

# A Comparative Study of Facial Indices of Maharashtra Adults with Other Ethnic Group and Test For Reliability of Sexual Dimorphism

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## Abstract

**Background:** Variations in different craniofacial features is studied and documented using various anthropometric techniques. The same depends on gender, race, ethnicity, nutritional and socioeconomic status of a person. So the human face and its variations has always been an object of interest for anatomists, forensic experts, anthropologists, plastic surgeons, maxillofacial surgeons, security experts and artists. The aim of the present study was to identify the facial phenotypes of the Maharashtra Males and Females. Availability of the Facial indices will augment the already available data of other studies.

**Materials and Methods:** The present study was done on 505 (243 males, 262 females) pure bred Maharashtra adults (3 generations on the maternal and paternal side of Maharashtra origin) of the age group 18-60 years. The data was analyzed using MS excel Data Analysis Pak and Two-Sample t-test for Unequal Variances was done for facial indices of male and females to check for sexual dimorphism.

**Conclusion:** The predominant facial type in Maharashtra male is Mesoprosopic (37.86%) followed by Euryprosopic (29.22%) and that of female is Mesoprosopic (33.21%) and Euryprosopic (32.06%). This is similar to the results of studies on Indian males and females except Gujarati males who have Hypereuryprosopic face and Rajput males having Hyperleptoprosopic (long )face. A statistically significant difference ( $p < 0.05$ ). was obtained between facial indices of Maharashtra males and females, which is a key to sexual dimorphism

**Key Words:** Anthropometry, Dimorphism, Maharashtra, Prosopic

## Introduction

The stature evaluation, age estimation, sex determination and population are the major parameters of forensic anthropology. Many studies have been conducted, with regards to sexual dimorphism and stature estimation over various ethnic populations; a majority of them have focused their attention on bony components of the body. Though few researchers among others like

Ghosh and Malik <sup>[1]</sup>, Jahanshahi et al <sup>[2]</sup> and Raji et al <sup>[3]</sup> have worked on the craniofacial anthropometrics. Human face has always been an interesting subject for anatomists, anthropologists, plastic surgeons, maxillofacial surgeons, forensic experts, security experts as well as artists <sup>[4]</sup>. Facial contour and other features of a person reflect the gender, race, and ethnicity, nutritional and socioeconomic status of a person.

Anthropological studies have documented differences among morphological characters and craniofacial features of various ethnic groups using anthropometric techniques. The variations in the facial morphology due to differential growth assist us in distinguishing one person from another. Craniometrical study of prehistoric skulls and facial bones has enabled

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anthropologists to trace gradual changes in size and shape of the human head also gradual changes in the facial construction reflect the increased mental alertness, activities and intelligence.

Anthropological research is based on bodily measurements, however racial and ethnic variations exist in these measurements because human body dimensions are affected by ecological, biological, geographical, racial, gender, age and nutritional factors [5]. Cephalic and Prosopic indices are important parameters, which are useful for ascertaining the variations between different sex and ethnic groups. Facial indices play a very important role in personal identification which is useful in forensic applications and for the purpose of state defense (biometrics) etc, particularly in different techniques of facial reconstruction which helps a forensic artist recreate the final face irrespective of the method used [6]. Comparison of changes in facial indices between parents, offspring and siblings give a clue to genetic transmission of inherited characteristics [7]. This analysis of facial indices is also essential for diagnosis of genetic and acquired anomalies, for the study of normal and abnormal growth and for morphometric investigations [8].

The present work was undertaken to determine facial variations within Maharashtrian adults. In addition, comparison of facial indices was made to determine possible variations (sexual dimorphism) between males and females of Maharashtrian origin.

### Aims and Objectives

Limited data is available for craniofacial parameters of Maharashtrian adults, though some studies have been done on cephalic indices in Maharashtra (sample size 300) and stature estimation from cephalic dimensions (sample size 320) [9] [10]. The aim of this study is to document and analyze the facial index data to find the variations in facial indices, to identify the facial

phenotypes of Maharashtrian adults and compare the facial indices for sexual dimorphism. It will help in improving the statistical data which are already available for facial indices of Maharashtrian adults.

### Materials and Methods

The present study was done on 505(243 males, 262 females) subjects, who are pure bred Maharashtrian adults (who have above 3 generations on the maternal and paternal side of Maharashtrian origin) of the age group 18-60 years with normal pleasing face and with no history of plastic, maxillofacial or reconstructive surgery. All the data were collected in fore noon to avoid any diurnal variation of facial soft tissue. The data was analyzed using MS excel Data Analysis Pak for comparison of the means of the prosopic indices of males and females and Two-Sample t-test for Unequal Variances was done for facial indices of male and females to check for sexual dimorphism.

