



Assessment of Cephalix Index among Medical Students

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ABSTRACT

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. Cranial index and other cranial indices are useful in differentiation of racial and gender difference. As studies on sexual dimorphism of cranium were very few, we have taken this study to find out the differences in cranial index, vertical index and transverse vertical index of male and female crania at first year students of SCB medical college of Odisha. This study was carried out on 210 (150 males and 60 females) dry human skulls available in department of anatomy of SCB medical college in Bhubaneswar. The mean and SD of cranial index was 74.23 +/- 4.06; for males: 73.19 +/- 3.76, and for females: 76.84 +/- 3.63. The mean and SD of transverse vertical index was 100.84 +/- 6.31; for males: 102.19 +/- 6.15, and for females: 97.46 +/- 5.41. The difference between cranial index ($p = 0.0001$) and transverse vertical index ($p = 0.000019$) of male and female skulls were significant. The results of the present study show that majority of male skulls of Mumbai region belong to dolicocephalic group and majority of female skulls to mesocephalic. The result of present study shows that majority of male skulls of Odisha region belong to acrocranial group (based on transverse vertical index). This data can be useful for forensic medicine experts, plastic surgeons, anatomist and oral surgeons for clinical and research purpose.

Keywords: Cranial index, vertical index, transverse vertical index, maximum cranial length, maximum cranial breadth, cranial height

INTRODUCTION

The Indian population is subdivided into numerous endogamous groups providing ample scope for deciphering the nature and the extent of the genetic variation within and between populations. Diversity of human society, both in biological and cultural features, has been the order of the day. Ethically anatomist like biological anthropologist, while studying human variation by measuring physical characteristics such as body size, and variation in other genetic traits, emphasize on similarities that make all humans appear fundamentally alike. They work on calculating genetic distance among modern human groups and thus provide a means of inferring rates of evolution and evolutionary relationship with other closer sub-species¹.

Craniometry pertains to the morphological study of all the structures present in human head or human skull and currently it constitutes the most versatile technique in the investigation of the craniofacial skeleton, because of its simplicity, acceptability and practicality.

This is of immense value in forensic science for facial reconstruction of disputed identity, orthodontics, different oral & maxillofacial surgery or craniofacial surgery, paleoanthropology and phylogeography².

Based on different measurements of the human head, between important bony landmarks various indices are worked out. Some of its examples are Cephalic index, Physiognomic Facial index, Morphological Facial index,

Inter-orbito Jugular index, Nasal index, Physiognomic ear index, Eye index and Forehead index³.

The Cephalic index is used for analysis of racial and gender characteristics of a population. The relevant data on cephalic index of a population is necessary for the preparation of cranial remodeling band [or helmet] as durable medical equipment, necessary for positional head deformities associated with premature birth, restrictive intra uterine positioning, cervical abnormalities, birth trauma, torticollis and sleeping positions in children when banding is initiated at 4-12 months of age. It is also used for infants with synostotic plagiocephaly to correct continued asymmetry following surgery or to correct without surgery⁴.

Assembling three words of different sources i.e. kephale (Gk: head), ikos (Gk: pertaining to) and index (Lt: point out) a suitable name for pertaining to that which points out the head is derived called cephalic index. The term was first used by Swedish professor of anatomy Andrew Retzius (1796–1860) and first used in physical anthropology to classify ancient human remnants found in Europe⁵. Otherwise known as Breadth index, Cephalic index is calculated by multiplying the breadth of head with 100 and dividing it with the head length. The maximum anteroposterior diameter (head length) is measured from glabella to inion (g-in) and the head breadth (maximum transverse diameter above supra mastoid crest) is the distance between two eurions (eu-eu)⁶.



All the measurements are taken with the subjects sitting in a chair, in relaxed condition and head in anatomical position. All measurements are taken to the nearest millimeter.

Head measurements, which were determined by Martin spreading caliper, are:

Head length = summit of glabella to furthest occipital point - opithhocranium.

Head breath = greatest breadth at right angles to median plane from eurion to eurion.

$$\text{Cephalic Index} = \frac{\text{Head width}}{\text{Head length}} \times 100$$

Above index was determined on the basis of international anatomical descriptive⁷, depending upon this index the types of head and face shapes were classified as follows⁸.

