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Research Article

Anthropometric Study of Facial Morphology in the Central Indian Population

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ABSTRACT

Background:
Facial anthropometry plays a crucial role in anatomy, forensic science, and reconstructive surgery by providing population-specific standards for personal identification. Facial dimensions exhibit significant sexual dimorphism and ethnic variation, making region-specific data essential. The present study aimed to evaluate facial anthropometric parameters in the Central Indian population and to assess their usefulness in estimating stature and sexual dimorphism. **Materials and Methods:** A cross-sectional comparative study was conducted on 320 adult individuals (170 males and 150 females) aged 18–50 years from Central India. Subjects with facial deformities, congenital anomalies, or a history of facial surgery were excluded. Nine facial parameters and stature were measured using standard anthropometric techniques. All measurements were converted to centimetres and analyzed using SPSS software. Descriptive statistics were calculated, and sexual dimorphism was assessed using demarcating points derived from mean ± 3 standard deviations. **Results:** All facial parameters and stature were significantly higher in males compared to females ($p < 0.001$). Stature (>172.6 cm), bigonial width (>12.45 cm), lower facial height (>7.91 cm), and upper facial height (>6.64 cm) were the most reliable parameters for male identification. For females, lower facial height (<3.43 cm), upper facial height (<4.13 cm), and stature (<147.1 cm) showed the highest identification accuracy. Total facial height demonstrated the strongest correlation with stature in both sexes. **Conclusion:** Facial anthropometric parameters exhibit significant sexual dimorphism in the Central Indian population. Total facial height emerged as the most reliable predictor of stature for both males and females. The findings provide baseline anthropometric data useful for forensic identification, anthropological research, and clinical applications involving facial reconstruction.

Keywords: Facial anthropometry, stature estimation, sexual dimorphism, Central India, forensic anthropology

INTRODUCTION

The face is one of the most essential and visually prominent parts of the human body. During interpersonal interaction, the face is the first feature to be observed, and its characteristics play a vital role in recognition and communication. Facial variations assist in differentiating individuals belonging to different ethnic and racial groups. Facial dimensions have therefore gained considerable importance in medical sciences, forensic investigations, and artistic disciplines. Facial analysis constitutes the initial step in the evaluation of patients undergoing cosmetic or reconstructive facial procedures. Among facial measurements, facial height and

facial width (bizygomatic distance) are particularly important, as they determine the total facial index.

Facial morphometry describes variations in facial shape within a population and allows comparison across races, ethnic groups, sexes, and even among members of the same family. It has long been of interest to anatomists, anthropologists, artists, and plastic surgeons. Facial parameters are useful in several practical situations, such as identifying missing persons, recognizing criminals, and establishing identity in cases of road traffic accidents, burns, and natural disasters. They are also valuable in the management of congenital and post-traumatic facial deformities. [1]

The face serves as a primary medium of communication and interaction with the environment and carries essential information for individual identification. Facial features—including bones, muscles, and cutaneous and subcutaneous tissues—together create a unique morphology for each individual. The face has been extensively studied by scientists, clinicians, and artists, all of whom have attempted to measure, analyze, and reproduce its defining characteristics. [2] Facial contour has consistently attracted interest among anatomists, anthropologists, plastic surgeons, and artists, while identification of racial and population traits is a crucial component of forensic identification and reconstructive surgery. [3]

MATERIALS AND METHODS

Type of Study

Cross-sectional, comparative study.

Duration of Study

The study was conducted from 2023 to 2026.

Study Population

Subjects were recruited from Central India, primarily from Indore city, Madhya Pradesh, India.

Sample Size

A total of 320 subjects were included in the study.

Inclusion Criteria

1. Adult individuals aged ≥18 years
2. Both males and females
3. Native residents of Central India
4. Belonging to Hindu, Muslim, or Christian religions

Exclusion Criteria

- Individuals with congenital facial deformities
- History of facial surgery
- Facial or stature deformities or anomalies
- A total of 320 subjects participated in the study, comprising 170 males and 150 females.

All facial measurements were recorded in millimetres and converted to centimetres prior to analysis. Statistical analysis was performed using SPSS software. Results are presented as mean, standard deviation, and minimum and maximum values for stature and facial parameters.

RESULTS

Table 1: Distribution According to Age and Sex

Age Group	Male	Female	Total
18-30	130	122	252
31-40	28	15	43
41-50	12	13	25
Total	170	150	320

The majority of both male (130) and female (122) participants belonged to the 18–30-year age group.