Computation of Facial index :

The facial landmarks used were Nasion(N), Gnathion(GN) and Zygion(ZY) [11] [12].

**Facial height (morphological facial length)** is the straight distance measured from Nasion to Gnathion.

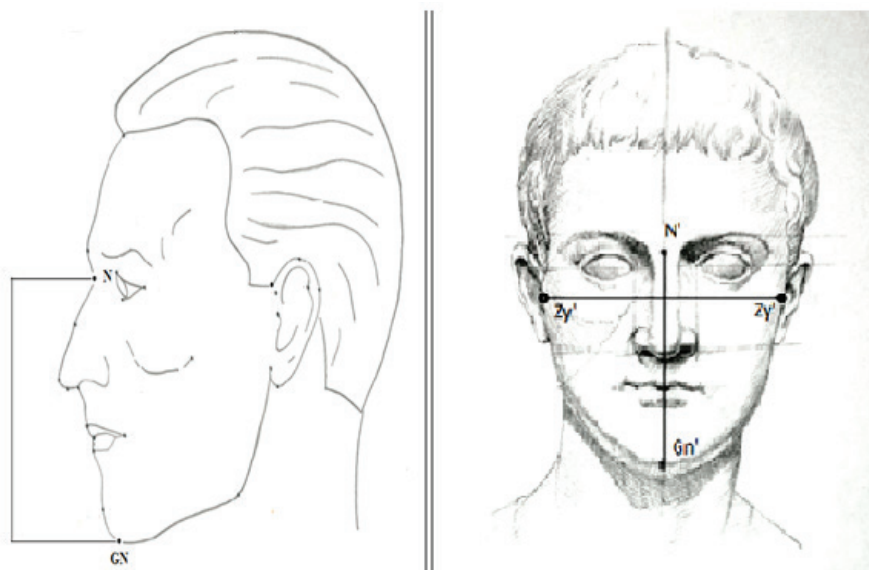
**Facial breadth (Bizygomatic breadth)** – Straight distance between the most wide apart points of both sided zygomatic arches i.e. Zygion to Zygion

Facial index is a ratio of facial height and Bizygomatic width. This has been listed elaborately by **Farkas and Munroe 1985, cleft palate journal** [13], and is calculated using the formula **Facial Index=**

$$\text{Index} = \frac{\text{NASION} - \text{GNATHION}}{\text{ZYGION} - \text{ZYGION}} \times 100.$$

Banisters classification [14] is used for phenotyping the facial type into five groups as given below–

- |  |                         |
|--|-------------------------|
| a) Hypereuryprosopic (Very broad face) | –facial index below 80. |
| b) Euryprosopic (Broad face)           | –facial index 80-84.9.  |
| c) Mesoprosopic (Round face)           | – facial index 85-89.9. |
| d) Leptoprosopic (Long face)           | –facial index 90-94.9   |
| e) Hyperleptoprosopic (Very long face) | –facial index above 95. |



**Fig: 1 Landmarks of Facial Index**

**Results**

The mean, standard deviation, maximum & minimum the various Prosopic parameters and the Pearson’s correlation coeff between Morphological facial length and Bizygomatic facial breadth was calculated, results are tabulated in **Table I**. The Mean facial index of Maharashtra adult male is 86.61±5.97 and that of female is 85.466 ± 6.446. There exist a moderate (0.3 to 0.7) positive correlation between Bizygomatic breadth and morphological facial length of both males and females ( males 0.407, females 0.37).

**Table 1: Descriptive Statistics of facial indices of Maharashtra adults**

		Mean + SD	Min	Max	Pearson’s correlation of facial length to Breadth	Regression equation using Facial length and Bizygomatic facial breadth.
Females	x= Facial Length (cm)	10.31+0.78	8.27	15.51	0.373 (p<0.001)	y = 0.3125x +8.8607
	y=Bizygomatic breadth (cm)	12.08+0.65	9.78	14.45		
	facial index female	85.47+6.45	70.49	115.05		
Males	x=Facial Length (cm)	11.15+0.75	9.27	14.66	0.407 p(<0.001)	y = 0.4007x + 8.431
	y=Bizygomatic breadth (cm)	12.90+0.74	9.93	14.46		
	facial index male	86.61+5.97	72.67	110.28		

The variations in prosopic index of the Maharashtra Adults, male and female and the result of two-Sample t-test for Unequal Variances of the Facial index of Males and Females are shown in **Table 2**.

