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Original Research Article

A study on morphometry of cranium and its index in dry human skulls of north India

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ABSTRACT

Background: Cranial indices, derived from skull measurements, are fundamental tools in cranial anthropometry. Establishing standard values for these indices is crucial for anatomists and craniofacial surgeons performing cranial reconstructions.
Materials and Methods: This study aimed to establish baseline data on cranial morphology and calculate cranial indices. One hundred dry skulls of unknown sex were measured in the Department of Anatomy at Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun. Cranial length and breadth were measured, and the cranial index was calculated. Cranial types were also classified.
Results: The mean cranial length was 190.90 mm, with a mean breadth of 139.40 mm. The cranial index was 73.03. Mesocranic (48%) and dolichocranic (42%) skulls were the most prevalent, while brachycranic (8%) and hyper-brachycranic (2%) skulls were less common.
Conclusion: This study provides baseline data on cranial morphometry in an unknown population sample. The results suggest a predominance of mesocranic and dolichocranic head shapes.

1. Introduction

Cranial anthropometry has become an increasingly significant field for anatomists, anthropologists, and plastic surgeons. In addition to metric measurements of the cranium, cranial indexes offer valuable insights into cranial morphology. The calculation of the cranial index is a method used to categorize human populations.[1] The cephalic index, introduced by Swedish professor of Anatomy Anders Retzius (1796–1860), was initially employed in physical anthropology to classify ancient human remains discovered in Europe.[2]

The cranium, comprising twenty-two bones interconnected to form the head skeleton, expands to twenty-nine with the inclusion of one hyoid bone and three pairs of ear ossicles. It is classified into two main divisions based on its surrounding structures: the neurocranium, encasing the brain, and the splanchnocranium (viscerocranium), enveloping the oral and nasal cavities. The neurocranium comprises eight bones, while the splanchnocranium consists of fourteen bones, all belonging to the flat and irregular bone groups. These bones, excluding the mandible, are linked via immobile joints termed sutures. Cranial anthropometry holds increasing significance for anatomists, anthropologists, and plastic surgeons, facilitating detailed analysis and understanding of cranial structures and their variations.[3]

The cephalic index is now widely used to describe individuals' appearances and to estimate the age of fetuses for legal and obstetrical purposes. As a result, it has broad applications in various forensic investigations. Analyzing changes in the cephalic index among parents, offspring, and siblings can provide insights into the genetic transmission of

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inherited traits. In anthropology, the cephalic index serves as a useful metric for distinguishing samples or individuals by race, sex, or personal identity.[4]

2. Materials and Methods

The present study was conducted in the department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun. A total 100 adult dry skulls of unknown sex and age were studied. The skulls which were damaged and with abnormalities were excluded from the study. The study was conducted by using spreading caliper.

Parameters measured:

1. Maximum cranial length in mm
2. Maximum cranial breadth in mm
3. Cranial index
4. Types of cranium

Following were the various landmarks used for the measurements of parameters:

Glabella: Most prominent point on the middle of frontal bone between the two superciliary arches (Figure 1).

Opisthocranion: Most posterior point on the skull above the external occipital protuberance (Figure 2).

Eurion: Most lateral point on the either side of skull (Figure 2).

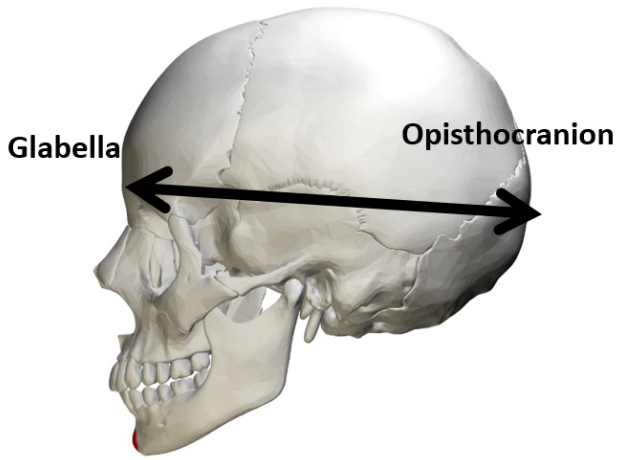

Figure 1: Maximum cranial length

Measurements taken were:

1. Maximum cranial length (CL): This is the distance between glabella and opisthocranion (Figure 1).
2. Maximum cranial breadth (CB): it is the linear distance measured between the eurion points located on both parietal bones (Figure 2).
3. Cranial index (CI = CB / CL × 100).

The data collected from dimensions of foramen magnum and cranium were statistically analyzed.

