

# Cephalic Index and Facial Index of Adults in Rural South Kerala, India

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## Abstract

**Introduction:** Standardized cephalometric measurements such as cephalic index and facial index are useful in the scientific disciplines, namely anthropology, archeology, anatomy, plastic surgery, forensic medicine, and genetics, to identify individuals' race and sex and for treatment of problems related to craniofacial morphologies. Indian studies on craniofacial measurements are available in the literature from states other than Kerala. The present research work has been planned to find the cephalic index and facial index of the adult population residing in rural South Kerala, India.

**Purpose:** The objectives of the study were to estimate the cephalic index and facial index of adults of rural South Kerala, India, and to determine the factors related to cephalic and facial indices of the study participants.

**Methods:** Cross-sectional study among adults aged 18 years and above residing in Perumkadavila block, Thiruvananthapuram district, Kerala, India, was conducted during a period of 6 months from January 2019. Cephalometric measurements were made on the participants sitting on a chair in a relaxed mood with the head in anatomical position. Cranial index and facial index were calculated using appropriate formulae.

**Results:** Among 1600 adults, 792 (49.5%) were males and 808 (50.5%) females with mean age  $52.3 \pm 3.2$ . Mean cephalic index in males was  $77.1 \pm 1.2$  and  $78.4 \pm 1.3$  in females with maximum number of participants having mesocephalic type of head. Mean facial index in males was  $80.13 \pm 1.3$  and mean facial index in female participants  $80.53 \pm 1.4$ , the difference being statistically significant.

**Conclusion:** Understanding the cranial and facial indices of individuals from different geographical areas will be beneficial in anthropometry archeology, forensic medicine, pediatrics, plastic surgery, and genetics.

**Key words:** Adult population, Cephalic index, Facial index, Participants, Rural

## INTRODUCTION

Craniometry<sup>[1]</sup> is one of the disciplines of anthropology, in which the dimensions of head and face are measured. The craniometry is helpful to study the frequency distribution of human craniofacial morphologies, craniofacial variations in different human races, ethnic groups and sex, as well as for clinical diagnosis and treatment.<sup>[2]</sup> Comparison of changes in craniometric measurements between parents, children, and siblings may give a clue to genetic transmission of inherited

characteristics.<sup>[3]</sup> Data on standardized cephalometric measures help diagnostic comparisons between patients and the normal population.<sup>[4]</sup> Craniometric measurements are useful in pediatrics, forensic medicine, plastic surgery, otolaryngology and syndromology, and oral surgery dentistry.<sup>[5]</sup> Craniofacial measurements are also employed to classify people according to race, criminal temperament, and intelligence.<sup>[6]</sup> Cephalic index and facial index are the measurements used by anthropologists, anatomists, plastic surgeons, and forensic scientists to identify individual's race and sex and for treatment of craniofacial problems.<sup>[7]</sup> Comparison between cephalic indices and facial indices with race, age, and sex is valuable for treatment monitoring and prediction of orthodontic treatment and in plastic and reconstructive surgeries concerned with craniofacial deformities.<sup>[8]</sup> The data on cephalic index and facial index of a population are necessary for the preparation of cranial remodeling band or helmet as durable medical equipment.<sup>[9]</sup>

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Manual measurements of craniometry are considered more easy and economical even though sophisticated radiologic methods are available now.<sup>[10]</sup>

Morphology of the face depends on many factors such as sex, ethnicity, race, climate, nutrition, genetic constitution, and socioeconomic status.<sup>[11]</sup> India is a nation with a complex and varied ethnic composition of its population, indicating multiple lines of ancestry and geographic origins.<sup>[12]</sup>

Literature shows international research studies on craniofacial measurements.<sup>[11,13]</sup> Indian studies<sup>[7-9]</sup> on craniofacial morphologies are available from states other than Kerala. No such research studies have been reported on the cephalic index and facial index of the rural population of Kerala. This research work had been planned to find the cephalic index and facial index of the adult population of Perumkadavila block of Thiruvananthapuram in rural South Kerala, India.

**Objectives**

The objectives of the study were as follows:

1. To estimate cephalic index and facial index of adults of rural South Kerala.
2. To determine the factors related to cephalic and facial indices of the study participants.

