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ORIGINAL ARTICLE

A Cross Sectional study of Cephalic Index to Determine Sexual Variation in male and female MBBS and BDS Students of a Tertiary Care Teaching hospital in North East India

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Abstract:

Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and are a manifestation of the internal structure and tissue components which in turn, are influenced by environmental and genetic factors. Cephalic Index is useful for identification of race. It is also used to determine sexual differences especially in individuals whose identities are unknown. A research study was conducted with an aim to determine cephalic index of MBBS and BDS students of a tertiary care teaching hospital in North East India and to compare sexual variation. A total of 480 MBBS and BDS students participated in the study with a ratio of 2:1. The mean age of the participants was 21 ± 2 years. Male participants were more in number than female with 2:1 ratio. Students belonging to all Northeastern States participated in the study with fewer from All India quota. The mean cephalic index was 82.07 ± 2.61 ranging from 72.43 to 84.21. The CI of female was more than male students and it was found to be statistically significant (p=0.02). The Brachycephalic type is the commonest cephalic index in both sexes (73.5% in male and 64.8% in female) respectively followed by Mesaticephalic (24.6% in male and 33.3% in female). Dolicocephalic is least common type of cephalic index. However, brachycephalic CI is higher in male participants and mesaticephalic CI is higher in female participants and this difference is found to be statistically significant.

Keywords: Cephalic index; Sexual dimorphism; North east india; Mesaticephalic; Dolicocephalic; Brachycephalic skull; MBBS students; BDS students; Tertiary care teaching hospital.

Introduction:

Anthropometric data are believed to be objective and they allow the forensic examiner to go beyond subjective assessments such as ´similar' or ´different'. With measurement data, the examiner is able to quantify the degree of difference or similarity and state how much confidence can be placed in this interpretation.[1]

Cephalic index is a useful anthropometric parameter utilized in the determination of racial variations.[2] It is also called as Cranial Index or Index of breadth and was defined by Swedish professor of Anatomy Anders Retzius (1796–1860) as the ratio between maximum breadth of the skull to the maximum length of the skull. It was first used in physical anthropology to classify ancient human remains found in Europe.[3] It is one of the clinical anthropometric parameters recognized in the investigation of craniofacial skeletal deformities and brain development because of its validity and practicality. Cephalic indices also play a crucial role in comparison of cephalic morphometry between parents, offsprings and siblings and provide information on inheritance pattern.[4] Further, cephalic index is the most frequently investigated craniofacial parameter as it utilizes the length and breadth of the head which are useful indices in the study of secular trend.[5] It gives an idea of how genetic characters are transmitted between parents, offsprings, and siblings.[6] It is inherited in a unitary fashion. Isolated or syndromic-craniosynostosis, primary microcephaly, and hydrocephalus are pathological disorders which manifest with abnormal cephalic indices in addition to other features.[7]

Cephalic Index is divided into three categories: Dolicocephalic (long headed), Mesaticephalic (medium headed), Brachycephalic (short headed).[8,9] Cephalometric studies can also be carried out by various methods like photogrametry, ultrasound, computed tomographic scanning, magnetic imaging, optical surface scanning and cephalometry.[10]

The present study was carried out to measure cephalic index, the types of head shapes in MBBS and BDS students of a tertiary care teaching hospital in North East India in order to study the sexual variation. This will help in establishing a database regarding sexual variations in cephalic index of the study population. This study will also help in identification, especially in sex differentiation of unknown bodies, decomposed bodies and mutilated remains and in mass disasters.

Materials and methods:

The present study is a Cross-sectional study and was carried out in a tertiary care teaching hospital, in North East India. This institute has yearly intake of 125 undergraduates medical students, 150 postgraduate medical students and 50 dental

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students. The study was done from January 2021 to October 2022. The study population comprised of MBBS and BDS students studying in the institute who were above 18 years of age and were willing to participate. Students with congenital craniofacial anomaly, trauma and those who have undergone reconstructive surgery were excluded.

