Arch Biol Sci. 2025;77(1):61-70 https://doi.org/10.2298/ABS250208006G

Assessment of facial and nasal phenotypes: implications in forensic facial reconstruction

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Received: February 8, 2025; **Revised**: February 15, 2025; **Accepted**: February 18, 2025; **Published online**: March 12, 2025

Abstract: The present study is an attempt to evaluate the phenotypes of face and nose based on facial and nasal indices in a North Indian population. The study comprises 228 (158 males and 70 females) healthy, young, and adult participants ranging in age from 18 to 35 years. Facial photographs and anthropometric measurements were taken for the assessment of facial and nasal indices. The faces and noses were classified into five phenotypes based on standard numerical values of facial and nasal indices. The most common facial phenotypes were observed to be hypereuryprosopic (61 males, 38.60%, and 31 females, 44.28%), and euryprosopic (51 males, 32.27%, and 14 females, 20%). For the nasal phenotype, mesorrhine was most common among males (56.32%, 89), while leptorrhine was predominant among females (55.71%, 39). The study's findings highlight facial variations and phenotype assessments that may aid forensic investigations, biometric evaluations, facial recognition technology, medico-legal applications, and facial reconstruction. Additionally, they serve as a valuable reference for enhancing facial surgeries and rhinoplasty. The study adds to the existing database of facial and nasal anthropometry for further use and comparison purposes.

Keywords: human biology, facial anatomy and morphology, facial and nasal phenotypes, facial recognition technology, facial and nasal index

INTRODUCTION

It is a well-known fact that no two individuals are identical in terms of the various aspects of their body morphology. The face is the most conspicuous and identifiable part of the human body. Therefore, the most natural approach utilized to identify a person is facial identification. Facial analysis attracts several scientific areas, such as anatomy and evolution of the human face, facial reconstruction, forensic identification, facial surgeries and rhinoplasty, facial recognition technology, biometrics, and others. Facial analysis is a useful tool to differentiate individuals based on their ancestry, ethnicity, and sex. Therefore, the study of inter- and intrapopulation variations is a topic of interest among anthropologists, anatomists, artists, surgeons, and forensic analysts [1].

The identification of individuals is becoming increasingly common due to the rise of CCTV surveillance systems, driven by growing concerns over crime rates, terrorist attacks, unauthorized access, and other security issues. Several techniques are applied to establish the identity of a suspect in surveillance systems, such as gait pattern analysis, height estimation, and facial identification [2]. In forensic science, the face plays a crucial role in establishing an individual's identity, as it can reveal information about age, sex, and other distinguishing features based on facial appearance [3]. However, an in-depth understanding of facial features and phenotypes across different populations is essential to enhance the accuracy of facial identification [4].

Facial identification in the modern context involves several techniques, including metrical analysis, morphological analysis, the superimposition technique, and the comparison of actual and suspected photographs, among others. Variations in facial features, characteristics, and facial indices among parents, offspring, and siblings can help provide clues for the genetic transmission of inherited characteristics [5,6,7]. Accurate facial analysis is essential for the study of normal and abnormal growth, diagnosis of genetic and congenital anomalies, and morphometric investigations. Since the middle of the 20th

How to cite this article: Guleria A, Krishan K, Sharma V. Assessment of facial and nasal phenotypes: implications in forensic facial reconstruction. Arch Biol Sci. 2025;77(1):61-70.

century, anthropometric studies on twin concordance and parent-offspring resemblance have demonstrated that heredity is the primary cause of variation in human face morphology [7,8]. The facial index is a useful parameter in anthropometry to differentiate humans based on their facial phenotype. The facial index, also known as the prosopic index, is defined as the ratio of the morphological facial height to the maximum breadth of the bizygomatic arches expressed in percentage. In addition, several studies have highlighted the usefulness of nasal anthropometry in differentiating humans into various ethnic groups. Studies reported that individuals of different ethnic groups exhibit variations in nasal anthropometry parameters. Therefore, the nasal index is an important parameter in anthropology to determine the sex and ancestry of an individual. The nasal index is calculated by the ratio of nasal width to nasal height, expressed in percentage [9].