**METHODOLOGY**

Study design: Cross-sectional study.

Study setting: Perumkadavila block, Thiruvananthapuram district, Kerala, India.

Study duration: Six months from January 2019.

Study population: Adults aged 18 years and above residing in Perumkadavila block, Thiruvananthapuram district, Kerala, India.

**Inclusion Criteria**

Adults aged 18 years and above belonging to both genders residing in the study setting and willing to participate were included in the study.

**Exclusion Criteria**

The following criteria were excluded from the study:

- All adults fulfilling the inclusion criteria but not willing to give consent.
- Adults who were absent on the day of data collection.
- Any adults having physical deformity or history of craniofacial trauma.

Sampling technique: Multistage sampling.

Study participants: All adults residing in the wards selected by multistage random sampling satisfying inclusion criteria.

Study tool: Pretested, semi-structured questionnaire containing two sections.

Section A: Sociodemographic details of the study participants.

Section B: Details on general health and anthropometric measurements.

**Definitions**

The anatomical landmarks were defined as follows.

Glabella: The central point between the eyebrows above the nose.

Inion: The projecting part of the occipital bone at the base of the skull.

Nasion: The point on the root of the nose where the midsagittal plane cuts the nasofrontal sutures.

Gnathion: The lowest point of the mandible where the lower margin of the lower jaw is intersected by the midsagittal plane.

Zygion: The most laterally placed point on the zygomatic arch.

$$\text{Cranial index} = (\text{Maximum head breadth} / \text{Maximum head length}) \times 100.$$

$$\text{Facial index} = (\text{Morphological facial height} / \text{Bizygomatic facial width}) \times 100.$$

Table 1 shows the classification of the head according to cephalic index.<sup>[7]</sup>

Table 2 shows the classification of face according to facial index.<sup>[14]</sup>

**Data Collection Method**

After obtaining ethical committee clearance from the parent institution, data on sociodemographic characteristics

**Table 1: Classification of head according to cephalic index<sup>[7]</sup>**

Type of head	Cephalic index
Hyperdolichocephalic	65.5–69.9
Dolichocephalic	70.0–74.9
Mesocephalic	75.0–79.9
Brachycephalic	80.0–84.9
Hyperbrachycephalic	85.0–89.9
Ultrabrachycephalic	90.0–>90

and general health were collected by interview method using pre-tested and semi-structured questionnaires. Cephalic index and facial index were calculated using the data on anthropometry collected by making cephalometric measurements.

Cephalometric measurements<sup>[15]</sup> were made on the participants sitting on a chair in a relaxed mood with the head in anatomical position. Anthropometric points for the cephalic index were measured using spreading calipers. Facial index measurements were taken by measuring tape. The head length was measured from the glabella to the inions to the nearest centimeter (cm), with an accuracy of 0.10. The head breadth was measured as the maximum transverse biparietal diameter between the two fixed points over the parietal bones to the nearest centimeter (cm), with an accuracy of 0.10.

The cephalic index and facial index were calculated for each subject using the following equations.<sup>[16]</sup>

$$\text{Cranial index} = (\text{Maximum head breadth} / \text{Maximum head length}) \times 100 \text{ and}$$

$$\text{Facial index} = (\text{Morphological facial height} / \text{Bizygomatic facial width}) \times 10.$$

**Data Analysis**

Data were entered in MS Excel Spreadsheet and analysis was done using SPSS 16.0 trial version.

**RESULTS**

The cross-sectional study was conducted among 1600 adults from Perumkadavila Block Panchayath to find out the cephalic index and facial index and related factors. Statistical analysis was done from the data collected. Cephalic index and facial index were calculated. Results were expressed in numbers and percentages for both genders [Figure 1].

Mean age of the participants = 52.3 ± 3.2 years.

Most of the participants belonged to the age group 36–49 years [Table 3].

**Table 2: Classification of face according to facial index<sup>[14]</sup>**

Type of face	Facial index
Hypereuryprosopic	<79.9
Euryprosopic	80.0–84.9
Mesoprosopic	85.0–89.9
Leptoprosopic	90.0–94.9
Hyperleptoprosopic	95.0–>95

Mean cephalic index in males was 77.1 ± 1.2 and mean cephalic index in female participants 78.4 ± 1.3, with a maximum number of participants having mesocephalic type of head [Table 4].