**Table 2: Prosopic Indices females and males**

Face shape Range of Prosopic index	Prosopic index	Females		Males	
		No	%	No	%
Hypereuryprosopic	< 79.9	46	17.56	27	11.11
Euryprosopic	80 – 84.9	84	32.06	71	29.22
Mesoprosopic	85 – 89.9	87	33.21	92	37.86
Leptoprosopic	90 – 94.9	27	10.30	33	13.58
Hyperleptoprosopic	> 95	18	6.87	20	8.23
Observations		262		243	
Variances		35.61		41.55	
Degree of freedom		503			
t value ( t stat > t critical)		2.06			
Two-tailed 'p' value, Significance		0.039			
significance of Null hypothesis test		Significant ( <0.05)			

The predominant facial type in Maharashtrian female is Mesoprosopic (33.21%) and Euryprosopic (32.06%), followed by Hypereuryprosopic (17.56%), Leptoprosopic (10.30%) and Hyperleptoprosopic (6.87%). The predominant facial type in Maharashtrian male is Mesoprosopic (37.86%) followed by Euryprosopic (29.22%), Leptoprosopic (13.58%), Hypereuryprosopic (11.11%) and Hyperleptoprosopic (8.23%).

A statistically significant difference (p= 0.039). was obtained between facial indices of Maharashtrian males and females.

**Discussion**

Anthropometry covers measurements of any aspect of human form & surface anthropometry refers to the measurement of the surface features. (Douglas, 2004). Thus Anthropometry provides means to assess facial shape. For the purpose of craniofacial measurement direct methods, Photometric measurement method and Cone Beam Computed Tomography is being used. In the present study direct method has been used as direct measurements are reliable and inexpensive though they are of time consuming nature.

The facial indices data provide useful parameters for evaluation of facial trauma, congenital and traumatic deformities. Craniofacial anthropometry helps in understanding the gradual evolutionary changes in human being, differences between various ethnic groups, the geographical migration and relocation of population from one climate and nutritional status to other.

The Mean facial index of Maharashtrian adult male is 86.61±5.97 and female is 85.466 ± 6.446. The predominant facial type in Maharashtrian males is Mesoprosopic followed by Euryprosopic and in Maharashtrian females it is Mesoprosopic and Euryprosopic. The mean value of facial indices of males and females observed among students population of Andhra region by V. M. Salve et al [15] were 89.50 ± 2.85 and 86.72± 3.40 respectively. The dominant type of face in males was Mesoprosopic (57.5%) and that in females was Euryprosopic (51.8%). The predominant facial types in this study are similar to the findings of the present study.

A study by V. R. Shetti et al [7] showed the mean facial index of Indian males was 87.19±5.2and that of females was 86.75±6.3respectively. The dominant facial types in both males and females were Mesoprosopic. Facial indices of Malaysian males were 85.72±5.4 which is comparable to Maharashtrian male’s facial index. In

a study of Haryanvi males<sup>[16]</sup> dominant facial types in both males and females were Mesoprosopic.

Facial Indices of Turkman males and females were 87.25% ± 5.18% and 81.48% ± 5.28%, respectively. Facial Indices of Fars males and females were 88.22% ± 5.21% and 84.48% ± 5.85%, In females of both Turkmen and Fars the dominant face types Euryprosopic and for the males of both dominant face types was Mesoprosopic in study of Gopalipour.<sup>[2]</sup> Newborn of Turkmen and Fars had Hypereuryprosopic type of face, whereas the adult of same race had Mesoprosopic type of face, which suggests the developmental pattern<sup>[5]</sup>.

The mean facial index of Gujarati males by U Kanan et al<sup>[17]</sup> was 81.7. Based on facial index dominant type of face shape in Gujarati males was Euryprosopic (42.96%) and similar findings were observed in Jat Sikhs (39.8%).

**Ref Table:2, Fig:2, 3.**

A statistically significant difference (p< 0.05) was obtained between facial indices of Maharashtra males and females. In the study by L C Prassana et al<sup>[18]</sup> Statistically significant differences (p= 0.001) were noticed between the facial index of north and south Indian females and a significant difference was obtained between facial indices of Indian males and females ( p= 0.003) indicating differences in facial indices over sex and geographic regions. Study by facial indices of Twisha shah<sup>[19]</sup> indicates no statistically significant difference in facial index between Gujarati male and female while length and width of their face showed significant difference (p-value<0.05). Non-Gujarati subject results show significant difference of Facial index between sex (male and female) which is a key to sexual dimorphism.

