



Gender Determination using Nasal Index and Nasal Parameters

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Abstract

Aim: To analyse the differences in the gender of an individual using nasal index and nasal parameters

Background of research: Gender determination is the first and crucial step in analyzing the skeletal remains to determine the identity of an individual in matters related to criminal investigations. Gender identification can be done through the measurements of various parts of the skeletal remains such as pelvic morphology, cranial features, and long bone measurements. Recent researchers have found that nasal parameters are one such factor that could also contribute to the gender identification of an individual. Therefore, the present study emphasizes the gender determination of an individual by using the nasal parameters on the students of Garden City University, Bangalore, Karnataka.

Methodology: The present study consisted of 200 students of both genders belonging to the age group of 18-25 years from Garden City University. The present study was conducted over 4 months. People with a history of trauma in the nose were excluded from the study. The measurement of the nasal parameters was done using the instrument 'Digital Vernier Calipers'. The nasal height (NH) and nasal breadth (NB) were measured. One observer was used to take the measurements to prevent measurement errors. Nasal index is calculated as $NB/NH \times 100$. All the values were statistically analyzed.

Results: The mean nasal height of males is estimated to be 44.18mm and the nasal breadth is 35.90mm. The mean nasal height of females is observed to be 43.13 and the nasal breadth is observed to be 33.73. Whereas the mean nasal index of the male and female population is observed to be 81.72mm and 80.58 mm, this indicates that there is not much difference in the nasal index of males and females.

Conclusions: These results indicate that the most common nose type in males is mesorrhine (57), leptorrhine (12), platyrrhine (25), and hyper platyrrhine (5). These results also indicate that

the most common nasal type in females is mesorrhine (53) and platyrrhine (41) and the least is observed to be (6).

Keywords: Nasal index, Anthropometric index, leptorrhine, mesorrhine, platyrrhine.

Introduction

Anthropology is the scientific study that emphasizes human beings' physical characteristics and their cultural and social development. Anthropometry is a subfield of anthropology, it is considered to be one of the critical tools for identifying skeletal remains to examine biological factors like age, sex, and individuality of a human being. These Anthropometric data play a pivotal role in the reconstruction of an individual's physical profile^[1]. Gender identification has a greater importance in the fields of forensic science, medicine, and anthropology. Earlier, gender determination relied much upon anatomical characteristics, such as skeletal morphology, and pelvic measurements. However, in recent years, there has been renewed attention to inspecting another accurate method for gender identification. One such emerging approach focuses on the analysis of nasal parameters to predict sexual dimorphism. The human nose, with its uniqueness in size and shape, provides potential information regarding gender differences^[2]. Despite this potential importance, nasal morphology has not been thoroughly studied concerning gender determination. One of the measurements used in anthropometry is the nasal index, which can be valuable in various fields, including nose reconstruction surgery^[7]. The nasal index helps in understanding and quantifying the shape and dimensions of the nose. These measurements are often part of a broader examination of human diversity, which is not limited to physical traits but also encompasses genetic, cultural, and social factors.

Hence, the present research work focuses on determining the degree to which the nasal parameters can be used as reliable predictors of an individual's gender. Through the implementation of the statistical analysis, the study aims to acknowledge the importance of the nose in gender determination.

Nasal Parameters

These are the specific physical characteristics and measurements of a human nose that are used to describe the size, shape, height, and proportions of various nasal features. Some common nasal parameters include:

