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Original Article

Anatomy Section

Variations in Nasal Index among Punjabi Population: A Cross-sectional Study

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ABSTRACT

Introduction: Anthropometry serves as a scientific framework for collecting and analysing morphometric data, enabling the study of human diversity across geographical and ethnic boundaries. The nasal index is a multifaceted anatomical entity. Nasal anthropometry is a study concerned with the precise measurement and analysis of nasal size, shape, and proportions. The human nose exhibits considerable variation in size and shape, which is attributed to the combined effects of age, sex, environmental influences, ethnic background, and regional characteristics. Knowledge of nasal measurements is indispensable for rhinoplasty, facial surgery, and forensic analysis, enabling professionals to make informed decisions and achieve optimal outcomes.

Aim: To provide the variations in nasal index among Punjabi males and females in the age group of 18-25 years.

Materials and Methods: The present cross-sectional study was conducted on 1,420 participants (710 males and 710 females) from Punjab, aged between 18 and 25 years. Nasal length and nasal width were measured with the help of a digital sliding vernier caliper in the natural head position, and the nasal index was calculated using the validated formula: Nasal Index = (Nasal Width/Nasal Length) × 100.

Results: The mean value of the nasal index was 67.32±6.21 for males and 65.40±6.07 for females. A significant difference was found in nasal length, nasal width, and nasal index between males and females, with a p-value<0.05.

Conclusion: A significantly higher nasal index was observed in males than in females of the Punjabi population. From this study, it was concluded that the dominant nose type in both males and females was leptorrhine.

Keywords: Digital sliding vernier caliper, Facial surgery, Forensic anthropology, Nasal anthropometry, Nasal length, Nasal width, Punjabi population, Rhinoplasty, Type of nose

INTRODUCTION

Anthropometry is the science of measuring human body dimensions. The term anthropometry refers to a set of systematised measuring techniques for expressing quantitatively the dimensions of the human body and skeleton [1]. The branch of anthropometry that deals with the shape and size of the human nose across different populations is termed nasal anthropometry [2]. The nose is widely accepted as one of the best clues to racial origin [3]. The nasal index is very useful in anthropology as it is one of the clinical anthropometric parameters recognised in nasal surgery and medical management [4,5]. The nasal index itself is a complex anatomical unit; thus, the anthropometric study devised around it might play an important role during the reconstruction of rhinoplasty and facial surgeries [6].

Punjabi males and females, being part of the diverse Indian population, exhibit unique nasal morphological characteristics shaped by genetic, environmental, and geographical factors. The nasal index is related to regional and climatic differences. Numerous studies have indicated racial and ethnic differences in the nasal index among different populations [7-12]. These studies have reported significant differences in nasal indices among various ethnic groups, highlighting the importance of population-specific data. In the Indian context, research has been conducted on various populations, including those from different regions and communities. Anthropometry has been applied in the clinical examinations of syndromic individuals and those with facial and jaw abnormalities, as well as in the treatment plans for maxillofacial surgery [13]. Accurate anthropometric measurements in the craniofacial region enable the successful treatment and reconstruction of congenital or post-traumatic facial disfigurements [14].

Anthropometry plays a crucial role in various clinical applications, particularly in rhinoplasty and facial reconstruction surgery [2]. The lack of detailed information on Punjabi males and females limits the understanding of their unique nasal morphological features and hinders the development of population-specific standards in fields such as forensic anthropology and plastic surgery. The need for this study arises from the importance of understanding the variations in nasal index among Punjabi males and females, which can contribute to the development of more accurate and population-specific standards in various applications. The novelty of this study lies in its focus on a specific subpopulation within India, providing detailed insights into the nasal morphology of Punjabi males and females. By exploring the variations in nasal index within this group, this study aimed to fill the existing gap in the literature and contribute to a more nuanced understanding of human facial morphology. This study investigated the nasal index variations among Punjabi males and females, providing valuable data that can be used in anthropology, forensic science, and clinical practices.