Table 2: Descriptive Statistics of Stature and Facial Parameters in the Central Indian Population (n = 320)

FP	Sex	Mean	SD	Min	Max	P value	IP	% of IP	% D. P.
TF H	M	11.2	1.34	9.01	13.1	<0.001	>13.41	0	1.14
	F	10.4	1.01	8.6	12.96		<8.95	1.3	1.3
UF H	M	5.67	0.39	4.22	7.24	<0.001	> 6.64	1.48	2.21
	F	5.36	0.48	3.48	6.68		< 4.13	1.09	3.34
LF H	M	5.52	0.55	3.41	7.36	<0.001	> 7.91	0	2.2
	F	4.72	0.71	2.19	7.92		< 3.43	1.17	3.28
NH	M	4.73	0.44	1.52	5.89	<0.001	> 4.21	1.67	0.86
	F	4.48	0.52	1.51	4.98		< 1.53	0.64	1.28
NW	M	3.51	0.41	2.25	4.61	<0.001	> 4.98	0	1.7
	F	3.31	0.38	1.35	4.87		< 2.41	1.93	1.64
BO W	M	10.24	0.56	7.74	11.18	<0.001	> 10.6	0.74	1.02
	F	10.1	0.51	7.23	11.24		< 7.12	0.94	1.28
IO W	M	3.45	0.32	2.38	4.71	<0.001	> 4.35	1.25	1.24
	F	3.27	0.31	1.91	4.67		< 2.54	2.15	0.86
BZ W	M	11.74	0.72	9.52	13.68	<0.001	> 13.11	0.34	1.93
	F	11.22	0.74	9.20	13.58		< 9.45	1.35	1.24
BG W	M	10.87	0.83	9.34	13.21	<0.001	> 12.11	2.11	2.41
	F	10.45	0.82	8.30	12.24		< 9.21	3.1	1.48
Ht	M	167.84	6.84	142	183	<0.001	> 175	2.24	3.5
	F	153.21	6.47	132	174		< 142	3.3	2.47

Statistical analysis revealed that mean stature and all facial parameters were significantly higher in males than in females. A highly significant statistical difference ($p < 0.001$) was observed for all measured variables.

Demarcating points were derived using calculated ranges (mean ± 3SD) to assess sexual dimorphism. Based on these demarcating points, the percentage of correctly identified males and females was calculated for each parameter.

Among all measured parameters, stature (>172.6 cm), bigonial width (BGW > 12.45 cm), lower facial height (LFH > 7.91 cm), and upper facial height (UFH > 6.64 cm) were the most reliable indicators for identifying males in the Central Indian population.

For females, LFH < 3.43 cm, UFH < 4.13 cm, and stature < 147.1 cm were found to be the most effective identifying parameters.

DISCUSSION

The present cross-sectional study was conducted to evaluate facial anthropometric parameters and their correlation with stature in the Central Indian population, with particular emphasis on individuals from Indore city. The findings were compared with data from South Indian, Haryanvi, Jat, Kattunaykan, Gujarati, Nepali, Sri Lankan, Nigerian, Ijaw ethnic group, and Central Serbian populations.

The study was carried out in the Department of Anatomy from May 2023 to November 2025. A total of 320 adult individuals aged 18–50 years were included. Subjects with facial deformities, a history of facial surgery, stature deformities, or congenital anomalies were excluded. Ethical clearance was obtained from the institutional ethics committee, and written informed consent was taken from all participants. Demographic data, stature, and nine facial parameters were recorded. Statistical analysis was performed separately for males and females to assess sexual dimorphism, and religion-wise comparisons were also made. Regression equations were derived.

Most participants belonged to the 18–30-year age group. The mean age of males and females was 23.74 ± 7.23 years and 23.65 ± 7.46 years, respectively. Males constituted 53.1% of the study population and females 46.9%. Similar age and sex distributions have been reported by Baral et al. in a Nepalese population and by Wankhede et al. in a Central Indian population. [4,5]

Consistent with previous studies, the mean stature of males was higher than that of females. The mean male stature in the present study (167.84 cm) was comparable to that reported in Nepalese populations, lower than Indo-Mauritian populations, and higher than Sri Lankan populations. [6–8] Compared with other Indian studies, male stature in the present study was lower than that reported in Nagpur, South Indian, and Haryanvi populations, but higher than Jat, Kattunaykan, and Gujarati populations. [5,9–12]

The mean stature of females (153.21 cm) in the present study was lower than that reported in Nepali, Indo-Mauritian, Nagpur, Northwest Indian, Haryanvi, and South Indian populations, but higher than Sri Lankan, Jat, Kattunaykan, and Gujarati populations. [5,7–15] These variations may be attributed to geographic, ethnic, genetic, and environmental factors.

Genetic influences play a major role in determining morphological features; however, environmental factors such as diet, climate, and socioeconomic conditions also affect gene expression. Buretic-Tomljanovic et al. demonstrated significant effects of environmental factors on body height and craniofacial variability. [16]

In the present study, the dominant facial type among Central Indian males was hypereuryprosopic, followed by euryprosopic, mesoprosopic, leptoprosopic, and hyperleptoprosopic types. Other studies have reported varying dominant facial types across different Indian and international populations, highlighting population-specific facial characteristics. [17–19]

CONCLUSION

The present study demonstrates that facial anthropometric parameters are valuable tools for estimating stature, particularly

when only facial remains are available. The facial measurements and stature data obtained may serve as baseline standards for the Central Indian population and can be applied in diagnostic, anthropological, and forensic contexts. These findings are useful for personal identification, including estimation of stature, sex, and population affinity. Among all facial parameters studied, total facial height (TFH) emerged as the most reliable predictor of stature in both males and females of the Central Indian population.

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