The sample size was calculated as follows:

Taking sample size as (N)

Taking power of the study (U) at 80% = 0.84

Value at 95% confidence interval (V) = 1.96

Standard deviation (SD) of cephalic index for male(SD_1)= 2.55 and for female(SD_2) =2.79

Taking, mean (M) for cephalic index in male (M_1) = 77.08 and for female (M_2) = 79.02 (from the study done by Gujaria[21]), sample size was calculated using the formula:

$$N = \frac{(U+V)^2 \times (SD_1^2 + SD_2^2)}{(M_1 - M_2)^2}$$

$$\text{Therefore, } N = \frac{(0.84 + 1.96)^2 \times (2.55^2 + 2.79)^2}{(77.08 - 79.02)^2}$$

$$= 29.77$$

The calculated sample size was 29.77 for male and female each, which was rounded to 30 for male and female each. Therefore, total sample size calculated was 60. However, MBBS and BDS students in the institute are enrolled from seven northeastern states quota and central quota. So, 60 students from each seven state and central quota if considered, then sample size came around 480. Since the number of students were less than 60 for some states, all the students from that particular state were included in the study.

Sampling: In some states number of students were more than 60, therefore, simple random sampling was done. Participants were selected by lottery method.

Study variables: Independent Variables:

1.Age 2.Sex 3. Ethnic group

4. Breadth of the skull (cm) 5. Length of the skull (cm)

Dependent Variables: Cephalic Index

Study tools: Martin's Spreading Calipers

Data collection: Working definition:

Cephalic Index: The ratio between the maximum breadth of the skull to the maximum length of the skull multiplied by hundred.

Maximum breadth of the skull: The distance between the two parietal eminences of the skull.

Maximum length of the skull: The distance between the glabella and the external occipital protuberance of the skull.

Procedure: Students were called in batches during free time or after the classes to the department of Forensic Medicine and Toxicology and the measurements were done and recorded. All the measurements were done maintaining privacy in a room.

Table 1. Distribution of the participants by state domicile (N=480).

State	Frequency	Percent
Arunachal Pradesh	44	9.2
Non Northeastern States	36	7.5
Manipur	150	31.3
Meghalaya	52	10.8
Mizoram	43	9.0
Nagaland	51	10.6
Sikkim	36	7.5
Tripura	68	14.2

Table 2. Distribution of the participants by their height and weight (N=480).

Anthropometric parameter	Measurement (Mean ± SD)
Height	161 ± 9 cm
Weight	58 ± 10 kgs

Table 3. Distribution of the participants by their skull breadth and length (N=480).

Skull	Measurement (Mean ± SD)
Breadth	14.9 ± 0.7 cm
Length	18.1 ± 0.6 cm

Table 4. Sex variation of cephalic index.

Sex variation	Cephalic index (Mean ± SD)	Mean difference	P value
Male	81.85 ± 2.68	0.54	0.02
Female	82.39 ± 2.57		

After getting due consent from the study subjects, these measurements were performed with subjects in a relaxed condition with head in the anatomical position using standard anatomical landmarks. A spreading caliper was used to measure the head measurements.

Statistical analysis: Data entry was using windows based statistical package for social sciences [SPSS] version 21.0 (Armonk NY: IBM Corp). Descriptive statistics like mean, standard deviation was used to summarize age and cephalic index. Frequency and proportion were used to determine sex and ethnic group. To compare between male and female cephalic index students test was used. A p-value of 0.05 or less was considered significant.

Ethical issues: Written informed consent was obtained from the students regarding the collection of data, and the approval from the Research Ethical Board (REB), of the institute was sought. The findings were recorded in proforma and the results were analyzed. Access to the data will be restricted to the investigator and the guides, and members of REB (Research Ethics Board) when they demand. The present study is a self-sponsored study and there is no conflict of interest.

Results:

A total of 480 students participated in the study. The mean age of the participant is 21 ± 2 years ranging from 18 years to 26 years including both sexes of MBBS and BDS students. Male subjects were 285 (59.4%) and females were 195 (40.6 %). (Figure 1). Majority belonged to MBBS – 326 (67.9%). BDS - 154 (32.1%). (Fig 2).

