranial volume**

The cranial breadth / biparietal distance (BPD), cranial length (GOL) and cranial height (BBH) (Fig. 2) were measured and cranial volume was calculated and presented in Table 3. The mean cranial volume in both males and female was 1686cc. The mean of cranial volume in male and female skulls were 1686cc and 1850cc respectively. The minimum and maximum mean cranial volume in males and female was in the range of 1373 to 2009cc. The cranial volume in the male skulls ranged from 1435 to 2009cc and in female skulls 1373 to 1850cc. The mean cranial volume of the present

study skulls is slightly higher than the previous study of Manjunath<sup>18</sup> in Bangalore skulls. Reed and Jensen<sup>19</sup> studies quoted that Intelligent Quotient (IQ) depends on the cranial volume. They classified the skulls into two groups depending on cranial volume. In first group if cranial volume is above 1550cc IQ is between 124-136 and categorized as Category 1 and in the second group if it is below 1549cc IQ is between 87-111 categorized as Category 2. In the present study n=38 (76%) skulls (29 male and 9 female) belong to category 1 and n=12 (24%) skulls (2 male and 10 female) to category 2 (Table 3).

**Table 3**  
**Cranial volume and Intelligent Quotient classified based on cranial volume**

Sex	No. of skulls	Cranial volume (cc)			Cranial volume (cc)	Intelligent Quotient	
		Maximum	Minimum	Mean		Category 1	Category 2
M	31	2009	1435	1686	1509-2009	29	2
F	19	1373	1850	1549	1372-1850	9	10
M + F	50	1373	2009	1686	1372-2009	38	12



**Cranial height**

**Figure 2**  
**Cranial height**

Craniometry is used in various fields. It is helpful in the study of human growth variation in different races, for clinical diagnosis and treatment. It is essential in the study of population dynamics especially with respect to quantitative variables. Craniometric methods are used in forensic medicine to identify the individuals from remains of the skull in medicolegal cases. It has a valuable place in clinical specialities like plastic and oral surgical departments.

**CONCLUSION**

The results of present study showed no significant

**REFERENCES**

1. El-Feghi I, Sid-Ahmad MA, Ahmadi M. Automatic localization of craniofacial landmarks for assisted

difference between cranial indices of male and female skulls indicating less sexual dimorphism in the skulls of Telangana region. In this study most of the skulls 24 (48%) were grouped under mesocephalic, and 21 (42%) skulls under dolicocephalic. This knowledge of cranial index is useful for forensic medicine experts, plastic surgeons, anatomist, anthropologist and oral surgeons for clinical and research purpose.

**CONFLICT OF INTEREST**

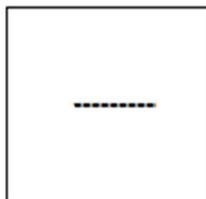
Conflict of interest declared none.

cephalometry. Pattern Recognition. 2004 Mar 31; 37(3): 609-21.

2. Douglas SJ. Cranial capacity and endocranial cast. TJ. 1990; 4(1): 56-65.

3. Lobo SW, Chandrashekar TS, Kuma S. Cephalic Index of Gurung Community of Nepal –an Anthropometric study. Kathmandu Univ Med J. 2005; 3 (11): 263-5.
4. Chaturvedi RP, Harneja NK. A cranimetric study of human skulls. J Anat Soc India. 1963; 12: 93-6.
5. Standring S et al. Gray's Anatomy. The anatomical basis of clinical practice. Churchill Livingstone and Elsevier. 2008; V 40: 419-20.
6. Das BM, Ranjan D. In: Physical Anthropology Practical Kitab Mahal Pub. Allahabad. 2013; pp. 408.
7. Ashley M. A handbook of Anthropometry. With a Section on the Measurement of Body Composition, 1961; pp. 198.
8. Lee A, Pearson K. Data for the problem of evolution in man-a first study of the correlation of the human skull. Philosophical Transactions of Royal Society, London. 1901; 196a: 225-64.
9. Turner W. Contributions to craniology of population of India. Tran Roy Soc Ed., 1906; 40: 59-101.
10. William PL, Warwick R, Moore REM, Bannister LH, Standring SM, Rees EL, Osborn JW. Gray's Anatomy. 35th ed. Longman Group Ltd. 1973; p. 312.
11. Seema Mahajan A, Gandhi D. Cephalometric study of adult human skulls of north indian origin international journal of basic and applied medical sciences. 2011; 1(1): 81-83.
12. Adejuwon SA, Salawu OT, Eke CC, Femi-Akinlosotu W, Odaibo AB. A craniometric study of adult human skulls from Southwestern Nigeria. Asian J Med Sci. 2011; 3(1): 23-5.
13. Orish CN, Ibeachu PC. Craniometric Indices of Nigeria Skulls. Int J Anat Appl Physiol. 2016; 2(1): 6-13.
14. Dhall U, Gopinath K. Sutural bones in North Indian population. J. Anat Soc India. 1998; 47 (2): 25-6.
15. Desai SD, Hussain SS, Muralidhar PS, Thomas ST, Mavishettar GF, Haseena S. A Craniometric Study of South Indian Adult Dry Skulls. J. Pharm. Sci. and Res. 2013; 5(2): 33-34. .
16. Cunningham DJ. Cunningham's Text-Book of Anatomy. 8<sup>th</sup> ed. Oxford Publ. H. Milford Publ., Oxford Univ Press. 1943; p 1558.
17. Robinson A. Skull Measurements and indices employed in physical anthropology. In: Cunningham's text book of Anatomy. Williams Wood & Company, 1918; 284-6.
18. Manjunath, KY. Estimation of Cranial Volume - an Overview of Methodologies. J of Anat Soc of India. 2002; 51 (1): 168-72.
19. Reed TE, Jensen AR. Choice reaction time and visual pathway conduction velocity both correlate with intelligence but appear not to correlate with each other: Implications for information processing. Intelligence. 1993; 17: 191-203.

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