**Table 3 Comparison of Male and Female Prosopic indices with other population**

	Maha, Male present study	Andhra Male	Gujrati male , Twisha Shah	Guj Male, Uttekar Kanan	south Ind male, Prassana L C	Sindhi males	Rajput males	NE Nigeria male	Turkman Race	Fars Race	Serbia Male, D Jeremic
Hypereuryprosopic	10.74	0.39	76.00	35.10	10.56	0.00	0.00	1.00	8.6	4.00	0.00
Euryprosopic	28.93	32.42	16.40	42.96	8.45	43.00	2.00	5.50	26.8	16.00	0.00
Mesoprosopic	38.02	15.63	5.30	18.20	7.04	18.22	9.00	9.50	38.4	44.00	17.78
Leptoprosopic	13.64	12.89	2.20	3.64	6.34	3.64	41.00	14.00	17.2	32.00	76.67
Hyperleptoprosopic	8.68	1.17	0.00	0.00	67.61	0.00	48.00	70.00	9.1	4.00	5.56
	Maha , female Present data	Andhra female	Guj fem, Shah	V shetti indian	South India fem, Prassana LC	Haryanvi, Female	v shetti Malay	NE Nigerian female	Turkman Race	Fars Race	Serbia Female, D Jeremic
Hypereuryprosopic	20.12	0.63	60	9.00	16.30	25	8.00	2.1	3.50	20.80	0.00
Euryprosopic	29.59	51.88	23.6	32.00	13.04	19.33	19.00	4.9	51.70	37.70	0.00
Mesoprosopic	33.14	25.00	12	32.00	10.87	35	34.00	19.6	6.90	22.20	10.59
Leptoprosopic	9.47	20.63	2.7	12.00	9.78	19	31.00	16.1	3.00	13.50	87.06
Hyperleptoprosopic	7.69	1.88	1.8	15.00	50.00	1.66	8.00	57.3	3.40	5.80	2.35