As per Banister’s classification of the facial index, most (49.1%) of the male participants had leptoprosopic type of face with facial index 80.13 ± 1.3. Majority (59.53%) of the females presented with euryprosopic type of face and mean facial index 80.53 ± 1.4. None of the female participants had hyperleptoprosopic type of face [Table 5].

The observed difference in cephalic index and facial index between male and female participants was statistically

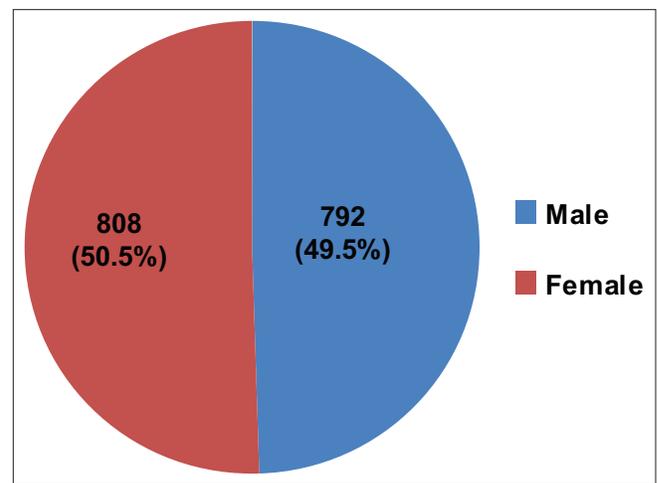


Figure 1: Gender-wise distribution of study participants

**Table 3: Age-wise distribution of study participants**

Age (range) in years	Study participants Number (percentage)
18–25	166 (10.4)
26–35	212 (13.3)
36–49	702 (43.8)
50–65	404 (25.3)
66–75	98 (6.1)
≥76	18 (1.1)
Total	1600 (100)

**Table 4: Distribution of participants according to cephalic index**

Type of head	Cephalic index	Study participants	
		Male Number (%)	Female Number (%)
Hyperdolichocephalic	65.5–69.9	39 (4.92)	9 (1.1)
Dolichocephalic	70.0–74.9	76 (9.6)	10 (1.2)
Mesocephalic	75.0–79.9	392 (49.5)	272 (33.7)
Brachycephalic	80.0–84.9	230 (29.04)	471 (58.3)
Hyperbrachycephalic	85.0–89.9	26 (3.28)	22 (2.7)
Ultrabrachycephalic	90.0–>90	29 (3.66)	24 (3.0)

significant at 95% confidence interval. However, the differences in socioeconomic status were not statistically significant [Table 6].

## DISCUSSION

The present study was conducted among 1600 adults, including 792 males and 808 females participants from Perumkadavila Block Panchayath of rural South Kerala, India.

Among male participants, 4.92% showed hyperdolichocephalic, 9.6% dolichocephalic, 49.5%

mesocephalic, 29.04% brachycephalic, 3.28% hyperbrachycephalic, and 3.66% ultrabrachycephalic type of head based on cephalic index. Among females, as per cephalic index, most of them (58.3%) showed brachycephalic type of heads followed by 33.7% mesocephalic, 3.0% ultrabrachycephalic, 2.7% hyperbrachycephalic, 1.2% dolichocephalic, and 1.1% with a hyper dolichocephalic type of head.

Literature includes research studies\* conducted in other parts of the country showing varying types of head and face.

### Cephalic Index

Table 7 shows the comparison of cephalic index of various populations and present study participants.<sup>[17-19]</sup>

### Facial Index

In the present study, among male participants based on facial index 49.11% possess leptoprosopic type of face, 26.76% euryprosopic, 17.17% mesoprosopic, 3.66% hyper leptoprosopic, and 3.3% with hypereuryprosopic type of face. In females, majority of them (59.53%) showed euryprosopic type of face, 25.62% of females with leptoprosopic, 7.92% mesoprosopic, and 6.93% were with hypereuryprosopic type of face.