Majority of participants belonged to Manipur state domicile – 150 (31.3%), followed by Tripura (14.2%), Meghalaya (10.8%), Nagaland (10.6%), Arunachal Pradesh (9.2%), Mizoram (9.0%),

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Table 5. Correlation between age of the participants and their cephalic index.

Correlation		Age (year)	Cephalic Index
Age (year)	Pearson Correlation	1	0.12
	P value (significant)		.009
	N	480	480

Table 6. Sex wise comparison of different types of cephalic index (N=480).

	Male		Female		
Type of Cephalic Index	Frequency	Percent	Frequency	Percent	P value
Dolichocephalic	9	1.9	9	1.9	
Mesaticephalic	118	24.6	160	33.3	0.02
Brachycephalic	353	73.5	311	64.8	

Sikkim (7.5%) and Non Northeastern States (7.5%) (Table 1 and Fig 3). Above table depicts that the height and weight of the participants where the mean height is 161 ± 9 cm and the mean weight of the participants is 58 ± 10 kgs (Table 2). Average measurement breadth and length of the skull of participants are 14.9 ± 0.7 cm and 18.1 ± 0.6 cm respectively where the measurement ranges from 13 to 16 cm and 16 to 19 cm respectively (Table 3). The mean cephalic index is 82.07 ± 2.61 ranging from 72.43 to 84.21 (Table 4). Above figure depicts the sexual variation of cephalic index where female's cephalic index is comparatively higher (82.39 ± 2.57) than male (81.85 ± 2.68) with mean difference of 0.54 and it is statistically significant with p value of 0.02 (Fig 4). Positive correlation is seen between age in years and cephalic index where with every unit increase in years of age, there is increase of cephalic index by 0.12 which is found to be statistically significant (p value 0.009) (Table 5).

Cephalic index classifications: for male - <75.9, 76 to 81 and > 81; for female - <75, 75.1 to 83.0 and > 83.

Above table 6 and figure 5 have shown that Brachycephalic type is the commonest Cephalic Index in both sexes (73.5% in male and 64.8% in female) respectively followed by Mesaticephalic (24.6% in male and 33.3% in female). Dolicocephalic is least common type of cephalic index. However, Bracycephalic CI is higher in male participants and Mesaticephalic CI is higher in female participants and this difference is found to be statistically significant with a p value of 0.02.

Fig 6 shows the gender distribution of the participants statewise where maximum number of participants belonged to Manipur. 82 males and 68 females participated form Manipur, 33 males and 35 females from Tripura, 35 males and 17 females from Meghalaya, 32 males and 19 females from Nagaland, 31 males and 13 females from Arunachal Pradesh, 25 males and 18 females from Mizoram, 24 males and 12 females from Sikkim and 23 males and 13 females from Non North Eastern states. Table 7 shows comparison of cephalic index between the course category i.e BDS and MBBS where CI in more among BDS students than MBBS with the mean difference of 0.81878 and it is found to be statistically significant with a p value of 0.002.

Discussion:

The present study was aimed at determining the sexual variation of cephalic index amongst MBBS and BDS students of a tertiary care teaching hospital where majority belongs to mongoloid origin.

The mean cephalic index was 82.07 ± 2.61 and ranged from 72.43 to 84.21 where male's cephalic index is 81.85 ± 2.68 and female's is 82.39 ± 2.57 with a mean difference of 0.54 which is statistically significant (p-value 0.02). The brachycephalic (large sized) type of cephalic index was the commonest type seen in both sexes (male - 73.5% and female - 64.8%) and this variation was found to be statistically significant with a p-value of 0.02. Mesaticephalic type of cephalic index is higher in female (33.3% vs 24.6%).