There is a research gap in the study of facial phenotype similarities within families and population groups, as well as in the reconstruction of the face based on facial features and anthropometric assessments. In countries like India, with a diverse historical background, rich demographics, various religions, beliefs, ancient civilizations, and multifaceted societies, there is a wide range of ethnic groups that exhibit a variety of morphological features. The human face reflects both the uniqueness of an individual and the characteristics of a specific population in a given region, as it is shaped by a combination of genetics and environmental factors. [10]. A few studies have been conducted on the phenotypic appearance of faces based on their features and characteristics. The main aim of the present study was to provide insights into the facial characteristics of a North Indian population, offering valuable information for identification and potential indicators for facial reconstruction. An attempt has been made to correlate the anthropometric measurements of the face and the facial indices with the actual appearance of the human face, based upon the standard procedures for classifying facial types.

MATERIALS AND METHODS

Ethics statement

Ethical permission was obtained from the Panjab University Institutional Ethical Committee, approval no. PUIEC 23062-II-112 of 09.06.2023. A well-informed and written consent was obtained from the participants. The research was conducted under the principles of the Declaration of Helsinki and in compliance with local regulatory requirements.

Study participants

The study was carried out on 228 healthy, young participants (158 males and 70 females) from a North Indian Rajput population. The sample size for the present study was calculated to be 384 following Cochran's method [11] using the formula:

$$n_0 = \frac{z^2\, p\, q}{e^2}$$

Where n_0 = sample size, z = selected critical value of desired confidence level, p = estimated proportion of an attribute that is present in the population, q = 1-p, and e = desired level of precision

Assuming the maximum variability,

p = 0.5 (50%), q = (1-0.5) =0.5, e = 0.05 (5%), z = 1.96

Therefore, the equation is:

$$n_0 = (1.96)^2\,(0.5)\,(0.5)/(0.05)^2 = 384.16$$

The minimum sample size was therefore considered to be 384. As per the inclusion criteria of the study, only healthy, young, adult participants aged 18-35 years belonging to the Rajput population group (a major North Indian caste group) were included in the study. Participants with facial anomalies, those who had undergone facial surgery, pregnant women, individuals under 18 or over 35 years old, and those not belonging to the Rajput population group were excluded from the study. With these criteria, a total of 228 participants were selected for the present study, which is a statistically robust figure.

Anthropometric measurements and facial photographs

The present study is based on anthropometric measurements of the face of each participant. Photographs of the participants were taken to visually document their features and provide context for the calculated facial/prosopic and nasal indices, offering a more comprehensive representation of the obtained phenotypes. The

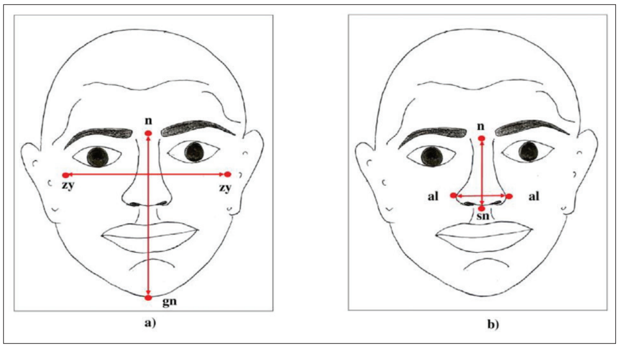

Fig. 1. Facial measurements taken on the participants to calculate facial and nasal indices (**a**) facial index: n-gn = morphological facial height, zy-zy = bizygomatic breadth; (**b**) nasal index: al-al = nasal breadth, n-sn = nasal length

photographs of participants were taken in norma frontalis position under standard conditions. Furthermore, facial measurements, including morphological facial height, breadth of the bizygomatic arches, and nasal breadth and length, were recorded directly on the participant's face in the Frankfurt-horizontal plane using standard instruments, landmarks, and techniques, as shown and defined in Fig. 1. While recording the measurements, the instruments were regularly checked for accuracy and reliability to ensure they could reproduce the same measurement consistently. The accuracy of the instruments was also checked with the help of an anthropometric verification for reproducibility of the measurements. Measurements were taken by a trained forensic anthropologist (AG) under the supervision of an experienced physical anthropologist/anthropometrist (KK) to avoid inter-observer error.