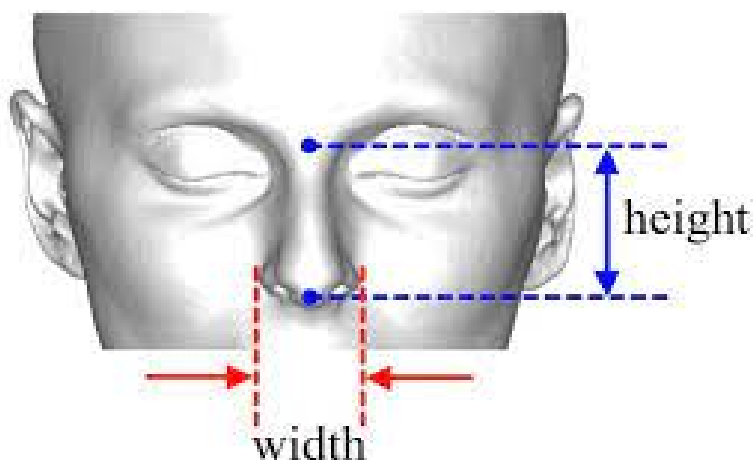
- **Nasal width:** The distance between the two sides of the nasal aperture.
- **Nasal Height:** The vertical distance from the highest point of the nasal aperture to the lowest point.
- **Nasal Length:** The distance from the nasion to the tip of the nose.

Nasal Index: It is a specific anthropometric measurement used to assess the shape of the nose to the overall facial structure. It is defined as the ratio that quantifies the proportions of the nasal width to the nasal height.

Formulae: $\text{Nasal Index} = (\text{Nasal width} / \text{Nasal height}) \times 100$

Whereas, Nasal Width: -the width from left ala to right ala.

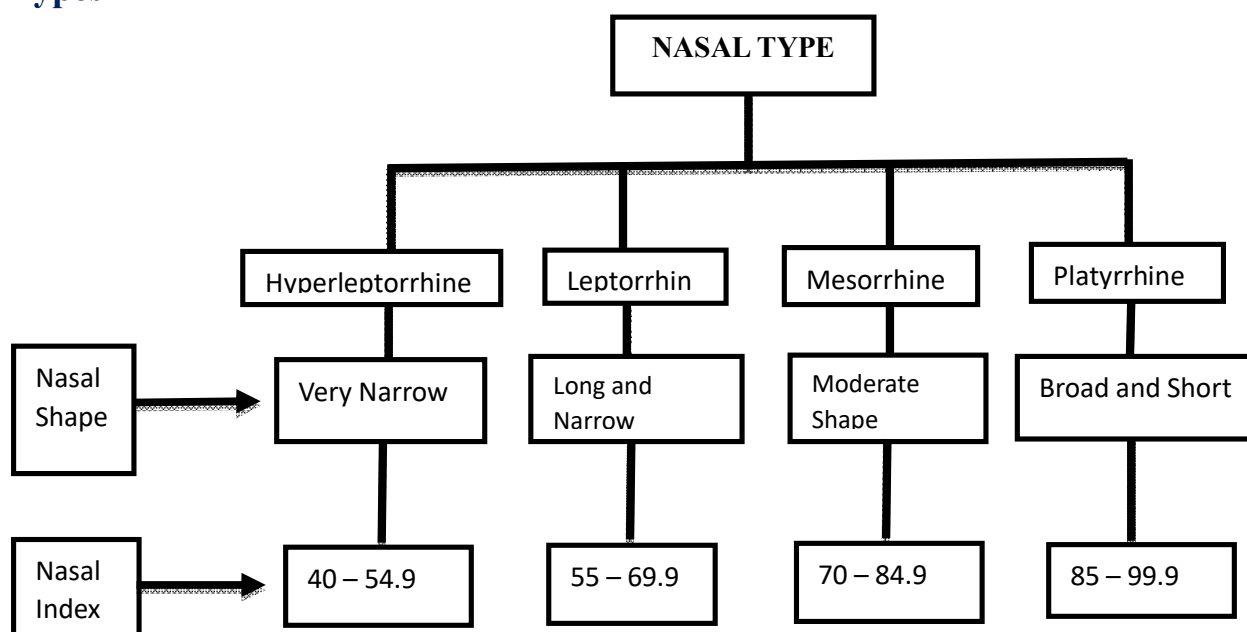
Nasal Height: -The distance between the nasion and to subnasal.



