Original Research Article

A study to estimate the cranial capacity in 100 dry human skull bones

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Abstract

Background: Craniometry is the scientific measurement of the skull useful for anthropometry and forensic practice. Cranial index variations between and within population have been attributed to a complex interaction between genetic and environmental factors. The morphometric and non-morphometric studies of human skulls are very helpful for identification of the sex and age by anthropologist and forensic practice. Cranial dimensions and Cranial indices are considered as simplest and most efficient way to indicate facial differences. **Materials and Methods:** The present study will constitute 100 dried adult skulls belonging to both sexes available in the department of anatomy and forensic medicine RRMC and H, MS Ramaiah medical college and Sapthagiri medical college, Bangalore. **Results:** The mean cranial index of the skulls were 76.989 which classifies them under mesocephalic type and we find a significant correlation between the cranial index and the length height and breadth height index with the p value coming below 0.001. **Conclusion:** The mean, SD of all the parameters to calculate is mentioned in table 1. The mean cranial index is 76.989 with the standard deviation of 5.8775, that of length height index was 76.991 with SD of 4.4615 And that of breadth height index was 100.268 with SD of 5.4350. There is a significant correlation between the cranial index, the length height and breadth height indices. With a correlation value of 0.681 for length height index and -0.635 for breadth height index. Both had a p value <0.001.

Keywords: skull bones, cranial cavity, cranial index, craniometry.

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INTRODUCTION

Craniometry is the study of the shape and form of the human head or skull, sometimes known also as craniology (the difference lies largely in that the former implies precise measurement, the latter less so). As it is such an obvious observation that people vary considerably in the size and shape of their heads and faces, it is hardly surprising that attempts to put this to scientific and other uses stretch well back in time. The modern and quantitative study of craniology derives essentially from the nineteenth century, when it became widely accepted that evolutionary changes could be explored through detailed comparisons of skulls. In effect it is a specialized branch of anthropometry, the quantitative study of the human body.[1] It is distinct from phrenology, the pseudoscience that tried to link personality and character to head shape, and physiognomy, which tried the same for facial features. However, these fields have all claimed the ability to predict traits and intelligence. When comparing skulls of different species and races, the anthropologists make use of measurements and indices which give numerical expression to certain features of the skull , which it may be difficult to describe otherwise.[2] Attempts to establish reliable craniometric differentiation between races is as old as craniometry itself and although the mandible and cranial capacity are in this connection less dependable, satisfactory characterization has been established for some racial groups and especially for Caucasian and negroes. [3] The human skull has been studied both metrically and non-metrically previously. These studies have thrown light on the functional and morphological aspect of the skull. To identify the unknown person from skeletal system is the

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most common practice. Skeletal remains have been used for sexing the individual as bones of the body are last to perish after death, next to enamel of teeth. Almost all bones of the human skeleton show some degree of sexual dimorphism. Sex of unknown skull can be determined with the help of metric analysis of skull. The physical differences between people can be recorded by measurements and based on these measurements different indices can be worked out. Cranial index and other cranial indices are useful in differentiation of racial and gender difference. Craniometry has further application in clinical specialities such as plastic surgeries and oral surgery with craniofacial deformities.[4] Craniomteric methods have a special use in forensic practise , where cranial remains can be compared with existing photographic and radiographic records in making an identification . they also play a part in attempts to reconstruct the appearance in life of individuals from their skeletal remains. The possibility of using the video superimposition technique for the identification of a skull by comparing it with photographs of missing persons is based on the fact that the human skull unlike any other part of the human skeleton , shows unmistakable individuals characterestics . In order to obtain a quantification, the individuality of the human skull is defined in craniometric terms and on their probable data. Cranial measurements and indices offer the simplest and fairly accurate way of judging the similarity or dissimilarity when comparing skulls of different species and races. [5]

Objective

To compare the cranial index with the other indices and find their correlation.

MATERIALS AND METHODS

The Present study was conducted at Raja Rajeshwari medical college from August 2013 to August 2015. A total of one hundred adult skulls belonging to both sexes were analyzed during the study period.