Technical error of measurement (TEM), the relative technical error of measurement (rTEM), and the coefficient of reliability (R) were analyzed to obtain intra-observer precision, using measurements from 20 participants [12,13]. Each measurement was taken twice on the same participant by the same investigator (AG).

After taking the facial measurements of all the participants, the facial/prosopic index and nasal index were calculated following the classification standardized by Martin and Saller [14], Singh and Bhasin [15], and Dhulqarnain et al. [9]. These two indices were calculated using the respective formulas, and the face and nose types were evaluated based on the standard ranges of the indices for each individual.

Statistical analysis and assessment of facial phenotypes

Statistical analysis was done using the statistical software IBM SPSS version 20. In this study, the normality of the data was assessed using normal P-P and Q-Q plots, descriptive statistics, and a confirmatory test, the Shapiro-Wilk test (P>0.05). Non-normality was observed in both the prosopic and nasal indices. The non-parametric Mann-Whitney U test was applied for the determination of sex from the prosopic and nasal indices. Subsequently, the types of faces (Figs. 2 and 3, showing facial phenotypes in males and females,

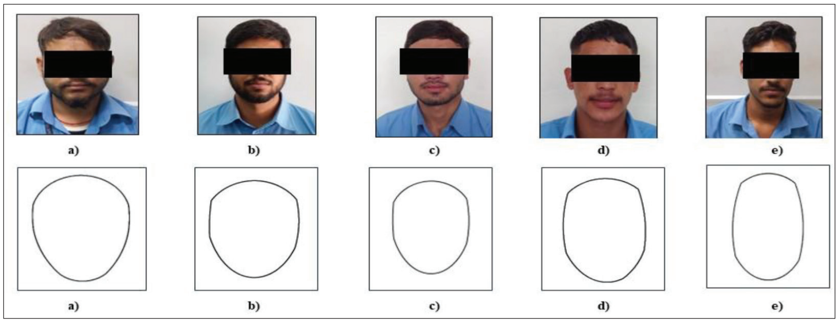

Fig. 2. Variations in facial morphology based on the prosopic index. The first row shows the facial shapes observed among male participants and the second row shows the outlines for different types of facial shapes based on the prosopic index i.e., (**a**) hypereuryprosopic, (**b**) euryprosopic, (**c**) mesoprosopic, (**d**) leptoprosopic, (**e**) hyperleptoprosopic face

Fig. 3. Variations in facial morphology based on the prosopic index: The first row shows the facial shapes observed among the female participants and the second row shows the outlines for different types of facial shapes based on the prosopic index i.e., (**a**) hypereuryprosopic, (**b**) euryprosopic, (**c**) mesoprosopic, (**d**) leptoprosopic, (**e**) hyperleptoprosopic face.

