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Photogrammetric study of nasal index in central India for sexual dimorphism

Manish Malhotra ¹, Rituja Gharote ^{1,*} and Bhanupriya Pande ²

¹ Central Forensic Science Laboratory, Bhopal, Madhya Pradesh, India.

² Annasaheb Chudaman Patil Memorial Medical College, Dhule, Maharashtra, India.

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Abstract

Along with other facial indices used in Forensic Anthropometry, the nasal index provides for determining ancestry, supporting facial reconstruction, important insights into population research and advancing our understanding of human variation. The present study aims to observe the gender variations of Nasal Index using 2D photogrammetric method on facial images among Brahmin adults of Central India. Present study was conducted on 134 Brahmin adults including 72 males and 62 females of Sagar district of Madhya Pradesh state situated in Central India. Nasal Indices were derived using linear measurements among relevant Nasal landmarks through ImageJ image processing software. Statistical non-parametric t-test (one-tailed) was applied to obtain p values in order to study significant differences between mean values of Nasal Index for both the genders. Mean Nasal Index value for Brahmin males was observed to be 101.7 ± 2.466 and for Brahmin females 87.30 ± 1.135 . It could be concluded from the present study that there is sexual dimorphism with respect to the Nasal Index in the Brahmin Adults of Central India in which the males have mostly Hyperplatyrrhine (Very Broad) whereas females have mostly Platyrrhine or Chamaerrhine (Broad) Nose shapes.

Keywords: Anthropometry; Brahmin; Central India; Forensic; Gender; Indices; Nasal Index; Sexual Dimorphism

1. Introduction

Physical anthropology relies mainly on external measurements and descriptions of the human body and the skeleton [1]. Method for taking measurements on photographs is termed as Photogrammetry which has implications in facial features examination and comparison using photographs of individuals for ethnic and gender studies [2]. 2D photogrammetrical method has been found to be as reliable as manual anthropometric method for analysis on facial features [3]. The nasal dimensions and indices are one of the important cephalo-facial parameters used in physical anthropology to distinguish different human populations and to categorize the human nasal morphology [4]. The shape and size of the nose are influenced by age, gender, ethnic background, and environmental & geographical conditions. The narrower noses are favoured in cold and dry climates while broader noses in warmer, moister ones as a consequence of natural selection in human evolution. Craniofacial anthropology also includes nasal height, nasal width, and nasal index which are very important for the study of variation in different races and also for clinical diagnosis and treatment [5][6].

Nasal indices have been used in forensic anthropology to assist in identifying the ancestry and geographic origin of individuals based on skeletal remains [2]. Though there are few researches done on nasal indices of the population of several countries including India and various states of India, the database of nasal indices of population belonging to various ethnic groups of India is not included in many of them. Hence, this study has focused on the population and ethnicity-specific nasal index involving both genders from the Central Indian Brahmins. This also involves tabular presentation of nasal indices of males and females from different states of India. The objectives of the present study are to understand the variation of nasal index within the Central Indian population and to get an insight on regional and

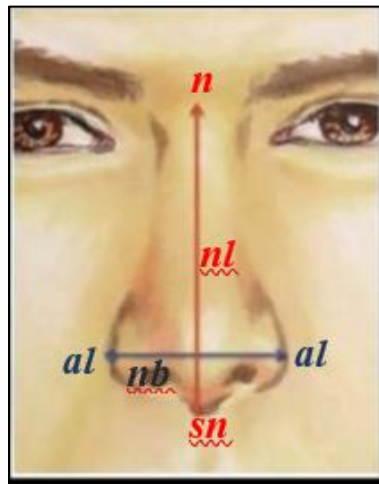
* Corresponding author: Rituja Gharote

genetic factors influencing nasal morphology, thus giving an idea of broader human evolutionary trends and its applications in forensic anthropology, cosmetology and clinical diagnostics [7].