Head shape	Cephalic index (CI) range (%)
Dolichocephalic	CI < 74.9
Mesocephalic	75 < CI < 79.9
Brachycephalic	80 < CI < 84.9
Hyperbrachycephalic	85 < CI < 89.9 and CI > 89.9

The cranial index is the same ratio when it is taken in a skull and is derived from cephalic index by subtracting 8 mm for soft tissue. According to the Frankfurt Agreement of 1882, skulls are divided into dolico (upto 74.9), meso (75-79.9) and brachy (more than 80) cephalic, and further into low or chamaecephalic (upto 70), medium or orthocephalic (70.1-75) and high or hypsicephalic (over75.0). The cephalic index has long been used by anthropologists, anatomists, and statisticians to study people of different pockets of world, to add some scintillating relation to their races, culture, food habits, body habits, and many more and a good numbers of works are also on the process.

The usual distribution of different types of skulls among different races i.e. Dolicocephalic among pure Aryans, Aborigines, Negroes, Caucasoid, Mesati cephalic in Europeans and Chinese and Brachy cephalic among Mongoloids has been reported⁹⁻¹².

MATERIALS AND METHODS

Previewing the various works on the cephalic index and observing the socio cultural uniqueness of students of S.C.B. Medical College, Cuttack a study was conducted to find out the distribution of this index, thus the pattern of head, in the students of S.C.B. Medical College, Cuttack taking the sex and caste differences. The present work has been undertaken to find out the average length, breadth and cephalic index of students of S.C.B. Medical College, Cuttack. This will provide a comparison of the average measurement pertaining to the students of S.C.B. Medical College, Cuttack with that of the people of other part of India. The study will also show any specific peculiarity that exists on the skull of male and female with respect to cephalic index.

Spreading caliper with Rounded tips

These are especially used for measurement of living. The measuring bar connecting the two branches is graduated from 0–300 mm for the small caliper which mainly intended for cephalometry and from 0–600 mm. For the large caliper which suitable for large diameters. The maximum antero–posterior diameter (head length) is measured from glabella to inion (g–in) and the head breadth (maximum transverse diameter above supra mastoid crest) is the distance between two eurions (eu–eu). All the measurements are taken with the subject sitting in chair, in relaxed condition and head in anatomical position. All measurements are taken to the nearest millimeter. Otherwise known as Breadth index, Cephalic index is calculated by multiplying the breadth of head with 100 and dividing it with the head length¹³⁻¹⁶.

RESULTS

The mean cephalic breadth of study population is 16.71 cm with standard deviation of 0.61.

The mean cephalic length of study population is 20.94 cm with standard deviation of 0.99.

The mean value of cephalic index of study population of study population is 78.52.

Table 1: Major types of Heads in the study population

Range of cephalic index	Types of Heads	Nos. of samples	Percentage distribution
<74.9	Dolichocephaly	46	15.33%
75-79.9	Meso-cephaly	120	40%
80-84.9	Brachycephaly	105	35%
>85	Hyper-brachycephaly	29	9.67%
	Total	300	100%

It has been found more number of cephalic index in meso-cephalic and brachycephaly and less number of hyperbrachycephaly.

Table 2: Gender Analysis showing distribution of heads in different sexes

Types of head	Range	No of females	No. of males
Dolichocephaly	<74.9	8	38
Mesocephaly	75-79.9	26	94
Brachycephaly	80-84.9	33	72
Hyper-brachycephaly	>85	9	20

From the collected data, statistics were analyzed and observations and results are presented in tabular form and the minimum cephalic index is found to be 70.24 and maximum cephalic index is found to be 88.57. The mean cephalic index is 78.52. The mean cephalic index for male is 77.91 and for females it is 79.02. In the male the head length varies from 16.5cm to 20.5cm, the mean head length being 17.92 cm. In females the head length varies from 16 cm to 20.5 cm with the mean head length 18.65 cm. In the male the head breadth varied from 13 cm to



15.7 cm, the mean being 14.35 cm whereas in females the head breadth varied from 13 cm to 15.4 cm, the mean being 14.1 cm.