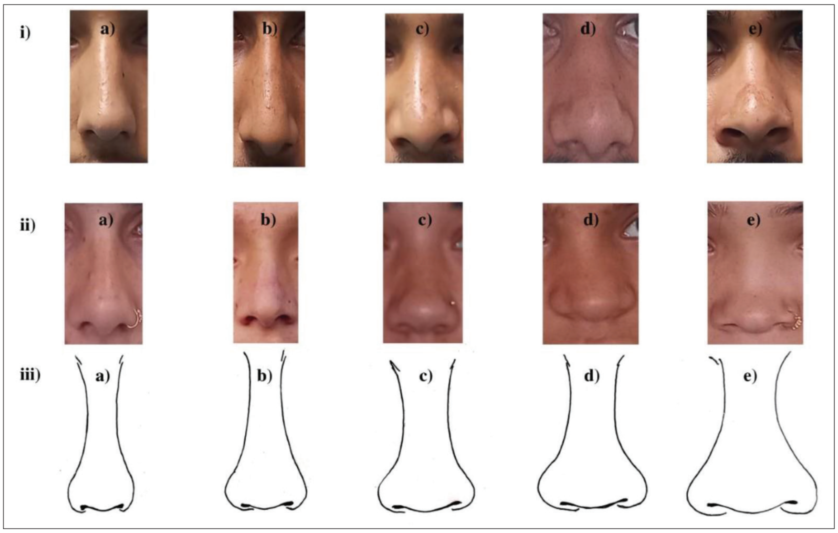

Fig. 4. Variations observed in nose morphology based on nasal index among the population studied; (**i**) nasal shapes observed in males, (**ii**) nasal shapes observed in females; (**iii**) outlines of the type of nasal shapes observed in the individuals based on the nasal index i.e., (**a**) hyperleptorrhine, (**b**) leptorrhine, (**c**) mesorrhine, (**d**) platyrrhine, (**e**) hyperplatyrrhine nose.

respectively, based on the prosopic index) and noses (Fig. 4, showing variations in nasal morphology based on the nasal index) were observed according to the standard range and classification. Based on the facial and nasal shapes, along with the values of the facial and nasal indices, outlines of the faces in males (Fig. 2) and females (Fig. 3), as well as nasal shapes (Fig. 4), have been drawn to illustrate the typical phenotype of the face and nose for the North Indian population considered in the present study.

RESULTS

The results of the technical error of measurement (TEM), the relative technical error of measurement (rTEM), and the coefficient of reliability (R) for morphological facial height, breadth of bizygomatic arches, nasal breadth and length, are presented in Table 1. The TEM values of face and nose measurements ranged between 0.14-0.33 cm and the rTEM values between 2.599-5.174%. The coefficient of reliability (R) for all the variables varied between 0.832-0.919. The calculated values of R were close to 1, showing an acceptable range of intra-observer precision [12,13].

Data normality was determined using descriptive statistics and the Shapiro-Wilk normality test as shown in Table 2. Mean and standard deviation values of the facial and nasal indices were observed to be 80.41±6.26 and 70.77±7.55, respectively, for the whole population considered in the present study. Sex differences were evaluated using the non-parametric Mann-Whitney U test. The mean and standard deviation values of the facial index and nasal index in males were 81.13±6.12 and 71.18±6.98, respectively. Whereas mean and standard deviation values of the facial index and nasal index in females were found to be 78.78±6.30 and 69.83±8.68, respectively. Significant sex differences were observed only in the facial index ($P<0.01$) as shown in Table 3.

The facial and nasal phenotypes were evaluated as per the objectives of the present study. According to the standard classification of the prosopic index for males and females by Martin and Saller [14] and Singh and Bhasin [15], a very broad face, i.e., hypereuryprosopic, was found in 61 males (38.60%) of 158 males and 31 females (44.28%) of 70 females. The second most common facial phenotype found in males (51,

Table 1. Precision estimates calculated for facial measurements (n=20)

Measurements (in cm)	TEM	rTEM	R
Morphological facial height	0.32	3.104	0.854
Breadth of bizygomatic arches	0.33	2.599	0.832
Nasal breadth	0.14	4.264	0.919
Nasal length	0.22	5.174	0.872

*TEM – technical error of measurement, *rTEM– relative technical error of measurement, *R – coefficient of reliability

Table 2. Descriptive statistics and normality assessment of facial and nasal index using the Shapiro Wilk test for a North Indian population comprising 228 participants (158 males and 70 females).