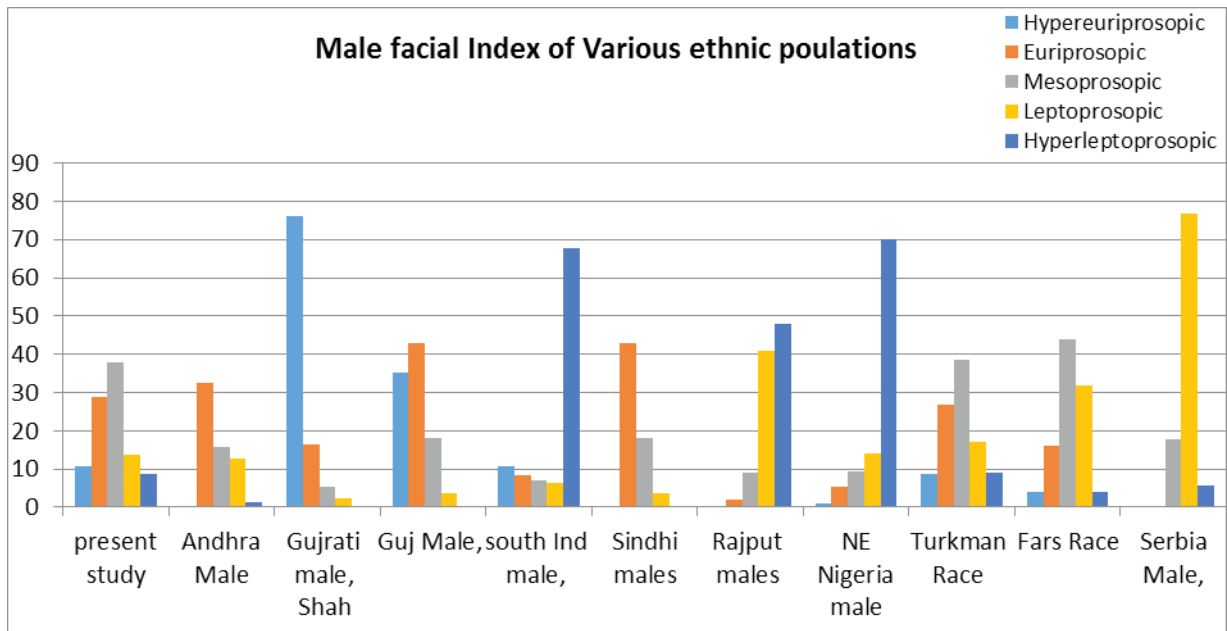


Fig: 2 Male facial indices of various ethnic groups

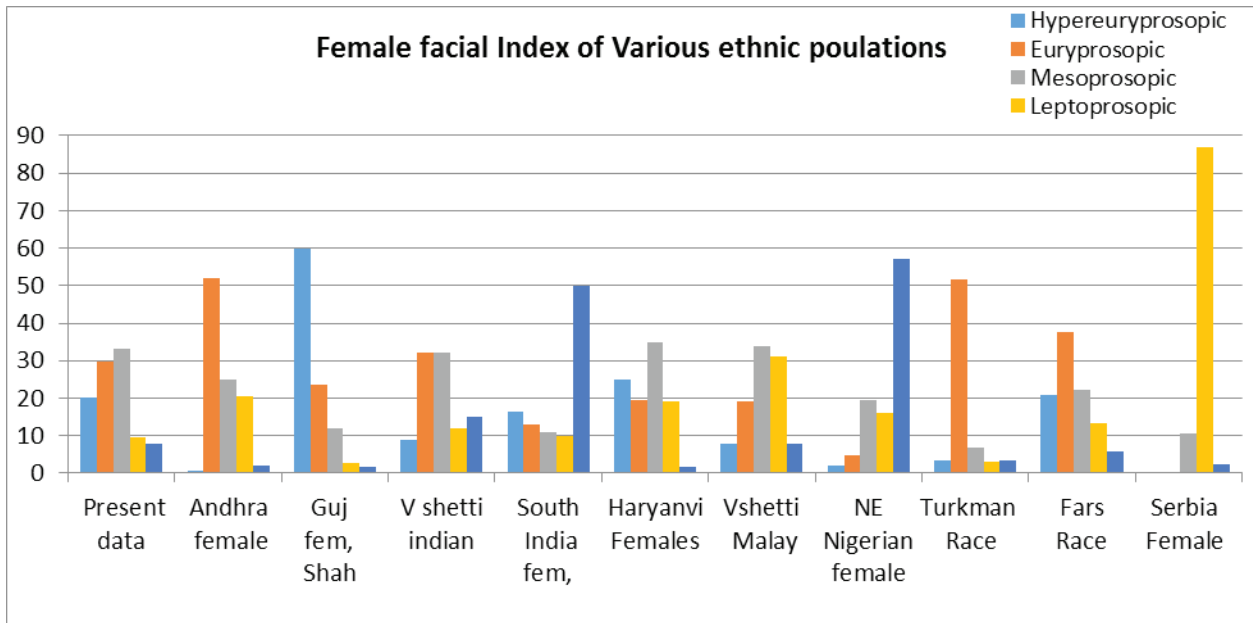


Fig: 3 Female facial indices of various ethnic groups

**Conclusion**

Facial measurement in the present study used direct method due to ease of collection of data. From our study, we can conclude that statistically significant difference in facial index exist for facial index for Maharashtra males and females, the predominant facial type was noted to be Mesoprosopic and Euryprosopic, The Morphological facial length has a statistically significant, moderate ( from (0.3 to 0.7) +ve correlation with Bizygomatic facial breadth for Maharashtra adults.

The facial indices of Maharashtra males and females show a statistically significant difference ( $p < 0.05$ ) indicating sexual dimorphism. This study has provided facial data of Maharashtra adults which will augment the cephalic data already available. The data provided by the study can be used in medical applications such as cosmetologists, orthodontists and plastic surgeons.

**Conflict of Interest:** None

**Source of Funding:** None

**Ethical Clearance:**

The subjects involved in data collection and were explained the consent forms ( in three languages English, Hindi and Marathi) approved by The Institutional Ethics Committee, Dr DY Patil Medical College Hospital and Research Centre. The subjects were intimated the risks to them and the benefits of the study to the society. They have the right to confidentiality regarding the privacy of their medical information. As per the consent form the information from the study, if published in scientific journals or presented at scientific meetings, will not reveal their identity. They also have Right to information regarding any new information obtained during this research study that may affect their decision to continue participating in the study. The data was collected at no cost to the participant.

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