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Research article

A STUDY ON MEASUREMENT AND CORRELATION OF CEPHALIC AND FACIAL INDICES IN MALES OF SOUTH INDIAN POPULATION

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ABSTRACT

Cranial, facial measurements and indices are used to estimate the sex and different shapes of head, and face. It is highly important for Anatomists, forensic scientists, plastic surgeons, physical anthropologists. Six craniofacial indices namely, head length, head breadth, cephalic index, face length, face breadth, facial index were calculated. **Method:** The present study was performed on 100 male medical students of south India of 18-23 year age groups, anthropometric points were measured by using spreading, sliding caliper. **Result:** The present study showed the correlation is statistically significant between the cephalic and facial indices in males. **Conclusion:** predominant head type in males was Dolico cephalic in 19 year age group.

Key words: Craniofacial indices, Dolicocephalic. Anthropometric points, Correlation.

INTRODUCTION

The Study of Humankind, physically, and culturally is known as Anthropology. And it has been developed by the following biologists Samuel George Morton, Charles Darwin and Alfred Russell Wallace and Comte De Buffon, Paul Broca, John Frederick Blumenbach.

Classical & New Physical Anthropology : Methodological approach of physical anthropology[1] is primarily based on compute indices, Statistics, defined measurements. However, the recent technical advancement and realization of role of genetics in anthropology, the global acceptance of anthropometry is linked with genetic heterogeneity to understand the variability of traits. The traditional physical anthropology concerns to describe the features of bones, whereas New physical Anthropology concern to explain the functional significance of bones, and the normal features of bone and its measurements are described by Traditional physical anthropology. Understanding the processes of the mechanism responsible for a specific trait is important and should be given due attention than to make a simple statement about its presence or absence .It necessitates the development of descriptive, quantitative methods. Physical anthropology is concerned with the direction of change age groups, and among individuals of past and present. It continues to be study of biological variation and human evolution. And Genetic differences and environmental modifications are responsible for the changes of sources, like the age group of individuals past to present. Human biology is

approached by the physical anthropology with emphasis on humanity. Since cultural context is considered as basic key to understanding, and proper appreciation of the problems of human evolution. Hence the physical anthropology is concerned with the communication of environmental[2] and socio-cultural factors. Physical anthropology is important in forensic sciences. It made some significant contributions, and also age and sex have determined by individual characterization. Physical anthropology helps in the fields of dermatoglyphics, serology, osteology, osteometry, and solves the problems of forensic science[3].

Cephalic index and physical anthropology : The cephalic index is nothing but the ratio of the maximum breadth of the head to its maximum length. Sometimes multiplied by 100 for convenience. It was given by Ander Retzius (1796-1860). In Twentieth century the index widely used by anthropologists to categorize human populations. Today it is mainly used to describe individual's appearances and estimating age of fetuses for legal, obstetrical reasons[4-8].

Cephalic index and sexual dimorphism: Variety of metric and non-metric measurements accesses the ethnic and sex differences of skull. The non-metric measurements are more subjective, and the actual measurements like cephalic indices provide a metrical recording of sizes, proportions of cranial features. Since these indices fall under numerical category, it prioritizes the evaluation of inter and intra population comparison of crania as well as sexual dimorphism.

Cephalic indices play a crucial role in comparison of cephalic morphometry between parents, offspring's and siblings and provide information on inheritance pattern. Also, it provides the roots for diagnostic comparison as in cases of Dolicocephalics (less prone to Otosis media[16]), and in the individuals with Apert's syndrome who are hyperbrachycephalic[17]. Studies that were carried on different ethnic groups, populations and comparisons clearly Human populations were characterized as either Dolicocephalic (long headed), Mesaticcephalic (Moderate headed), Brachycephalic (Short headed). These were earlier issues on the role of cephalic index in determining the race and mapping of the ancestral population. The lack of plastic evidence[9] led to implementation of advanced techniques in 2002, 2003 and provided a genetic back drop in head shape[10-13].