MATERIALS AND METHODS

The present cross-sectional study was conducted at Sri Guru Ram Das University of Health and Sciences, Sri Amritsar, Punjab, india from August 2022 to January 2025, after obtaining ethical approval (SGRD/IEC/2022-38). A convenience sample of 1,420 participants was taken. The study participants consisted of 710 males and 710 females from the Punjabi population, aged between 18 and 25 years. Informed consent was obtained from the participants before the start of the study.

Inclusion criteria:

- The study participants hailed from Punjab and were aged between 18 and 25 years;
- Willingness to participate in the study was essential.

Exclusion criteria:

- Individuals with a history of congenital craniofacial defects, significant facial trauma, or previous orthodontic/craniofacial surgery were excluded;

- Those with irregular teeth, deviations of the nasal septum, or signs of dwarfism/gigantism were also omitted;
- Participants with skin allergies or other relevant medical conditions were not included.

Study Procedure

The study participants were fully informed about the study's purpose and procedures, and their written consent was obtained after clarifying any queries. Participants were allowed to refuse participation, and their decision was respected. During measurements, participants removed glasses and jewellery, sat in a relaxed position with a natural head position [15-18] in the Frankfort plane [19] and refrained from smiling or changing facial expressions.

Relevant nasal surface landmarks were identified on the study participants through careful inspection and were then marked on the nose with the help of a surgical skin marker. Anthropometric measurements were subsequently taken by positioning the jaws of a digital sliding vernier caliper from the starting point to the ending point of the landmark to be measured, ensuring that the tips of the jaws touched the skin surface gently without applying any pressure. To ensure accuracy and consistency, all measurements were taken twice by one examiner, and the average value was calculated to reconfirm and avoid any discrepancies. Following the measurement process, the marked landmarks were erased using cotton.

For measurement, widely accepted and operational definitions were used:

Nasal Surface Landmarks [14]:

N (Nasion): A small depression at the root of the nose where the frontonasal and internasal sutures meet.

Sn (Subnasale): The midpoint of the baseline of the nose at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane.

Al (Alare): The most lateral point of the nose.

Nasal Measurements [Table/Fig-1,2] [20]:

Nasal length (N-Sn): Distance measured from nasion to subnasale.

Nasal width (Al-Al): Distance measured from right ala to left ala

The required distances were measured, and the nasal index was calculated as shown in [Table/Fig-3] [21].

[Table/Fig-1]: Nasal length (N-Sn).
[Table/Fig-2]: Nasal width (Al-Al). (Images from left to right)

Anthropometric indices	Measurement
Nasal Index	Nasal width/Nasal length × 100

[Table/Fig-3]: Measurements of anthropometric Nasal Index [21].

With the help of the Nasal Index, the phenotypes of the nose in the study group were assessed. The Nasal Index divides the nose into different types, as classified by Martin R and Saller K in [Table/Fig-4] [22].

STATISTICAL ANALYSIS

All the collected data were presented with descriptive analysis, i.e., number, percentage, mean, and standard deviation. Genders were compared using the Chi-square test. Means were compared using the unpaired Student's t-test among males and females. The software used was Statistical Package for Social Sciences (SPSS) version 23.0.

Catergories	Size of nose	Nasal index
Hyperleptorrhine	Long narrow nose	40-54.9
Leptorrhine	Moderately narrow nose	Less than 70
Mesorrhine	Moderate or medium size	70-84.9
Platyrrhine	Moderately wide nose	85-99.9
Hyperplatyrrhine	Very wide nose	100 or more

[Table/Fig-4]: Classification of nose according to nasal index [22].

RESULTS

The study includes a total of 1,420 participants, with 710 males and 710 females. The mean age for males was 20±1.8 years, while the mean age for females was 21±2.2 years [Table/Fig-5].

Demographic variables	Males (n=710)	Females (n=710)
Age (years) Mean±SD	20±1.8	21±2.2

[Table/Fig-5]: Demographic characteristics of study participants.