Table 3: Incidence in various cephalic index

Cephalic index	No. observed	Cephalic index	No. observed
70.01 to 71	4	80.01 to 81	16
71.01 to 72	2	81.01 to 82	24
72.01 to 73	15	82.01 to 83	37
73.01 to 74	12	83.01 to 84	16
74.01 to 75	13	84.01 to 85	12
75.01 to 76	16	85.01 to 86	02
76.01 to 77	11	86.01 to 87	04
77.01 to 78	29	87.01 to 88	19
78.01 to 79	39	88.01 to 89	04
79.01 to 80	25	89.01 to 90	00

Maximum no of cephalic index observed in the range of 78.01 to 79 and minimum number is observed the range of 70.01 to 71 and 88.01 to 89.

Table 4: Relationship of Sex with Cephalic Index

Cephalic index	Male	Female	Cephalic index	Male	Female
70.01 to 71	3	1	80.01 to 81	12	4
71.01 to 72	1	1	81.01 to 82	16	8
72.01 to 73	13	2	82.01 to 83	24	13
73.01 to 74	10	2	83.01 to 84	10	06
74.01 to 75	11	2	84.01 to 85	10	02
75.01 to 76	11	5	85.01 to 86	02	00
76.01 to 77	08	03	86.01 to 87	03	01
77.01 to 78	24	05	87.01 to 88	11	08
78.01 to 79	32	07	88.01 to 89	04	00
79.01 to 80	19	06	89.01 to 90	00	00

From the above table it has been observed that the maximum numbers of male students in the range of 78.01 to 79 and the minimum number of male students observed in the range of 71.01 to 72. From the above table it has been observed that the maximum numbers of female students in the range of 82.01 to 83 and the minimum number of female students observed in the range of 70.01 to 71, 71.01 to 72, 86.01 to 87.

Table 5: Head length in males and females

Male		Female	
Head length (cm.)	No observed	Head length (cm.)	No observed
16.01 to 17	13	16.01 to 17	09
17.01 to 18	102	17.01 to 18	38
18.01 to 19	84	18.01 to 19	25
19.01 to 20	20	19.01 to 20	05
20.01 to 21	03	20.01 to 21	01

In the male the head length varies from 16.5cm to 20.5cm, the mean head length being 17.92 cm. In females the head length varies from 16 cm to 20.5 cm with the mean head length 18.65 cm.

Table 6: Head Breadth in male and female

Male		Female	
Head breadth (cm.)	No observed	Head length (cm.)	No observed
13.01 to 14	52	13.01 to 14	27
14.01 to 15	140	14.01 to 15	45
15.01 to 16	30	15.01 to 16	06
16.01 to 17	00	16.01 to 17	00

In the male the head breadth varied from 13 cm to 15.7 cm, the mean being 14.35 cm whereas in females the head breadth varied from 13 cm to 15.4 cm, the mean being 14.1 cm.

The mean cephalic index of 1st year students of SCB Medical College, Cuttack is 78.52, which comes in the mesocephalic range. In tropical to sub-tropical zone the major type of head form is dolicho & mesocephalic and in temperate zone it changes to brachy & hyper-brachycephalic types. Since India comes under tropical zone, the major type of skull in students of SCB Medical College, Cuttack is mesocephalic type which is in accordance to variation of cephalic index according to different geographical zones as reported by Bharati.

Cephalic index was found to be different for different groups.

Table 7: Mean Cephalic Index of workers

S. No.	Race	Workers	No.	Mean Cephalic Index
1	K. Vangaja	Basu (1963)	100	79.50
2	Bhils	Bhargav and Kher (1960)	100	76.98
3	Barelas	Bhargav and Kher (1961)	100	79.80
4	Gujurati	Saha G.V., Jadav HR (2004)	302	80.42
5	SCBMCH	Sahoo Sanjukta (2010)	300	78.12

The cephalic index of students of SCB Medical College, Cuttack is similar to that of Bhils as observed by Turner. The value of C.I. of Bhils is 72.90 as reported by Turner in 1906, so also for the people of Western Orissa as observed by Mishra AK. The value observed by Bhargav & Kher in case of Bhils in 1960 is 76.98 and this study shows the value of C.I of students of SCB Medical College, Cuttack is 78.52. This shows a trend in change in C.I. towards brachycephalisation (continuous growth of brain more in the lateral direction) in Bhil people and also in students of SCB Medical College, Cuttack (Figure 1). A trend change in head shape from mesocephalic to brachycephalic was observed by Avicenna & Jorjani in Iranian

people, by Nakishima in Japanese, by Saha GV & Jadav HR in Gujurati peoples, by Bertis B Little in Oaxa Mexico etc.