Inclusion criteria: Complete adult crania of both sexes

Exclusion criteria: Atrophied /decomposed/deformed crania. Skulls with any injury, pathology or congenital anomaly are excluded.

Methods: Measurements were made on all skulls, mounting the skulls on the stand and fixing it in anatomical position **Anatomic position:** The skull is placed in such a way that either the Frankfurt plane(line passing through the infraorbital border and the upper border of external acoustic meatus) or the reid's base line (a line passing through the infraorbital border and the middle of the external acoustic meatus)is parallel to the platform on which the skull to be measured is placed. The measurements which could be taken accurately with the skull fixed on the stand were recorded, whereas the rest of the measurements were made on the skull, demounting the skull from the stand and placing it on the sand bag. Measurements were made using vernier and sliding callipers, the measurement were taken to the nearest millimeter.

Statistical analysis was carried out on all measurements and indices to find out the minimum and maximum values, and also to calculate the standard deviation and standard error for each measurement and index. Mean values were also calculated for the above findings.

Correlation between the indices were calculated to find out its significance between the compared indices.

RESULTS

The mean cranial index of the skulls were 76.989 which classifies them under mesocephalic type and we find a significant correlation between the cranial index and the length height and breadth height index with the p value below 0.001.

Table 1: Minimum, maximum, standard deviation, standard error and mean of Cranial measurements

	No Of Skull	Mean	SE	SD	Min	Max
Maximum Cranial Length	100	17.339	0.0852	0.8520	14.5	20.5
Maximum cranial breadth	100	13.311	0.0667	0.6673	12	15.8
Basion Bregmatic Height	100	13.318	0.0443	0.4425	12.2	14.5
Maximum Bizygomatic Breadth	100	12.605	0.0609	0.6091	11	14
Upper Cranial Facial Height	100	6.195	0.0445	0.4446	5.4	7.2
Basion Prosthion Length	100	9.328	0.0536	0.5360	8.2	10.4
Nasal Height	100	4.86	0.0281	0.2807	4.2	5.6
Nasal Breadth	100	2.524	0.0209	0.2090	2	3
Orbital Height (left eye)	100	3.7206	0.0317	0.3168	3.1	4.4
Orbital height (right eye)	100	3.709	0.0310	0.3098	3	4.5
Orbital heaght (left eye)	100	3.418	0.0291	0.2911	2.9	4.4
Orbital heaght (right eye)	100	3.448	0.0275	0.2751	3	4.2
Palatal length	100	5.223	0.0421	0.4214	4.4	6.3
Palatal Breadth	100	3.642	0.0301	0.3009	3	4.6
Basion Nasion Length	100	9.867	0.0454	0.4544	8.5	11.

Table 2: Mean, minimum, maximum, standard deviation and standard error of the various cranial indices. No. of Skulls

	No ok Skull	Mean	SE	SD	Min.	Max.
Cranial index	100	76.989	0.5878	5.8775	61	96.6
Length height index	100	76.991	0.4462	4.4615	59.5	89.7
Breadth height index	100	100.268	0.5435	5.4350	87.3	112.5
Orbital index	100	108.963	1.2736	12.7358	79.3	133.3
Nasal index	100	52.109	0.5281	5.2807	40	65.2
Palatal index	100	70.165	0.8000	7.9999	55.2	91.3

Table 3: Classification of Skulls based on Cranial Index

	Hyperdpolicocephalic (<=69.9)	Dolicocephalic (70.0-74.9)	Mesocephalic (75.0-79.9)	Brachycephalic (80.0-84.9)	Hyperbrachycephalic (>=85.0)
n	8	28	37	15	12
Percent	8.0%	28.0%	37.0%	15.0%	12.0%

From the above classification, it is clear that the majority of skulls falls under mesocephalic at 37%, followed by dolicocephaly at 28%.