The mean nasal length for males was found to be 51.89±3.58 mm, which was significantly higher than that of females, which was 48.16±2.96 mm ($p<0.001$). The mean nasal width observed in males was 34.78±2.42 mm, which was slightly higher than that of females, which was 31.39±2.32 mm. The difference in mean nasal width between males and females was highly statistically significant ($p<0.001$) [Table/Fig-6].

Variables	Mean Value (mm)±Standard deviation	
	Male	Female
Nasal length	51.89±3.58	48.16±2.95
Nasal width	34.78±2.41	31.38±2.32

[Table/Fig-6]: Mean- nasal length, nasal width with standard deviation.

The mean nasal index in males was 67.32±6.21 and in females, it was 65.40±6.07. Statistically significant differences were found between the nasal indices of male and female students ($p<0.001$) [Table/Fig-7]. The mean values of the nasal index in both males and females fell under the category of the predominant nose shape, which is the Leptorrhine type of nose.

Variable	Mean value		Standard deviation		Min-Max	Min-Max
	Male	Female	Male	Female	Male	Female
Nasal index	67.32	65.40	6.21	6.07	51.9-86.8	54.1-84.2

[Table/Fig-7]: Mean, standard deviation, minimum and maximum values for Nasal Index.

DISCUSSION

The present study showed that the mean nasal index of males and females in the Punjabi population was 67.32±6.21 and 65.40±6.07, respectively, with the predominant nose type being Leptorrhine. The nasal index is a very important ethnically sensitive feature; therefore, knowledge of it is crucial for surgeons who aim to maintain core ethnic features while performing any surgery on the nose [23-26].

It was observed that the Nigerian population [27-31] predominantly has platyrrhine or short and broad noses, whereas Caucasians and Albanians [14,32] have leptorrhine noses. Additionally, medical students in the College of Bangalore [33] have mesorrhine noses. These variations in the nasal index may be attributed to different sample sizes, various measurement techniques used, and also to genetic, hormonal, nutritional, and climatic factors.

Author/Year	Population	Nasal index		Predminant type of nose
		Male	Female	
Oladipo GS et al., (2009) [27]	Okrika (Nigeria)	86.23±1.72	86.46±2.37	Platyrrhine
Anas IY et al., (2014) [28]	Yoruba (Nigeria)	100.9±8.9	94.1±8	Platyrrhine
Eboh DE (2011) [29]	Bini Adolescents (Nigeria)	99.13±9.26	99.27±11.67	Platyrrhine
Jimoh RO et al., (2011) [30]	Ilorin (Nigerian Africans)	90.7	88.2	Platyrrhine
Eboh DEO and John EA (2011) [31]	Ukwuani (Nigeria)	97.47±12.88	98.07±8.37	Platyrrhine
Farkas LG et al., (2005) [14]	Caucasian	65.5	64.2	Leptorrhine
Staka G et al., (2012) [32]	Kosovo Albanian	67.07±6.67	63.87±5.56	Leptorrhine
Asharani SK (2015) [33]	Med Students in college of Banglore, South India	75.80±3.23	73.60±3.21	Mesorrhine
Jovanovic J et al., (2014) [34]	Serbia	67.56	66.01	Leptorrhine
Agrawal V et al., (2019) [35]	North Indian	67.79±9.03	60.44±11.09	Leptorrhine
Sharma S et al., (2023) [36]	Central Indian	69.94±5.87	58.44±4.70	Leptorrhine
Jabeen N et al., (2019) [37]	Jammu and Kashmir	72.15±11.30	65.98±9.36	Males- Mesorrhine Females- Leptorrhine
Premraj M et al., (2025) [38]	South Indian	71.29±8.96	71.05±8.18	Mesorrhine
Rohith MM et al., (2020) [39]	Gujarat	81.08±8.61	77.30±9.02	Mesorrhine
Kaushal S et al., (2013) [24]	Punjab	67.04±8.87	69.38±8.09	Leptorrhine
Present study	Punjabi Population	67.32±6.21	65.40±6.07	Leptorrhine

[Table/Fig-8]: Shows comparison of Nasal index with other studies [14,24,27-39].