2. Materials and methods

Facial Photographs of Brahmin adult subjects (both males and females) from Central India were included for the present study. Adult population from the Sagar district of Central India with age range of 20-30 years were chosen and convenience sampling was conducted to obtain the raw data. Cases of dental and facial reconstructive surgeries and subjects with major facial deformities were excluded from the study. Facial Photographs of 134 Brahmin adults (72 Males and 62 Females) were included in this study.

All the subjects were informed about the objectives of the present study and informal consent was obtained from them prior to initiating the study. A measuring setup was created by placing a chair against a wall and keeping the camera on a tripod approximately at 1 metre distance from the subject. Digital 2D photographs were taken using an 18 Mega Pixel DSLR camera (Make: Canon, Model: EOS 1200D). Photographs of all subjects were taken under similar light conditions in same room and on same chair. Lens of the camera was adjusted in such a manner that it remains parallel to the face of subject while subject remain seated with head in Frankfort plane horizontal to the floor. Measurements were taken on photographs by using Image J software (version 1.51j8), an open-source image processing program designed for scientific multidimensional images. 3 classical nasal anatomical landmarks i.e., nasion (n), subnasale (sn) and alar (al) were taken in account (Fig. 1). The linear measurements were taken in pixel values. Nasal Index was derived from the linear measurements for each subject by digital 2D photogrammetric method. The derivation of the Nasal Index was done by same observer for each photograph. Statistical analysis for the values of mean and standard deviation were evaluated for both genders using GraphPad Prism statistical software.



(n = nasion, sn = subnasale, al = alare); (nl = nasal length from 'n' to 'sn'); (nb = nasal breadth between both 'al' points)

Figure 1 Linear Measurements to calculate NI [6][8]

The Nasal Index was calculated for each individual of both gender groups using following formula:

$$\text{Nasal Index (NI)} = [\text{Nasal Breadth (NB)}/\text{Nasal Length (NL)}] \times 100$$

Morphological Classification of Human Nose based on the Nasal Index given by Martin and Sallar (1957) as per Figure 2 and Table 1.

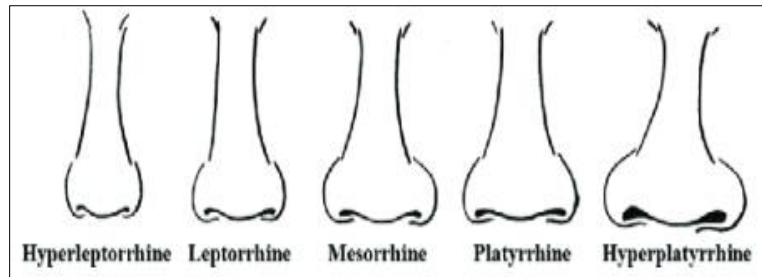


Figure 2 Nose shapes

Table 1 Nose shapes and corresponding Nasal Index.

Nose Shape	Nasal Index
Hyperleptorrhine (Very Narrow)	≤ 54.9
Leptorrhine (Narrow)	55.0 to 69.9
Mesorrhine (Medium)	70.0 to 84.9
Platyrrhine or Chamaerrhine (Broad)	85.0 to 99.9
Hyperplatyrrhine (Very Broad)	≥ 100.0

Finally, the scrutiny, tabulation and analysis of the whole data were done by applying unpaired one tailed student’s t-test with 95% confidence intervals. A p value of <0.05 was considered to be statistically significant and <0.0001 as highly significant.

3. Results and discussion

The measurements showed that the mean Nasal Index was 101.7 ± 2.466 for the Brahmin male individuals and 87.30 ± 1.135 for Brahmin female individuals. Nasal Index for both Brahmin Males and Females was found statistically highly significant ($p < 0.0001$) (Table 2). On the basis of calculations made on Nasal Index, it was found that the Hyperplatyrrhine (Very Broad) nose shape was predominant in Brahmin male individuals, while Platyrrhine (Broad) nose shape is predominant in Brahmin female individuals of Central India. In the present study, none of the Brahmin Males and Females had Hyperleptorrhine nose shape, 2.78% of Brahmin males and 0% Brahmin female had Leptorrhine nose shape, 36.11% males and 43.55% females among Brahmins had Mesorrhine nose shape, 40.28% Brahmin males and 50% females had Platyrrhine nose shape, 20.83% Brahmin males and 6.45% females had Hyperplatyrrhine nose shape.