Cephalic indices: Cephalic index is derived from the Greek word " Kephalic" meaning "Head", The Greek work " ikos" meaning "Pertaining to" and the Latin word "Index" meaning" that which points out". Header length is the distance from the glabella to opistocranion. And head breadth is the distance between two irons.

Formula: Cephalic index (CI) = [Head width/ Head length] X 100

According to Frankfort agreement of 1882 , martin and smaller classification[14]. Skulls can be classified on the basis of cephalic indices, According to Banister's classification[15] ; the following facial types are classified according to facial index. (Table.1)

indicated that the cephalometric dimensions and indices have clear racial trend. Amount of population and age specific data on cephalic indices which gives an indication of growth and development and abnormalities of cranial shape and size of individuals.

Proscopic (Facial) index: For the evolution of craniofacial morphology during development which differs among races and ethnic groups, Proscopic index (PI) becomes an important anthropological parameter. PI was reported to be different among races and current investigations are moving around the changes in closely related populations. Precipice index is the relation to the length of the face to its maximum width between zygomatic prominences. The length of face measured from the nasion to mental tubercle and breadth is measured as bizygomatic width. The total facial index is calculated

Formula: Proscopic (facial) index (FI) = Total facial height/ Bizygomatic width] X 100

Table.1: Classification of human head and face based on cephalic indices and facial index

Cephalic index		Facial index	
CI range	**Scientific term**	**FI range**	**Scientific term**
<75.9	Dolico cephalic (long headed)	<79.9	Hyper Euryproscopic (very broad face)
76 – 80.9	Mesatic cephalic(medium headed)	80 – 84.9	Euryproscopic face (Broad face)
81 – 85.9	Brachycephalic (short headed)	85 – 89.9	Mesoproscopic face (round face)
86 – 90.9	Hyper Brachycephalic	90 – 94.9	Leptoproscopic face (long face)
>91	Ultra Brachycephalic	>95	Hyperlepto Proscopic face (very long face)

METHODOLOGY

Study Design: A cross sectional study was conducted in the Department of Anatomy, Meenakshi medical college, Kanchipuram, including 100 subjects (100 males) together from south India. The participants who volunteered in the study were healthy and without any obvious craniofacial abnormalities like developmental disability, oculofacial trauma, craniofacial congenital anomaly, and had no history of plastic or reconstructive surgery. The age group of 18-23 years male volunteers was selected. Instruments used include weighing machine, measuring tape, sliding and spreading calipers. The following measurements namely, age, sex, weight, height, head length, head breadth, Bizygomatic breadth, Total facial height, From above measurements the following indices calculated.

Cephalic index, Proscopic index (Facial index)

Cephalofacial measurements:

Hrdlicka's method [18] used for the Assessing Cephalic index, Hooten's Method[19] used for Assessing Total facial index.

Head length = Glabella to opisthocranion (G-OP), it was measured by spreading caliper.

Head breadth = Euryon – Euryon (Eu-Eu), it was measured by spreading caliper.

Total facial height (Nasion – Gnanthion) (N-Gn), it was measured by sliding caliper.

Bizygomatic breadth (Bizygomatic, Zy- Zy), it was measured by Sliding caliper.

Cephalic index (CI) = (Eu-Eu/ G – OP)×100

Prosopic (facial) index (FI) = (N – Gn/ Zy-Zy) × 100

Depending on these indices the types of head & face shapes were classified according to Martin & saller (1957) method and Farkas (1981, 1994) method.

Microsoft Excel and by a statistical software – SPSS (Statistical Package for Social Sciences)

RESULTS

Table 2: Ranges of head length, head breadth of males

Head length	No of cases	Head breadth	No of cases
16.01 – 17.00	**1**	**11.01 – 12.00**	**1**
17.01 – 18.00	**17**	**12.01 – 13.00**	**6**
18.01 – 19.00	**47**	**13.01 – 14.00**	**29**
19.01 – 20.00	**32**	**14.01 -15.00**	**53**
20.01 – 21.00	**3**	**15.01 – 16.00**	**10**
-	**-**	**16.01 – 17.00**	**1**