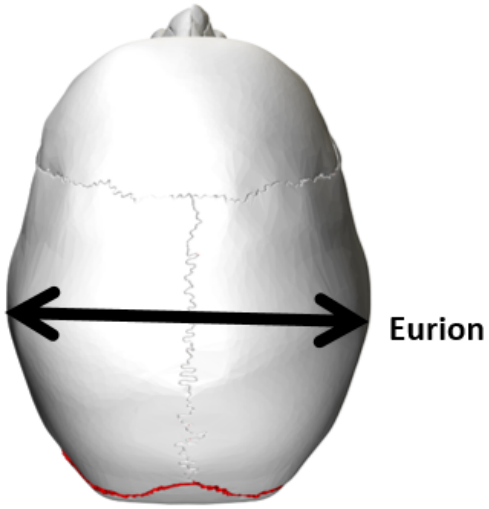

Figure 2: Maximum cranial breadth

3. Result

Table 1: Mean and standard deviation of various parameters

Variables		Mean ± Sd (mm)(N= 100)
Cranium	Maximum Cranial Length	190.90± 1.67
	Maximum Cranial Breadth	139.40± 1.42
	Cranial Index	73.03± 3.23

The mean length of the cranium was recorded as 190.90 mm, with a mean breadth of 139.40 mm. The cranial index, obtained by dividing the breadth by the length of the cranium, was found to be 73.03 mm (Table 1).

Table 2: Classification of skulls of various cranial indices (based on M.F Ashley Montagu, 1960)

Type	Number of Skulls (N=100)	Percentage
Dolichocranial (0-74.9)	42	42%
Mesocranial (75-79.9)	48	48%
Brachycranial (80-84.9)	8	8%
Hyper brachycranial (85-89.9)	2	2%

This study indicated that out of total 100 skulls, the maximum belonged to Mesocranial (48%) and Dolichocranial (42%) groups, however low percentage was noticed in Brachycranial (8%) and Hyperbrachocranial (2%) groups as per M.F Ashley Montagu classification (Table 2).

Table 3: Comparison of maximum cranial length, maximum cranial breadth and cranial Index of present study with previous studies

Author	Maximum cranial length (mm)	Cranial breadth (mm)	Cranial Index
Howale et al[3] (2012)	171.1	129.8	75.49
Senol et al[1] (2019)	172.20	139.15	81.59
Singh et al[2] (2018)	Males: 186.30	Males: 144.58	Males: 77.71
Samson et al[5] (2019)	Males: 182.99	Males: 138.59	Males:76.09
	Females: 178.53	Females: 137.21	Females: 75.81
Kaithackal et al[6] (2021)	Males: 178.74	Males: 131.37	Males:73.71
	Females: 166.43	Females: 129.11	Females: 77.68
Present study	190.90	139.40	73.03

4. Discussion

Anthropometric measurements are essential tools for making comparisons and achieving more objective racial assessments. Standardized cephalometric records allow for diagnostic comparisons between patients and the normal population. Examining changes in the cephalic index among parents, offspring, and siblings can provide insights into the genetic transmission of inherited traits. Since the dawn of human existence, morphological appearances have been continuously evolving. Evolution is essentially defined as genetic change over time, and physical anthropology is a science based on evolutionary principles. The cephalic index is a highly useful anthropological tool for identifying racial and sex differences and can also be used to establish individual identity.[7]

Cranial anthropometry is becoming increasingly significant for anatomists, anthropologists, and plastic surgeons. In addition to metric measurements of the cranium, cranial indexes offer valuable information about cranial morphology. The calculation of the cranial index is a method used to categorize human populations. In this study, craniometric measurements were conducted using previously defined parametric values, and various index values were calculated based on these measurements. These indexes provide insights into the morphology of the head and face of different societies, as well as the impact of various factors on the development of the head and face. Furthermore, they are crucial for planning surgical procedures. This study aimed to investigate cranial index values anthropometrically and to contribute to the existing literature.[1]

In the present study, the mean cranial index was recorded as 73.03. This contrasts with Howale et al's findings, who calculated a mean index of 75.49.[3] Senol et al. reported a higher average index of 81.59.[1] Singh et al found differing averages between genders, with 77.71 in males and 79.35 in females.[2] Nair et al. estimated the mean cranial index to be 76.67.[4] Samson et al. found 76.09 in males while 75.81 in females.[5] Kaithackal et al. reported the mean cranial index in males was 73.71 and in females was 77.68.[6] These variations underscore the diversity in cranial morphology across different studies and populations (Table 3).

The variations of head shape may be due to hereditary factors or environmental which may act as secondary effect. The kind of diet taken could also play a role in influencing the dominant head shape. Head shapes can also change from one generation to the other.[8]

5. Conclusion

The data from this study can be applied across various medical fields, including forensic medicine, plastic surgery, oral surgery, pediatrics, and dentistry, to compare patients with the normal population. The observations and results of this study may serve as a foundation for extended cephalometric studies across different geographical zones. Anthropologists and measurement experts can utilize this data for a variety of anthropological applications. The morphometric analysis of the cranium aligns with previous literature to some extent, indicating similarities in measurements and supporting existing findings.

6. Sources of Funding

None.

7. Conflict of Interest

None.

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