Table 4: Correlations between Cranial index vs other index Length height index

	Length Height index	Breadth height index	Orbital index	Nasal index	Palatal index
Correlation	0.681	-0.635	-0.148	0.064	0.149
P value	<0.001	<0.001	0.140	0.527	0.138

The above table shows the correlation between the cranial index and the other indices. The p value for length height index 0.001 and breadth height index 0.001 is less than 0.05 and hence have a positive correlation with the cranial index. Whereas the orbital index, nasal index and the palatal index have their values above 0.05 and can be summarized as having no correlation with the cranial index in the above study.

DISCUSSION

Anthropologists measure the skull in belief that the results obtained from craniometry would enable them to trace the relationships between the races of mankind. The form of skull remained constant in each race and that in different races, exhibited different cranial indices. The craniometric values have become increasingly important in the identification of persons and also in the comparative studies with fossil man. In the present study on 100 adult dry crania belong to random sampling where mandible is missing. The study enlists 13 different measurements of crania and the data obtained will be used to calculate six different indices. The Correlation between cranil index and the other indices is tabulated. In the present study, 8% were hyperdolicocephalic 20% were dolicocephalic, 37% were mesocephalic, 15% were brachycephalic and 12% were hyperbrachycephalic. The mean cranial index is 76.989 with standard deviation of 5.87 and can be classified as dolicocephalic. Based on the length – height index, 5% were chamaecranic, 17% were orthocranic and 78% were hypsicranic . The mean is 76.99 with SD of 4.46 and can be classified as Hypsicranic. Based on the breadth – height index, 10% were tapeinocranic, 25% were metriocranic and 65% were acrocranic. The mean is 100.26 with SD of 5.43 and can be classified as Acrocranic. Based on the orbital index, 0% were chamaeconch, 10% were mesochonc, 90% were hypsichonc. The mean is 108.96 with SD of 12.73 and can be classified as hypsichonc. Based on the nasal index ,19% were Leptorrhine, 14% were mesorrhine, 58% were chamaerrhine and 9% were hyperchamaerrhine. The mean is 52.1 with SD of 5.28 and can be classified as chamaerrhine. Study done by S.A. Adejuwon (2009)[6] showed that the skulls represent dolicocephalic heads with mean cranial index of 72.54, which is at variance with mesocranic skull of the Hausas/Fulanis of Northern Nigeria and brachycephalic head shape of the Ogonis in Southern Nigeria reported by Adebisi (2003) [7] and Oladipo *et al.* (2009) [8] respectively. In 2010, S.D Desai [9] did a study in Davangere, Karnataka, India, on 125 dry adult human skulls. The results of the study showed that most of skulls belong to Mesocephalic (Cranial Index between 75 to 79.9mm). In 2011, Seema [10] did a study on sixty two adult human skulls and concluded that the skulls belonged to dolicocephalic type with mean value of 72.54. A study done by Dr. Vishal Manoharrao [11] in 2012 on 136 adult skulls, which showed a mean cranial index of 72.05 and can be classified as dolicocephaly. In 2013 P.Sri Devi [12] did a study on 40 adult skulls and concluded that, the Mean cephalic index is 71.6 and most of the skulls are Dolico cranial type, Mean orbital index is 72.1 and the Orbits belongs to skulls were Hypsi cranial type and Mean auricular height is 66.52mms, the skulls are Hypsicephalic type. In the present study, the mean cranial index is 76.989 with the standard deviation of 5.8775, that of length height index was 76.991 with SD of 4.4615 And that of breadth height index was 100.268 with SD of 5.4350. There is a significant correlation between the cranial index, the length height and breadth height indices.

With a correlation value of 0.681 for length height index and -0.635 for breadth height index. Both had a p value <0.001. The other indices which include nasal, palatine and orbital index do not show a good correlation with the cranial index.

CONCLUSION

In present study, significant correlation was found in the cranial indices of skulls. The mean cranial index falls under mesocephaly and that tends to agree with the similar studies conducted earlier in the south Indian population. Therefore, estimating the various cranial indices of skulls is an undisputable criterion for determination of racial changes from one area to the next. Most of the anatomists and anthropologists while studying crania of various races on the basis of morphological metrical features concluded that the population of a country is no more formed by one homogenous element but instead constituted by heterogenous elements. This explains how there can be s wide range of variation of cranial capacity within a group of population.

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