Table.3: Showing the incidence of Cephalic index

Cephalic index	Noof observed	Cephalic index	No of observed	Cephalic index	No of observed
66.01 – 67.00	1	73.01 – 74.00	5	80.01 – 81.00	7
67.01 – 68.00	0	74.01 – 75.00	6	81.01 – 82.00	1
68.01 – 69.00	2	75.01 – 76.00	8	82.01 – 83.00	5
69.01 – 70.00	1	76.01 -77.00	13	83.01 – 84.00	2
70 .01 – 71.00	3	77.01 – 78.00	9	84.01 – 85.00	0
71.01 – 72.00	8	78.01 – 79.00	5	85.01 – 86.00	1
72.01 – 73.00	7	79.01 – 80.00	16		

Mean±SD of Cephalic index in male volunteers of different age groups is 76.48±3.84.

Table 4: **Distribution of head shapes according to observed cephalic index**

Age	Dolicocephalic heads	Mesocephalic heads	Brachy cephalic heads	Hyper Brachy cephalic heads	Ultra Brachy cephalic heads
18	7	9	3	0	0
19	12	8	1	0	0
20	6	3	4	0	0
21	6	9	0	0	0
22	3	16	1	0	0
23	6	6	0	0	0

Above the table shows a number of different types of headings, among of that and mesocephalic cephalic head was predominantly observed.

Table 5: **Ranges of face length and face breadth**

Face length (cm)	**No of cases**	**Face breadth (cm)**	**No of cases**
9.01 – 10.00	5	10.01 – 11.00	10
10.01 – 11.00	51	11.01 – 12.00	39
11.01 – 12.00	43	12.01 – 13.00	43
12.01 - 13.00	1	13.01 – 14.00	7
13.01 – 14.00	0	14.01 – 15.00	1
14.01 – 15.00	0	15.01 – 16.00	0

More number of volunteers have face length ranges from 10.01 to 11.00, and 11.01, to 12.00, and face breadths ranges from 12.01 to 13.00 and 11.01 to 12.00.

Table 6: Showing the incidence of facial index

Facial index	No of observed	Facial index	No of observed	Facial index	No of observed
74.01 – 75.00	2	85.01 – 86.00	9	96.01 – 97.00	8
75.01 – 76.00	2	86.01 – 87.00	2	97.01 – 98.00	7
76.01 – 77.00	0	87.01 – 88.00	1	98.01 – 99.00	5
77.01 – 78.00	2	88.01 – 89.00	2	99.01 – 100.00	3
78.01 – 79.00	1	89.01 – 90.00	4	100.1 – 101.00	1
79.01 – 80.00	0	90.01 – 91.00	9	101.01 – 102.00	0
80.01 – 81.00	2	91.01 – 92.00	4	102.01 – 103.00	1
81.01 – 82.00	3	92.01 – 93.00	3	-	0
82.01 – 83.00	1	93.01 – 94.00	9	-	0
83.01 – 84.00	4	94.01 – 95.00	8	-	0
84.01 – 85.00	2	95.01 – 96.00	5	-	0

Mean±SD facial index of male volunteers of different age groups is 90.95±6.448, the correlation between the facial index and cephalic index showing significant difference, and statistically significant, the p value is $p<0.0001$ at 95% confidence interval.

Table 7: Distribution of face shapes according to observed facial index

Age	Hyper Euri Proscopic faces	Euri Proscopic faces	Meso Proscopic faces	Lepto Proscopic faces	Hyper Lepto Proscopic faces
18	1	2	7	4	5
19	3	1	3	9	6
20	1	1	1	6	4
21	0	2	4	4	5
22	0	3	1	5	11
23	0	3	2	5	2

The Hyper Lepto Prospect face was a dominant face shape than other face shapes.