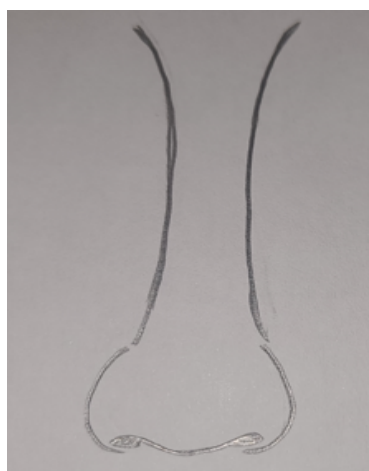
Morphological Classifications of the Human Nose based on Nasal Index and Nasal Parameters

- **Hyperleptorrhine:** This nose type has a very long narrow nose with a nasal index of 40- 50. This type of nose generally appears in cold regions or dry regions.
- **Leptorrhine:** This type of nose is characterized by its narrow width and height. The nasal index is typically less than 70mm.
- **Mesorrhine:** They have intermediate proportions concerning height and width. The nasal index falls within the range of 70-85mm.
- **Platyrrhine:** They are broad and relatively short nose types. The nasal index is typically greater than 85mm.

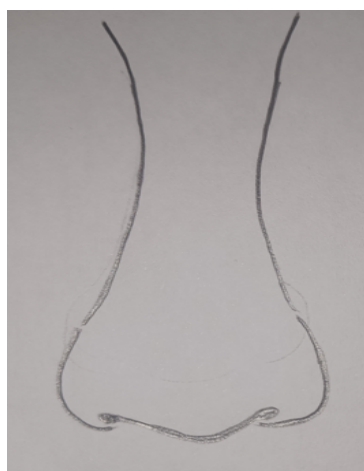
Flow Chart Indicating the Nasal Shape and Nasal Index of Different Nasal Types



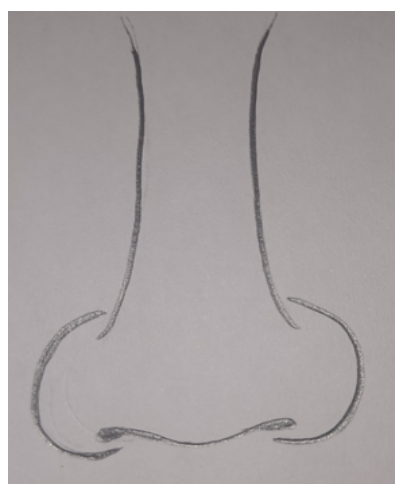
Diagrammatic Representation of Various Nasal Types