Table 2 Statistical analysis of Nasal Index values for significance.

Gender	Ethnicity	Mean Nasal Index	P Value
Male	Brahmin	101.7 ± 2.466	<0.0001
Female		87.30 ± 1.135	

Table 3 Percentage of Nose Shapes of Brahmin Males and Females of Central India.

Sex	Hyperleptorrhine (Very Narrow)		Leptorrhine (Narrow)		Mesorrhine (Medium)		Platyrrhine (Broad)		Hyperplatyrrhine (Very Broad)	
	N	%	N	%	N	%	N	%	N	%
Male	0	0	2	2.78	26	36.11	29	40.28	15	20.83
Female	0	0	0	0	27	43.55	31	50	04	6.45

(Table 3) In the present study, it was also observed that both Brahmin males and females of Central India had broader nose compared to earlier reported data of J & K, Gujarat, South Indian, UP, Bihar, Kerala Population. (Table 4) [7][8][9][10][11][12][13][14][15][18].

Table 4 Comparison of Nasal Index among different populations.

Place and People	Reference	Age (in Years)	Nasal Index	Nose Shape
J & K Males	Jabeen et al.,2019 [10]	17-22	72.15	Mesorrhine
J & K Females	Jabeen et al.,2019 [10]	17-22	65.98	Leptorrhine
Nepalese and Indian Males	Sudikshya KC et al.,2019 [16]	17-25	81.54	Mesorrhine
Nepalese and Indian Females	Sudikshya KC et al.,2019 [16]	17-25	75.70	Mesorrhine
Gujarati Males	Rohith et al.,2020 [14]	20-40	81.08	Mesorrhine
Gujarati Females	Rohith et al.,2020 [14]	20-40	77.30	Mesorrhine
South Indian Males	Radha K.,2019 [17]	17-23	67.04	Leptorrhine
South Indian Females	Radha K.,2019 [17]	17-23	64.84	Leptorrhine
South Rajasthan Males	Gangrade et al.,2012 [1]	18-50	83.00	Mesorrhine
South Rajasthan Females	Gangrade et al.,2012 [1]	18-50	79.73	Mesorrhine
Hindu Males of Gwalior Region	Sharma SK et al.,2014 [18]	18-28	80.59	Mesorrhine
Hindu Females of Gwalior Region	Sharma SK et al.,2014 [18]	18-28	77.29	Mesorrhine
Kashmiri Males	Gulzar S.,2022 [7]	20-30	83.31	Mesorrhine
Kashmiri Females	Gulzar S.,2022 [7]	20-30	226.83	Hyperplatyrrhine
Yoruba Nigerian Males	Oladipo G et al.,2009[11]	18-45	90.02	Platyrrhine
Yoruba Nigerian Females	Oladipo G et al.,2009[11]	18-45	83.58	Mesorrhine
Central Indian Brahmin Males	Present Study	20-30	101.7	Hyperplatyrrhine
Central Indian Brahmin Females	Present Study	20-30	87.30	Platyrrhine

4. Conclusion

It was concluded from the present study that there is sexual dimorphism in terms of Nasal Index of the Brahmin individuals of Madhya Pradesh state of Central India. The Brahmin males have mostly Hyperplatyrrhine (Very Broad) whereas Brahmin females have mostly Platyrrhine (broad) nose. There is dominance of Platyrrhine nose shape and absence of Hyperleptyrrhine nose shape amongst the Brahmin population in Central India considered in the present study. The study can be extended to generate large databases throughout India for establishing normative for nasal Indices. The nasal index would be highly useful cephalometric parameter for understanding the human variation, facial reconstruction, ancestral information and population research.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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