DISCUSSION

The determination of sex, is an important concern of the osteologist and forensic anthropologist as it is critical for individual identification. Sex determination eliminates approximately 50% of the population from further considerations in cases of missing persons. Moreover, many individualization criteria are sex specific[20]. Several factors such as genetic factors are responsible for Morphological differences between the sexes. However, the phenotypic expression is due to mixture of genetic and environmental factors Gravlee, Clarence, Russell Bernard[21], and William R. Leonard. Studies on sexual dimorphism are primarily based on biological differences between male and female. Male are more robust than female. The weight of axial skeleton in male is relatively and absolutely heavier than female approximately by 8%.Estimation of stature is an important tool in forensic examinations especially in unknown, highly decomposed, fragmentary and mutilated human remains. Stature being one of the criteria for personal identification helps to narrow down the investigation processes. Stature has a definite and a proportional biological relationship with each and every part of the human body. Though most parts of the body are essentially helpful in stature estimation, Cephalo-facial region has its potential effect.

The present study provides valuable new data pertaining to cephalic indices and the shapes of the head in individuals between 18-23 years of age; belonging to south Indian. Comparatively these following previous studies Shah GV jadhav[22] Mean values of cephalic index is 80.42, Mahajan et al[23] Mean is 81.34, and Anitha MRet al[24] Mean is 79.14. Have more mean values than the present study. The present study mean is 76.48. Present study facial index mean 90.95 is more than the previous studies Singh and Purkait[25] mean is 82.5 in Ahiwar of Khurai block of MP, And 85.1 in Dangi of Khurai block of MP[26]. Shetti R[26] mean is 87.19.

Interaction of gene expression, and cranial dimensions can make the gene expression differs in various racial, and ethnic groups in geographical zones[27]. Because cranial dimensions depends on gene expression. It becomes a determining factor. The first generation of Hawaii immigrants had higher cephalic index than their parents. Thus, it is an interesting factor to know that cephalic indices very significantly among populations in different geographical zones. The cephalic indices in the present study are valid for the age group 18-23 year population. Cranial dimensions can differs

with the age of individuals, it reaching peak around 16-23 years of life and also genetic expression influenced by age factor. Genetic information can induce by age factor.

Sexual dimorphism is an important factor in morphological variation in biological populations. The cranial morphology explains the significance of anatomical variation data to individuals of a population. And it also influences the growth rates of skeletal maturity in male and female during the course of growth and development. The significance of age, gender and population specific cephalometric data is of multifold. Comparison between cephalic indices and the head shapes with race and age, and sex is important, which are valuable for treatment monitoring and prediction of orthodontic treatment and the knowledge is valuable in plastic and reconstructive surgeries concerned[28] with craniofacial deformities. . It also provides important evidence in the forensic craniofacial reconstruction.

Causes for variations in cephalic index:

Craniosynostosis is defined as premature closure of the cranial sutures and is classified as primary or secondary. Primary Craniosynostosis refers to the closure of one or more sutures due to abnormalities of skill development, Secondary Craniosynostosis results from failure of brain growth.

Incidences of primary and Craniosynostosis: The Incidence of primary Craniosynostosis approximates 1/ 2,000 Births. The cause is unknown in the majority of children; however, genetic syndromes account for 10 -20% of cases.

Development and Etiology: The cause of Craniosynostosis is unknown, but the prevailing hypothesis suggests that abnormal development of the base of skull creates exaggerated forces on the Dura that act to disrupt normal cranial suture development.

Factors Responsible for variations in cephalic index: The shape of the head depends on the timing and order of suture fusion but most often is a compressed back- to – front diameter or Brachycephaly due to bilateral closure of the coronal sutures. The orbits are underdeveloped, and ocular proptosis is prominent. Hypoplasia of the maxilla and orbital hypertelorism are typical facial features.

CONCLUSION

The primary aim of the study was to evaluate and report, the association of sexual dimorphism and stature with cephalic, proscopic indices in individuals of 18-23 year male age group from the south Indian population. The statistical correlation between cephalic, facial index is significant the up' value is $p < 0.0001$ at 95% confidence interval. And correlation of age, height, with cephalic, facial index was not significant statistically. These observations also indicate that there is existence of sexual dimorphism with reference to proscopic index.

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