The mean cephalic index of this study finding is similar to the studies conducted in various parts of the country (Nepal, Central India, Nigeria, China and Malaysia) conducted by Timsina et al.,[17] Yagain et al.,[22] Eliakim et al.,[29] Raji et al.,[30] Thu et al.,[32] and Murniati et al.[34] where the study were focused on different ethnic group and found the mean cephalic index higher in comparison to the other race. Above mentioned studies also found that the cephalic index – brachycephalic type was majority.[17,22,29,30,32,34] But previously many studies were conducted in North, South and Central India, where the findings showed that the medium sized (mesaticephalic type of cephalic index) head/skull were common.[11-15,19,49-51] Majority of the studies show that the cephalic index of female was predominant and it was statistically significant.[15,17,19,22,25,29,33-36,52,53]

The present study also showed similar finding where female's cephalic index is higher (82.39 ± 2.57) and difference by 0.54 in average and this difference is found to be statistically significant.

In the present study, the mean cephalic index in females (82.39) [Brachycephalic] was higher than the studies of Yagainet al.,[22] (78.20); Patro et al.[19] (78.38); and Khair et al.[51] (75.22); which shows Mesatocephalic range in the above studies.

These findings are compared with the studies conducted by Kumaranet al.,[11] Shah et al.,[13] Timsina et al.,[17] Muhammed et al.,[33] Akhter et al.,[36] Ansari et al.,[38] and Thomas et al.,[49] where the researchers compared the cephalic index between different ethnic group and races and found that Mongoloid cephalic index is higher than other ethnic groups. The northeast Indian people are mainly of Mongoloid origin having higher cephalic index which is different from other parts of India.

In the present study the Mean Cephalic Index in overall study sample (82.07) was higher than the studies of Mishra et al.[16] (77.79); Patro et al.[19] (77.75); Salve et al.[23] (76.94); and Khair et al.[51] (78.48); which shows the mesaticephalic range in the above studies, whereas, it was similar in Nair et al.[52] (81.21); and Kanan et al.[53](81.00); which shows the brachycephalic range.

In our study, the dominant head shape type was brachycephalic (47.2%) followed by mesaticephalic (30.4%). Dominant head type in this study was similar to other studies in Nigeriaby Akinbami,[10] the study in central India by Yagain et al.[22] showed that there is a tendency towards brachycephalic. This was not similar to a study performed by Muhammad et al.[33] who found 58.5% of the Indian population was dolichocephalic.

Comparing the previous records of the CI with current work proves the tendency towards "brachycephalic," which is a confirmation of continuous growth of the brain more in the lateral direction. Also, in tropical zones, the form of the head is longer

(i.e., dolichocephalic), but in temperate zones, the head type is round (i.e., mesaticephalic or brachycephalic). Since India is in both temperate and tropical zones partly, the present classification depicts a tendency to be Brachycephalic from dolichocephalic. The average measurement of breadth and length of the skull of participants of both sexes are 14.9 ± 0.7 cm and 18.1 ± 0.6 cm, respectively, where the measurement ranges from 13 to 16 cm and 16 to 19 cm, respectively. The variations of head shape may be due to hereditary factors or environmental, which may act as a secondary effect. Vermaet al.[50] also found the head lengths (18.85 cm), which is slightly higher than the present study. The results of the present study validate that there is a variation in the Cephalic Index between males and females. Though both categories have Brachycephalic skulls, the value in the female sex is higher with a significant difference ($p = 0.02$), confirming sexual dimorphism of the Cephalic Index.

Conclusion:

In the present study, Cephalic Index has been calculated for the MBBS and BDS students of a tertiary care teaching hospital in North East India. It is found that the majority of the students (64.8%) have a Brachycephalic type of skull, and there is a significant ($p = 0.02$) sexual variation, i.e., sexual dimorphism between males and females. Though both males and females have a brachycephalic skull, the Cephalic Index is higher in females, and the difference is significant, with a p-value of 0.02. This confirms the Sexual Dimorphism of the Cephalic Index and hence can prove useful in the identification of skeletal remains in this part of the country.

Ethical Clearance: taken

Conflict of Interest: Nil

Source of Funding: Nil

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