Variables	Minimum	Maximum	Mean±SD	Median	Mode	Shapiro Wilk	p-value
Facial index	67.90	108.82	80.41±6.26	80.15	79.52	0.977	0.001
Nasal index	51.78	112.89	70.77±7.55	71.11	68.75	0.965	0.000

Table 3. Descriptive statistics and evaluation of sex differences in facial and nasal index among the North Indian population using thenon-parametric Mann-Whitney U test

Descriptive statistics and sexual dimorphism	Non-parametric variables			
	Facial index		Nasal index	
	Males (158)	Females (70)	Males (158)	Females (70)
Minimum	68.65	67.90	51.78	54.90
Maximum	108.82	93.67	90.90	112.89
Mean	81.13	78.78	71.18	69.83
Mode	80.88	78.66	72	68.96
Median	79.52	71.96	78.26	62.50
Standard deviation	6.12	6.30	6.98	8.68
Mann Whitney U test value	4258.500		4643.500	
P	0.006**		0.054	

** P is highly significant if <0.01, * P is significant if <0.05

32.27%) and females (14, 20%) was euryprosopic, indicating a broad face. The rarest facial phenotypes observed in males were mesoprosopic (16.45%, 26), leptoprosopic (10.12%, 16), and hyperleptoprosopic (2.53%, 4). In females, the rarest phenotypes were mesoprosopic (17.14%, 12), leptoprosopic (11.4%, 8), and hyperleptoprosopic (7.14%, 5). The prevalence of facial shape based on the prosopic index observed among males and females is given in Table 4.

The findings also indicate that the most common nasal phenotype present in the males of the North Indian population was mesorrhine (moderate/medium size), observed in 89 (56.32%) males, followed by leptorrhine in 65 (41.13%) out of the total male population. In females, the leptorrhine nose was the most common (55.71%, 39), followed by the mesorrhine nose (40%, 28). The rarest nasal shapes observed in males were hyperleptorrhine (1.26%, 2), platyrrhine (1.26%, 2), and hyperplatyrrhine (absent). In females, the rarest nasal shapes were platyrrhine (1.42%, 1), hyperplatyrrhine (1.42%, 1), and hyperleptorrhine (1.42%, 1). Variations in nasal morphology observed in both males and females are represented in Fig. 4. The distribution and percentage of these nasal morphological variations found among males and females are given in Table 5.

Table 4. Prevalence of facial shape based on prosopic index evaluated in males (n=158) and females (n=70) of the North Indian population

S.No.	**Facial Shape**	**Shape of Face**	**Range of Prosopic Index**		**Prevalence of Facial Shape**	
			Male	**Female**	**Male**	**Female**
1	Hypereuryprosopic	Very broad face	X-78.9	X-76.9	61 (38.60%)	31 (44.28%)
2	Euryprosopic	Broad face	79.0-83.9	77.0-80.9	51 (32.27%)	14 (20%)
3	Mesoprosopic	Round face	84.0-87.9	81.0-84.9	26 (16.45%)	12 (17.14%)
4	Leptoprosopic	Long face	88.0-92.9	85.0-89.9	16 (10.12%)	8 (11.4%)
5	Hyperleptoprosopic	Very long face	93.0-X	90.0-X	4 (2.53%)	5 (7.14%)

Table 5. Prevalence of nose shape based on nasal index evaluated in the males (158) and females (70) of the North Indian population

S.No.	**Nose Shape**	**Size of Nose**	**Range of Nasal Index**	**Prevalence of Nose Shape**	
				Male	**Female**
1	Hyperleptorrhine	Long narrow nose	< 54.9	2 (1.26%)	1 (1.42%)
2	Leptorrhine	Moderately narrow nose	55.0 – 69.9	65 (41.13%)	39 (55.71%)
3	Mesorrhine	Moderately or medium size	70.0 – 84.9	89 (56.32%)	28 (40%)
4	Platyrrhine	Moderately wide nose	85.0 – 99.9	2 (1.26%)	1 (1.42%)
5	Hyperplatyrrhine	Very wide nose	>100	Nil	1 (1.42%)

For convenience, the detailed calculations and formulas for the prosopic/facial index and nasal index, along with definitions of the measurements and landmarks involved, are provided in Supplementary Table S1.