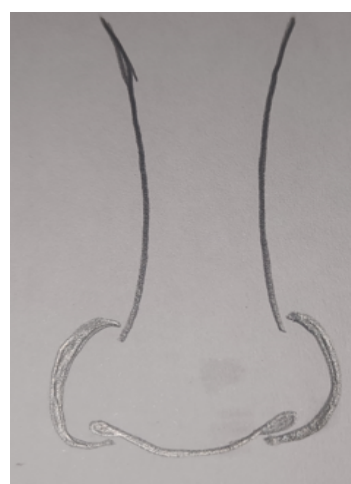
Hyper-Leptorrhine



Leptorrhine



Mesorrhine



Platyrrhine

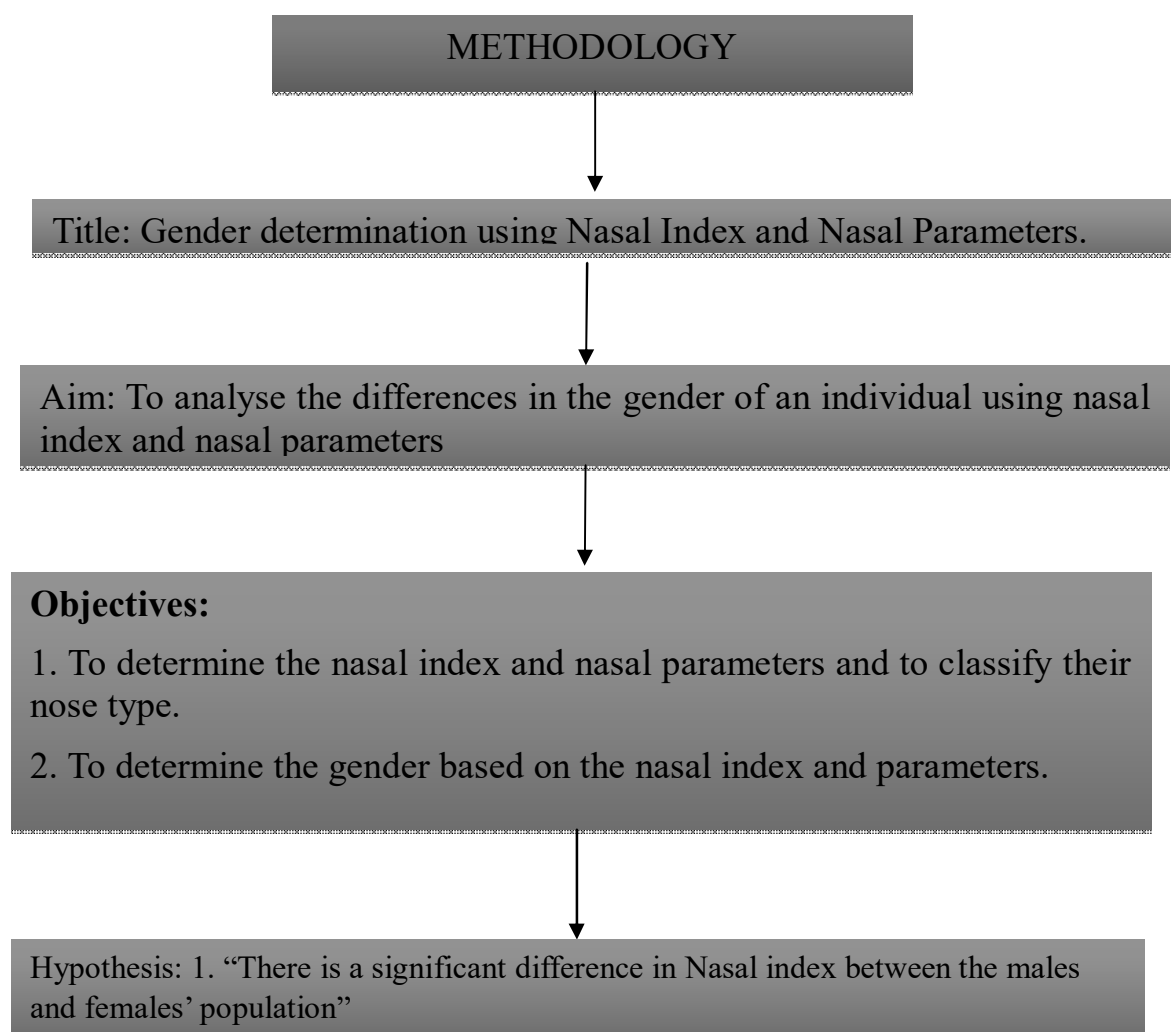
Review of Literature

1. **Shah, B., S., Chavda, R., S., Purohit, J, B., et.al., (2023)** researched “**An anthropometric study of nasal index among Indians in Gujarat**”: This present study was conducted to measure Nasal heights of the Bhavnagar city population and to determine the differences between males and females. The study included individuals of age 18 to 30 years, from Government Medical College, Gujarat. A total of 510 individuals have participated in this study. The study was conducted for over 6 months. Subjects with nasal trauma were excluded. The results of the study show that the Mean nasal height was 44.977mm with a standard deviation of 3.662mm and differences in male and female nasal height were statistically significant at a 95 % confidence interval ($p\text{-value} = 0.0001 < 0.05$). The results of the study show that the difference in male and female nasal index was highly significant and the nasal height of females was significantly lower than that of males; this indicates females of Bhavnagar city have shorter noses than males. The study concluded that there is a highly significant difference found between either sex with values being higher for males than females^[4].