In the present study, the nasal index of study participants belonging to the Punjab region was examined, and it was observed that the nasal type, based on the mean nasal index, was Leptorrhine in both males and females. These findings were consistent with the research conducted by Jovanovic J et al., in Serbia, who found a leptorrhine shape in males and females with nasal indices of 67.56 and 66.01, respectively [34]. Thus, Leptorrhine was the dominant form of the nose in both sexes. On the other hand, Staka G et al., observed that the nasal type in the Albanian population in Kosovo was leptorrhine in males and females, with nasal indices of 67.07 and 63.87, respectively [32]. Another study conducted by Agrawal V et al., also found that the leptorrhine shape was the most common form of nose in the North Indian population, showing nasal indices of 67.79 in males and 60.44 in females [35].

In the present study, leptorrhine was the most common type of nose, which was not in concordance with Asharani SK et al., who studied the nasal index of males (75.80) and found it to be higher than that of females (73.60) among medical students in a Karnataka Medical College [33]. They discovered that the majority of students had a mesorrhine type of nasal form, followed by platyrrhine and leptorrhine forms.

Authors such as Farkas LG et al., found that the mean nasal index was higher in males (65.5) compared to females (64.2), with both groups exhibiting the leptorrhine type of nose [14]. This aligned with the findings of the present study. Similar findings were observed by Kaushal S et al., where females (69.38) had a higher nasal index than males (67.04), also showing a leptorrhine type [24]. This correlated with the observations made in males and females from Central India [36] and females from Jammu and Kashmir [37], whereas it contradicted the findings from males and females in South India [38], males from Jammu and Kashmir [37], and males and females from the Gujarati population [39]. Therefore, the nasal index demonstrated sexual dimorphism. The nasal indices observed by different authors conducting studies on various populations were compared, and their nose types were estimated [Table/Fig-8] [14,24,27-39].

The form and structure of the nose vary according to genetic heritage, cultural identity, and climatic conditions [40]. The variation in nasal shape among human populations is a consequence of adaptation to different climates, with natural selection favouring narrower noses in cold, dry climates and broader noses in warm, moist ones [41,42]. Thus, it serves as a useful index for classifying racial differences. Nasal anthropometric parameters play a crucial role in aesthetic and reconstructive nasofacial surgery, guiding surgical decisions and techniques [43].

These findings have important applications in various fields, including forensic anthropology, where they can aid in facial reconstruction and ethnic identification [44]; plastic surgery, where understanding ethnic variations in facial proportions is crucial for planning facial aesthetic procedures [45]; and orthodontics, where facial proportions guide treatment planning [46]. From the above results, it is clear that nose type helps to determine characteristic racial features. The results of the present study will assist surgeons in facial reconstructive surgery and, consequently, in rhinoplasty as well.

Limitation(S)

The study's limitations include its restricted age range (18-25 years), which may not be representative of the entire Punjabi population across different age groups. Additionally, the study's findings may be specific to the Punjabi population and may not be generalisable to other ethnic or geographic groups. Furthermore, the study's sample size and selection methodology may also impact the external validity of the results.

CONCLUSION(S)

The findings highlight significant variations in the nasal index between males and females, contributing to a better understanding of nasal morphology in this population. The dominant nose type in both males and females was Leptorrhine. The results of the study can be used to establish population-specific standards for nasal anthropometry, which can be valuable in fields such as forensic science, plastic surgery, and anthropology. The data can also serve as a reference for future studies and clinical applications within the Punjabi population. This study emphasises the importance of considering population-specific nasal morphometric characteristics in clinical and forensic applications, enabling more accurate and effective diagnosis, treatment, and identification.

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