

Study of Cephalic Index among the Tamil Population

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Abstract

Various cephalofacial measurements are helpful to establish human identity with respect to sex, race, stature etc. The objective of this study is documenting the craniofacial traits and sex differences with respect to Cephalic Index of Tamil population. Maximum breadth and length of human head are measured in subjects comprising of 100 males and 100 females in the age group of 18-23 years. The mean Cephalic Index calculated based on above metric data for males and females comes to 77.93 ± 5.10 and 75.22 ± 2.92 respectively. As per our findings, the predominant head shape of the study subjects in Tamil population is Mesocephalic for both sexes.

Keywords: Cephalic Index, Head breadth, Head length, Mesocephalic, Tamil population, Race.

Introduction

Identification is defined as the determination of the personality of an individual. Race is one criterion that is used to determine the identity of a person. Anthropometry consists of systematic measurements with respect to human physical properties particularly analyzing different dimensions such as size, shape, height, body proportions etc. These anthropometric data thus collected will be helpful to differentiate human beings of different ethnic groups, economic strata, nutritional status as well as gender. Cephalometric measurements can be used as a tool to establish the race and ethnicity with respect to specific geographical distribution.¹

Cephalometry is a scientific measurement of the dimensions of the human head. One of the most important indices used in cephalometry is the Cephalic Index (C.I.) or Breadth Index. The use of Cephalic Index was first advocated by Swedish professor of Anatomy, Anders Retzius (1796-1860).² It is the ratio of the maximum breadth of the skull to the maximum antero-posterior

length of the skull multiplied by hundred. Cephalic Index is race and population specific and hence there exists a clear racial variation. This index is used to assist in forensic investigations in which the identity of a dead individual has to be established.

In scenarios such as air crash accidents, ship wreckage, bomb explosions, multi-storied building collapse, train accidents etc., where facial features are unrecognizable, the application of cephalic index therefore plays a major role in determination of identity of individuals belonging to different races. In certain unfortunate situations such as genocides followed by mass burials, anthropometric assessments and their applications pertaining to race based segregation of decomposed, mutilated, burnt, skeletonized bodies are imperative for determining the preliminary partial or total identity which in turn helps to establish corpus delicti to proceed with further investigations. Due to global shrinkage and diversity of populations all over the world, compiling of topography based database of cephalic index has become very essential. Based on cephalic index, human head shapes can be grouped as dolichocephalic, mesocephalic, brachycephalic and hyperbrachycephalic with Cephalic Index 70-74.9, 75-79.9, 80-84.9 and 85-89.9 respectively.

So it has become the need of the hour to create population and geography based Cephalic Indices which can be compiled to create an authentic database

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for a specific population. Likewise within the same population, the data can be split on the basis of gender and various sub-groups.

Materials and Method

This study was carried on 200 individuals (100 Males and 100 Females) of Tamil ethnicity. Students residing in Kelambakkam region of Chennai were selected for this study. The corresponding age group of the subjects ranged from 18 to 23 years. The subjects chosen for this study were apparently healthy and well nourished, while those with craniofacial deformities, prior history of craniofacial trauma and plastic or reconstructive surgeries were carefully excluded. Before taking measurements, the necessary individual informed written consent was obtained.

Measurements were taken as per the Hrdlicka's method³, i.e. the subject was made to sit on a chair in the relaxed posture with head kept in the anatomical position. The anatomical landmarks required for calculating the Cephalic Index are four in number viz. Glabella (the mid-point between the eyebrows in the mid-sagittal plane situated just above the root of nose), Ophisthocranium (posterior-most point of the external occipital protuberance along the mid-sagittal plane) and both sides Euryon (lateral most point of the parietal eminence on either side of the head). The measurements were made using a spreading caliper with rounded tips procured from a reliable standard company. Measurement of the maximum head breadth was done by extending the tips of the caliper in such a way that they reached

the maximum lateral point of the parietal bone on either side of the head. In a similar fashion, the maximum head length was estimated by placing one tip over the glabella and the other tip on the most distal point of the external occipital protuberance along the mid-sagittal plane. All the measurements were taken by a single investigator to avoid possible inter-observer variations.

Depending upon the cephalic index, the head shapes are classified as shown in Table 1.^{4,5}

Table 1

S. No.	Head Shape	Cephalic Index
1.	Dolicocephalic	70.0-74.9
2.	Mesocephalic	75.0-79.9
3.	Brachycephalic	80.0-84.9
4.	Hyperbrachycephalic	85.0-89.9

Results

The head breadth and head length were measured in centimetres with the help of caliper and the cephalic index was calculated.

Computational and statistical analysis of the results was done using the SPSS software version 21 through which the mean and standard deviation were calculated. The results are shown in tables 2 and 3.