Table 8 shows a comparison of facial index of various populations with that of the present study.<sup>[20-25]</sup>

The close resemblances to Northern Indians in the study conducted by Heidari *et al.*<sup>[26]</sup> explains a common origin of immigrant Aryans of India and Bauchs and Sistanis of Iran.

**Table 5: Categorization of participants according to facial index**

Type of face	Facial index	Participants	
		Male Number (%)	Female Number (%)
Hypereuryprosopic	<79.9	26 (3.3)	56 (6.93)
Euryprosopic	80.0–84.9	212 (26.76)	481 (59.53)
Leptoprosopic	85.0–89.9	389 (49.11)	207 (25.62)
Mesoprosopic	90.0–94.9	136 (17.17)	64 (7.92)
Hyperleptoprosopic	95.0–>95	29 (3.66)	-

**Table 6: Factors related to cephalic index and facial index**

Test variable	Gender	Mean	SD	SE	"Z"	Significance
Cephalic index	Male	77.1	1.2	0.061	21.3	Significant*
	Female	78.4	1.3			
Facial index	Male	80.13	1.3	0.067	5.970	Significant*
	Female	80.53	1.4			

\*Significant at 95% CI

**Table 7: Comparative studies on cephalic index of various populations**

Study setting/population	Authors	Cephalic index Male/Female
Indians (Male/Female)	Yagin <i>et al.</i> <sup>[17]</sup> (2012)	77.92/80.85
Maharashtra (Male/Female)	Sultan <i>et al.</i> <sup>[18]</sup> (2017)	79.12/78.67
Mumbai (Male/Female)	Khair <i>et al.</i> <sup>[19]</sup> (2011)	94.41/75.22
Andhra Pradesh (Male/Female)	Kumari <i>et al.</i> <sup>[7]</sup> (2015)	80.21/79.25
Punjab (Male/Female)	Seema and Verma <sup>[9]</sup> (2016)	80.52/84.32
Present study – South Kerala (Male/Female)	Ranga and Mallika (2020)	77.1/78.4

**Table 8: Comparative studies on facial index of various populations**

Study setting/population	Authors	Type of Face Male/Female
Nigeria (Male/Female)	Raji <i>et al.</i> <sup>[20]</sup> (2010)	Hyperleptoprosopic (Very long face)
Iran (Male/Female)	Jahanshahi Metal <sup>[21]</sup> (2008)	Mesoprosopic to Euryprosopic (Round to broad)
West Bengal (Male/Female)	Ghosh and Malik <sup>[22]</sup> (2007)	Euryprosopic to Hypereuryprosopic (Broad to very broad)
Andhra Pradesh (Male/Female)	Kumari <i>et al.</i> <sup>[7]</sup> (2015)	Leptoprosopic/Mesoprosopic
North India (Male/Female)	Prasanna <i>et al.</i> <sup>[23]</sup> (2013)	Hyperleptoprosopic/Mesoprosopic to Euryprosopic
Andaman and Nicobar Island (Male/Female)	Pandey <sup>[24]</sup> (2006)	Hypereuryprosopic (Very broad face)
South India (Male/Female)	Senthil <i>et al.</i> <sup>[25]</sup> (2019)	Leptoprosopic/hyper leptoprosopic
South India (Male/Female)	Soames <sup>[14]</sup> (2008)	Euryprosopic to Leptoprosopic (Broad to long face)
Present study (Male/Female)	Ranga and Mallika (2020)	Leptoprosopic/Euryprosopic

### Factors Related to Cranial and Facial Indices

The observed difference in cephalic index and facial index between male and female genders was found to be statistically significant in the present study.

A similar finding showing a statistically significant difference between the two genders with respect to the facial morphology was observed in other studies also.<sup>[25,27]</sup>

A study<sup>[28]</sup> conducted for investigating correlations between the cranial and facial types observed that certain dentomaxillary anomalies' share both in geographical space and in a population group. All the facial parameters and facial indices were found to be statistically highly significant and they showed interregional and gender variations.

### CONCLUSION

Cranial index and facial index show variations with respect to race, gender, geography, and ethnicity. Estimating these indices will be beneficial clinically in various disciplines for facial reconstruction surgeries, maxillofacial surgeries, forensic medicine, pediatrics, and genetics as well as for determining the stature and sex of the individual.

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