DISCUSSION

It is well-established that no two individuals are exactly alike in their measurable characteristics and features. In everyday life, individuals are identified based on their unique facial characteristics. The human face is a topic of interest for multiple scientific disciplines, including, but not limited to, anatomy, forensic science, anthropology, surgery, and biometrics. Forensic examiners and anthropologists study variations in facial morphology and dimensions to assist in identifying individuals. The present study evaluated facial and nasal phenotypes based on the prosopic and nasal indices. The study defined five types of faces and noses observed in a North Indian population and supplements the existing database of facial and nasal anthropometry for further use and comparison purposes. Significant sex differences were observed in the prosopic index (P<0.01). The study showed that the hypereuryprosopic, i.e., a very broad face was the most common facial phenotype among the males and females of the North Indian population. The least common facial shape among males was hyperleptoprosopic, whereas, in females, the least common was leptoprosopic followed by hyperleptoprosopic facial phenotype. Bhasin [16] reported that the mesoprosopic face type is dominant among Indians. A study by Mane et al. [17] observed a hyperleptoprosopic face type with significant sexual dimorphism among the Indian population. Prasanna et al. [18] observed statistically significant differences in the facial index between North and South Indian populations. Their study reported facial index values of 101.4±1.95 for the North Indian population and 100.28±1.77 for the South Indian population. Indian males exhibited a hyperleptoprosopic facial phenotype, while North Indian females (107.7±7.69) were predominantly hyperleptoprosopic, and South Indian females (85.39±6.33) were primarily hypereuryprosopic. Özşahin et al. [19] reported that the most common facial type among Turkish males was euryprosopic (35.3%), while in females, both euryprosopic (34.3%) and mesoprosopic (34.3%) were equally prevalent. Jeremić et al. [20] reported significant (P<0.001) sexual differences, with females having lower facial height, breadth, and facial index values than males. Their study found that the leptoprosopic facial phenotype was predominant in the Serbian population, with a distribution of 76.67% in males and 87.06% in females, followed by mesoprosopic and hyperleptoprosopic facial configurations. Torres-Restrepo [21] reported that among Envigado school children in Colombia, the most predominant facial phenotypes were leptoprosopic (>93.1%), followed by mesoprosopic (81–93%) and euryprosopic (<80.9%). Maina et al. [22] observed facial variations among three different ethnic groups: Fulani, Tangale, and Tera. The dominant facial phenotype in both males and females of all three tribes was hyperleptoprosopic, except for Tangale males, whose dominant facial type was leptoprosopic. Additionally, Muralidhar et al. [23] reported that the average facial index in the Kerala population ranged from 94.3±7.2 to 106.9±2.02, derived using a formula specific to the population studied. This range was relatively higher than the average facial index found in our study, as well as the values proposed by Martin and Saller [14].

The shape and outline of the face show extensive variations across different populations around the world. Numerous studies show that individuals from different geographical locations exhibit significantly varied craniofacial morphologies and specific facial characteristics, making them distinguishable from one another with distinct sets of unique features [2,4]. When observing a face, our first consideration is its facial configuration or contour, which helps distinguish a person from a group. These differences among individuals hold great significance for scientists and medical professionals in areas such as forensic identification, biometric evaluation, and the possible diagnosis of diseases and treatments [17].