Table 2: Mean head breadth, head length and Cephalic Index in sample study group

No.	Gender	Total subjects examined	Mean Head Breadth	Mean Head Length	Cephalic Index
1.	Male	100	14.15 ± 0.83	18.18 ± 0.63	77.93 ± 5.10
2.	Female	100	13.04 ± 0.56	17.33 ± 0.38	75.22 ± 2.92

The mean breadth for the male head was 14.15 ± 0.83 and the mean length for the male head was 18.18 ± 0.63. The mean breadth for the female head was 13.04 ± 0.56 and the mean length for the female head was 17.33 ± 0.38. The mean cephalic index for male subjects was

77.93 ± 5.10 and for female subjects it was 75.22 ± 2.92. The study shows a statistically significant difference in the cephalic index between the male and female skulls with a p value of <0.001 i.e. highly significant.

Table 3: Sex wise distribution of head shape in sample study population

S.No.	Head Shape	C.I.	Male	%	Female	%
1.	Hyperdolicocephalic	65.0-69.9	9	9%	5	5%
2.	Dolicocephalic	70.0-74.9	20	20%	36	36%
3.	Mesocephalic	75.0-79.9	36	36%	58	58%
4.	Brachycephalic	80.0-84.9	29	29%	1	1%
5.	Hyperbrachycephalic	85.0-89.9	6	6%	-	-

In the current study it was found that 36% of the males and 58% of the females belong to the mesocephalic range, 29% of the males and 1% of the females lie within the brachycephalic range, 20% of the males and 36% of the females show dolicocephalic range, 9% of males and 5% of females are of hyperdolicocephalic range and 6% of males and none of the females fall within the hyperbrachycephalic range.

Discussion

A large number of studies have been done on cephalic index on other ethnic groups in the Indian subcontinent. We compared the results of our study with that of other investigators and the results are shown in table 4.

Table 4: Comparison of the mean Cephalic Index in our study with that of other populations:

S. No.	Name of the Researcher	Year	Population for study	Cephalic Index	
				Male	Female
1	Present Study	2018	Tamil Nadu	77.93	75.22
2	S. I. Sultan et al ⁶	2017	Maharashtra	79.12	78.67
3	L. K. Kumari et al ⁷	2015	Vizag	80.21	79.25
4	S. Patro et al ⁸	2014	South Odisha	77.28	78.38
5	M. Mishra et al ⁹	2014	Madhya Pradesh	75.84	79.05
6	S. Nair et al ¹⁰	2014	Central India	81.24	80.31
7	K. Uttekar et al ¹¹	2013	South Gujarat	80.88	82.48
8	S. Khair et al ¹²	2013	Mumbai	81.28	75.22
9	V. K. Yagain et al ¹³	2012	Manipal	77.92	80.85
10	V. Salve et al ¹⁴	2011	Andhra Pradesh	75.68	78.2
11	A. Mahajan et al ¹⁵	2009	Punjab	81.34	85.75

As per our study, with respect to mesocephalic and dolicocephalic types of head, the proportion of females outnumbers the males within their respective groups. As far as the other head types are concerned, the proportion of males outnumbers the females within their respective groups. But the mean cephalic index for the male and female heads was 77.93 and 75.22 respectively. The value of the cephalic index is higher for males compared to females in our study. This is consistent with studies done by S. I. Sultan et al.⁶, L. K. Kumari et al.⁷, S. Nair

et al.¹⁰ and S. Khair et al.¹² Other groups report a higher value in the female sex.

The mean cephalic index of 77.93 for the male heads was found to be lower than the study done by S. I. Sultan⁶, L. K. Kumari⁷, S. Nair¹⁰, K. Uttekar¹¹, S. Khair¹² and A. Mahajan¹⁵ and their groups, while the mean cephalic index for the female heads was 75.22, a figure lower than that reported in the study done by all the groups except S. Khair et al.¹² with whom our Cephalic Index matches.

In our study we find the occurrence of a rather rare head shape, hyperdolicocephalic i.e. a Cephalic Index between 65.00-69.99 in 9% of the males and 5% of the females. The occurrence of such a head shape is not reported in similar studies done on other ethnic groups in the Indian subcontinent.

The distribution of various head shapes and the predominance of a particular type is determined by genetic factors, environmental, dietary factors etc.¹⁶

Conclusion

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 in Tamilians.

From the present study we can classify Tamil population as Mesocephalic heads. The mean Cephalic Index of Tamil population for males and females came around 77.93 ± 5.10 and 75.22 ± 2.92 respectively. As there is no data published on Cephalic Index of Tamil population, the metric data provided in the present study can be an important tool to the forensic experts for establishing identity of human subjects with respect to Race.

Conflict of Interest: None declared

Source of Funding: Nil

Informed Consent: Informed consent was obtained from all subjects

Ethical Clearance: Necessary ethical approval was obtained from the Institutional Ethics Committee, Chettinad Academy of Research and Education.

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