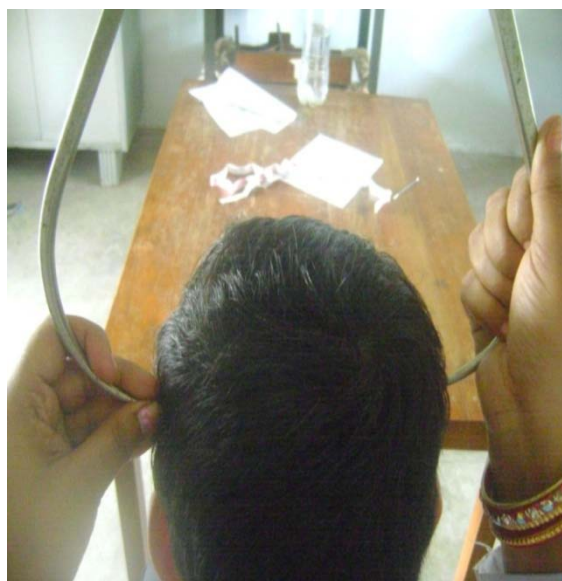


Figure 1: Measurement of cephalic index of a male

The mean cephalic index of male is 77.91 and that of female is 79.02. This shows that female head has a higher cephalic index than that of male in a group as observed by different workers as follows.

Table 8: Mean Cephalic Index of Female

Study Group	Name of workers	Mean cephalic index of female	Mean cephalic index of female
Dangis	Priyanka Singh & Ruma Purkit	71.60	71.92
Ahirwar	Priyanka Singh & Ruma Purkit	73.40	73.70
Gujurati	Shah GV, Jadav HR	80.42	81.20
British Isles	Parson & Lukas Kenne	75.42	76.22
SCBMCH	Sahoo Sanjukta	77.91	79.02

Measurement of Head Breadth by spreading Caliper Maximum Transverse Diameter above Supra Mastoid Crest) is the distance between two Eurions (EU–EU).

DISCUSSION AND CONCLUSION

The study also shows that in brachycephalic type of skull the females outweigh the males in number and in mesocephalic types, males predominates over the females. This is in accordance with the findings of His, Davis, Broca etc in different groups.

The cephalic index of aborigines show a tendency for long headedness (C.I. < 80) and those of migrants show for broad headedness (C.I. > 80). The major types of skull found among aborigines are of mesocephalic type and that of migrants are of brachycephalic type. The cephalic index of students of SCB Medical College, Cuttack is affected by migration of peoples from other parts of country. In the Punjab, Haryana, Rajasthan and V.P. long

heads predominate, but the type gradually changes eastward. In the Bihar medium heads prevails on the whole, while in certain of the Bengal groups a distinct tendency towards brachycephaly may be observed. The above observation has been reported by Sir Hebert Risley and this study shows some association with it. This shows a greater tendency of genetic flow between hindi speaking people and peoples of this region as observed in its dialect pattern, because language is a major determining factor in the social interaction (marriage), thus regulating genetic mix-up. This study shows some degree of association between the types of work and the cephalic index. Persons doing mental work thus confine themselves to indoor environment in most of the times e.g. students, office bearers etc show a tendency for brachycephalization as compared to those who engage themselves in physical work, thus exposed to physical environment in major part of their life. This data will serve as a useful guide to the anatomists and the anthropologists who may like to study the peculiarity of students of SCB Medical College, Cuttack.

Modern man is fond of making comparisons to prove his superiority over other creatures. Measurements are the important tools for comparisons. Nowadays so many references are available in this subject. This bespeaks of validity of this subject. Cephalic index is very useful anthropologically to find out racial differences. It can also be utilized to find out sexual differences. That is how it has role in Forensic sciences. Comparison of changes in cephalic index between parents, offsprings and siblings can give a clue to genetic transmission of inherited characters. We observed and analysed carefully as a whole and it is found that findings are corroborating to the previous workers with little variation which may be due to different geographical distribution and small group of subjects taken into consideration for this study. With the help of the above statistics the sex as well as the race of deceased can be determined accurately with the head measurement. Comparing previous records of cephalic index with recent work proves tendency towards "brachycephalisation"- evidence of continuous growth of brain more in the lateral direction¹⁷⁻¹⁹. This knowledge can be of immense to anthropologists as well as forensic science experts and in genetics.

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