The nose varies in shape and size across different population groups, as ethnic differences, along with environmental and genetic factors, can influence the phenotypic appearance of the human body. Therefore, the nasal phenotype is considered a useful anthropometric parameter to categorize the ethnicity and sex of an unknown individual. In the present study, the mesorrhine nose (moderately or medium-sized) was the dominant nasal shape in North Indian males (56.32%, 89 out of 158), with hyperleptorrhine and platyrrhine being the rarest nasal shape. In females (n = 70), the leptorrhine nose (55.71%, 39) was the most common, followed by the mesorrhine nose (40%, 28). The results of our study were compared with the anthropometric findings of nasal index in the Hausa population of Northwestern Nigeria [24]. The study reported significant differences between sex groups. The most common nasal shape observed in males was mesorrhine (71%), while in females, leptorrhine (50%) and mesorrhine (49%) were almost equally prevalent. However, both males (81.08±8.61) and females (77.30±9.02) of the Gujarati population exhibited mesorrhine noses with a significant difference in their nasal index [25]. Dhulqarnain et al. [9] reported that the predominant nose shape in the Iranian population was leptorrhine (31.9%), while the Hausa population of Nigeria predominantly exhibited a mesorrhine nose shape (30.2%). Several experts have also noted that the prosopic indices vary between males and females across different populations. Regression functions to predict nasal profiles in forensic analyses using CT-based 3D models of Korean adults, considering factors such as sex and age have been developed [26].

The nose is also one of the most distinguishing features for establishing an individual's identity [27,28]. Genetic and environmental factors affect nose shape, size, and morphology. Facial type, age, sex, ethnicity, and ancestry are some of the factors that can affect external nasal morphology. People with longer faces tend to have narrower noses than individuals with shorter or neutral faces [26,29]. Natural selection has caused humans to have smaller noses in cold, dry areas and wider noses in warmer, wetter environments [30-32]. Therefore, understanding the morphological variations in a particular population group may also provide valuable insights into evolutionary and physiological adaptations and ecological and environmental conditions of the population. For instance, individuals with European ancestry (EUR) typically have noses that protrude more than those with East Asian ancestry (EAS). The genetic basis of these differences is likely significant, remaining largely unknown, as there have been comparatively few investigations conducted in East Asian (EAS) populations compared to European (EUR) populations [33].

The analysis of facial and nasal shapes can assist forensic practitioners in reconstructing the facial features of unidentified individuals based on skeletal remains. Forensic artists can create more accurate facial sketches, and reconstructions from unidentified individuals based on skeletal remains by understanding the typical variations of facial morphology present within a specific population. Facial recognition technology relies on analyzing facial features to distinguish individuals [34,35]. Studies on facial configuration can provide baseline data to develop more robust and accurate biometric identification tools, enable comparative analysis, offer clues about ancestry or ethnic background, and assist in age progression and regression techniques used in forensic investigations [36,37]. Additionally, facial type is a crucial component in orthodontic therapy, as it can influence the anchorage system, help anticipate the growth of maxillo-mandibular structures, and impact muscle strength and treatment stability [22].

The present study offers a classification of facial and nasal phenotypes for the North Indian population, presenting the facial configurations of this population in a novel manner. These morphological variations can further enhance facial recognition technology, with potential applications in law enforcement, facial reconstruction, and biometric identification, leading to more accurate and reliable identification methods. Moreover, this study recommends further investigations to compare the facial and nasal dimensions of the present population with other population groups in India and internationally.

There is a difference in the sample size between males and females in the present study. The relatively small number of females in the study may be considered a limitation. While the sample size is statistically valid, it may influence the observed sex differences to some extent.

CONCLUSIONS

Craniofacial dimensions are considered one of the important tools for the estimation of inter and intraracial morphological features of the head and face. Similarly, facial indices play an important role as an identification tool for biometric and forensic, anthropological purposes. In the present study, the most common and rare facial and nasal phenotypes were evaluated by calculating prosopic and nasal indices. Significant sex differences were also found only in the prosopic index considered in the study. The most common facial phenotype observed among males and females was hypereuryprosopic and the least common was hyperleptoprosopic facial phenotype. Whereas in the case of a nasal index, mesorrhine and leptorrhine noses were dominantly present in males and females respectively and the least common nasal shapes were hyperleptorrhine, platyrrhine, and hyperplatyrrhine in both males and females.