2. **Gulzar, S., Hussain, A., Kumar, A., I., et.al., (2022)** researched “**Sexual dimorphism of the nasal index, nasal breadth, and nasal height among the young Kashmiri population**”: The present research study focused on determining sexual and ethnic differences in the nasal type among the youth Kashmiri population. The study was conducted on 300 students elected based on random sampling. from the Government Medical College, Kashmir. The individuals were aged between 20-25 years. This study was continued for 6 months. The individuals with nasal deformities were excluded. The measurements were taken in three dimensions; nasal height using a digital caliper. The nasal index was measured using nasal height, nasal breadth, and nasal length. The results of the study state that the nasal index of the male Kashmiri population is obtained to be 83.31 ± 12.31 mm and the nasal index of females is obtained to be 226.83 ± 46.41 mm. The findings of the study conclude that the nasal height was less in females (13.97 ± 2.01) as compared to males (36.17 ± 20.9 mm). The predominant nasal type among the Kashmiri female population is hyper platyrrhine, whereas among males 50.6% had the mesorrhine, 30% had platyrrhine, and 12% had a hyper platyrrhine nasal type^[3].
3. **Nasir, N., Khursheed Muzammil, K., Hassan, A., Nasir, S., et.al., (2021)** researched on “**Anthropometric study of nasal indices in four Indian states**”: The present study emphasized comparing and calculating the nasal indices of four major states of India. The objectives of the study were to compare male and female nasal indices and identify different types of noses in four different states, Kerala, Bihar, Uttar Pradesh, and Jammu and Kashmir. The study included 808 subjects of age ranging from 21-35 years. The sliding caliper was used as an instrument in the present research. Using the nasal height and nasal breadth, the nasal index was calculated. The results of the study show that the nasal index of females from UP, Bihar, Jammu, and Kerala was obtained to be 76.94 ± 0.32 , 80.38 ± 1.27 , 62.96 ± 0.40 and 72.50 ± 0.30 , on the other hand, in males from these states were 77.47 ± 0.32 , 78.76 ± 0.24 , 62.31 ± 0.42 and 72.53 ± 0.33 respectively. Where as, the nasal index of overall males and females was 73.09 ± 0.46 and 72.85 ± 0.36 . Hence, the study concludes that not all four states have a platyrrhine type of nose rather they have either leptorrhine or mesorrhine type of nose. The nasal index of males is observed to be significantly higher than in females^[8].
4. **Shrestha, R., Manandhar, B., Madhikarmi, L. N., et.al., (2019)** researched on “**Mean Nasal Index of Dental Students of a Dental College in Nepal**”: The present study emphasized the identification of the nasal type and mean nasal index of dental students of Kantipur Dental College of Nepal. This study included a total population of 140 dental students, at Kantipur Dental College, Nepal. Based on the value of the nasal index the nose was classified into 3 different types, the mean nasal index of the total population was calculated to be 81.34 ± 14.88 mm which falls under the mesorrhine type of nose. The mean nasal index of females is 80.66 ± 15.32 mm and in males is 84.49 ± 12.46 . Hence the study concludes that the mean values of the nasal index of the total population fall under the mesorrhine type of nose^[5].
5. **Radha, K., Srinivasan, Kr., (2019)** researched “**Nasal Index: A cross-sectional Study among South Indian Population**”: The present study aims to determine the values of nasal height, nasal breadth, and nasal index in the South Indian population. The study was conducted on the population aged between 17 to 23 years at Vinayaka Mission Medical

College. The nasal height and nasal breadth were calculated and the results were statistically analyzed. The mean height and breadth of the nose in females were 53.89mm and 34.59mm and in males were 55.75mm and 37.26mm. The nasal index for females was found to be 64.8 and for males is 67.0mm. From these results, the study concluded that leptorrhine followed by mesorrhine type of nose was most commonly found in the present population^[9].