The study provides baseline data for facial phenotype and nasal morphology among a North Indian population. Additionally, the study serves as a reference for future research and similar studies on this population, particularly in assessing ethnicity and individual identification. This study proposed novel facial and nasal outlines of facial and nasal morphology for the North Indian population based on indices and their standard classification. Therefore, it will be valuable for medical and aesthetic surgeries, forensic investigations, and anthropological studies. In the future, similar studies should be conducted on larger populations to improve the accuracy of predictions and to examine the effects of environment and genetics on facial features across different population groups.

Funding: The authors received no specific funding for this work.

Acknowledgments: The principal author (AG) expresses gratitude to the Department of Science and Technology, Government of India, for awarding the INSPIRE Fellowship under Grant No. IF190719 to support the pursuit of their Ph.D. KK is supported by the UGC Centre of Advanced Study (CAS II), awarded to the Department of Anthropology, Panjab University, Chandigarh, India.

Authors contributions: AG: Conceptualization, data collection, data entry, writing original draft, review & editing, final approval, KK**:** Writing, review & editing, data analyses and interpretation, final approval and supervising the work, VS: Writing, review & editing, data analyses and interpretation, final approval and supervising the work.

Conflict of interest disclosure: The authors declare that they have no competing and conflict of interests.

Data availability: The data underlying this article are available in the online supplementary material: https://www.serbiosoc.org.rs/NewUploads/Uploads/Guleria%20et%20al_Dataset.pdf

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SUPPLEMENTARY MATERIAL

Supplementary Table S1. Table showing the formulae for prosopic/facial and nasal indices along with definitions of measurements and landmarks considered in these indices

Indices	Definition	Landmarks	Phenotypes based on range			References
Prosopic Index = morphological facial height/ breadth of bizygomatic arch *100						
Morphological facial height (n-gn)	This measures the straight distance between nasion (n) and gnathion (gn). Instrument used - Sliding caliper	Nasion (n) = this is the point on the nasal root intersected by mid sagittal plane. Gnathion (gn) = this is the lowest point on the lower margin of the lower jaw in the mid-sagittal plane.	**Facial type**	**Male**	**Female**	Martin and Saller [14], Singh and Bhasin [15]
			Hypereuryprosopic (Very broad face)	X-78.9	X-76.9	
			Euryprosopic (Broad face)	79.0-83.9	77.0-80.9	
			Mesoprosopic (Round face)	84.0-87.9	81.0-84.9	
Breadth of bizygomatic arch (zy-zy)	This measures the straight distance between the two zygia (zy) which are the most lateral points on the zygomatic arches. Instrument used- Spreading caliper	Zygion (zy) = this is the most laterally placed point on the zygomatic arch.	Leptoprosopic (Long face)	88.0-92.9	85.0-89.9	Martin and Saller [14], Singh and Bhasin [15]
			Hyperleptoprosopic (Very long face)	93.0-X	90.0-X	
Nasal Index = nasal breadth/ nasal height *100						
Nasal breadth (al-al)	this measures the straight distance between the two alaria (al) points. Instrument used: Sliding caliper	Alare (al) = this is the most laterally placed point on the nasal wing.	Hyperleptorrhine (Long narrow nose), < 54.9 Leptorrhine (Moderately narrow nose), 55.0 – 69.9 Mesorrhine (Moderately or medium size),70.0 – 84.9 Platyrrhine (Moderately wide nose), 85.0 – 99.9 Hyperplatyrrhine (Very wide nose), >100			Dhulqarnain et al. [9], Martin and Saller [14], Singh and Bhasin [15]
Nasal height (n-sn)	this measures the straight distance between the nasion (n) and subnasale (sn). Instrument used: Sliding caliper	Nasion (n) = this is the point on the nasal root intersected by mid sagittal plane. Subnasale (sn) = this is the point where the lower margin of the nasal septum meets the integument of upper lip.				Dhulqarnain et al. [9], Martin and Saller [14], Singh and Bhasin [15]

ONLINE SUPPLEMENTARY MATERIAL

The data underlying this article are available in the online supplementary material: https://www.serbiosoc.org.rs/NewUploads/Uploads/Guleria%20et%20al_Dataset.pdf