6. **Tahmasebi, F., Khanehzad, M., Madadi, S., et.al., (2015)** emphasized “**Anthropometric study of nasal parameters in Iranian University students**”: This research aimed to study the nasal parameters of Iranian male and female students and classify their nose type. The research study was conducted on 200 individuals between the age group of 18 to 30 years. Individuals with nasal trauma were excluded from the study. The Nasal height and nasal breadth were measured. The results obtained were analyzed by SPSS (Statistical Package for Social Sciences) and the descriptive statistics of obtained data were presented by mean and standard deviation values of $P \leq 0.05$ were considered statistically significant. The results obtained show that the means of nasal indexes in men and women were 68.91 ± 8.11 and 66.05 ± 7.53 mm, so these indicate that Iranian people have a Leptorrhine type of nose. This shows that there was a significant difference ($P \leq 0.05$) between the two groups. Therefore, the study concludes that sexual dimorphism is essential in nasal morphology, and the nose can play a vital role as an anthropometric tool in the determination of gender^[10].

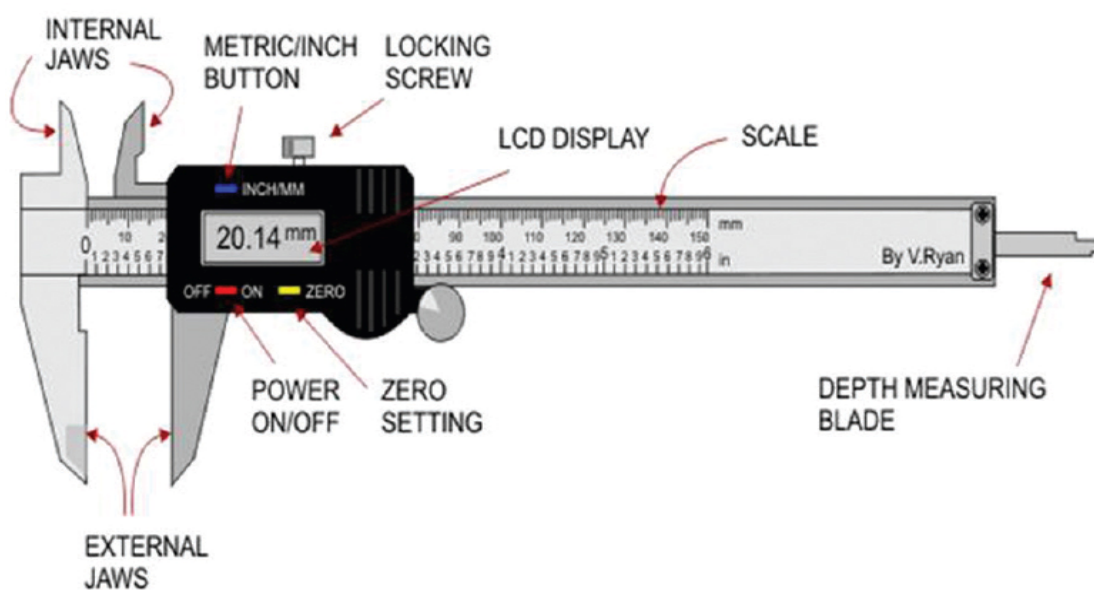


Materials and Methods

The present study was focused on determining the difference in the gender of an individual by studying their nasal parameters and nasal index. The sampling consisted of 200 students; 100 males and 100 females' population belonging to the age group of 18-25 years from Garden City University. The present study was conducted over 4 months. All the participant's informed consent was obtained before conducting the study and after explaining the procedures clearly. The muscles of the face were relaxed so as not to alter the size of the nose. People with a history of trauma in the nose were excluded from the study. The measurement of the nasal parameters was done using the instrument 'Digital Vernier Calipers'. The Nasal Height (NH) was measured from nasion to nasospinale. The nasal breadth (NB) was measured from the right ala to the left ala. All measurements were taken with the subject in a sitting position and the head in an anatomical position. One observer was used to take the measurements to prevent measurement errors. Nasal index is calculated as $NB/NH \times 100$. All the values were tabulated and statistically analyzed.

Instrumentation

The "Digital Vernier Caliper" is the tool utilized in this present study. Accurate measurements of an object's interior and external distance can be made with this precise tool called a digital vernier caliper. This device provides high-resolution measurements of an object's diameter and width. All standard-use 6-inch calipers, be they digital or Vernier, are constructed of stainless steel and have a resolution of 0.01 mm or 0.005 inches and a claimed accuracy of 0.001 inches. The main scale has readings in millimeters. In the present instrument, the jaws move in a to and fro motion, due to the connection and disconnections between the sensors, the signals will pass to the chip then the chip will send the data and allow the LCD to display the value.



Images representing the collection of samples during the research



Figure 1: Showing the measurement of Nasal Height

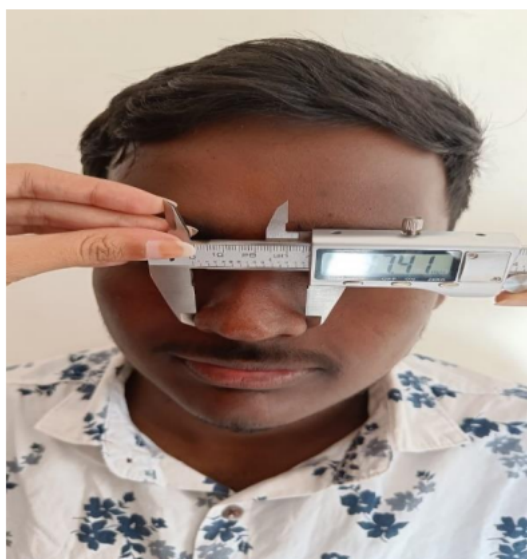


Figure 2: Showing the measurement of Nasal breadth

Graphical Representation and Interpretation

Table No 1: Shows the age-wise distribution of the Female sample.

Age	No. of Subjects
18-19	56
20-21	21
22-23	19
24-25	4

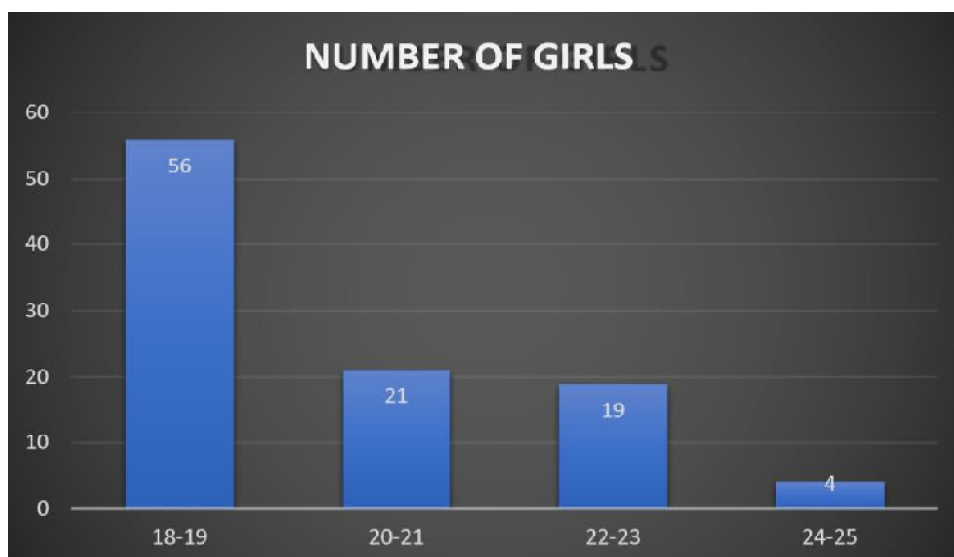


Figure 1: Shows the age-wise distribution of the female sample

Table No 2: Shows the nasal parameters of the Female sample

	Length	Breadth
Mean	42.13	33.73
Median	42.41	33.7
Standard Deviation	3.35	2.43

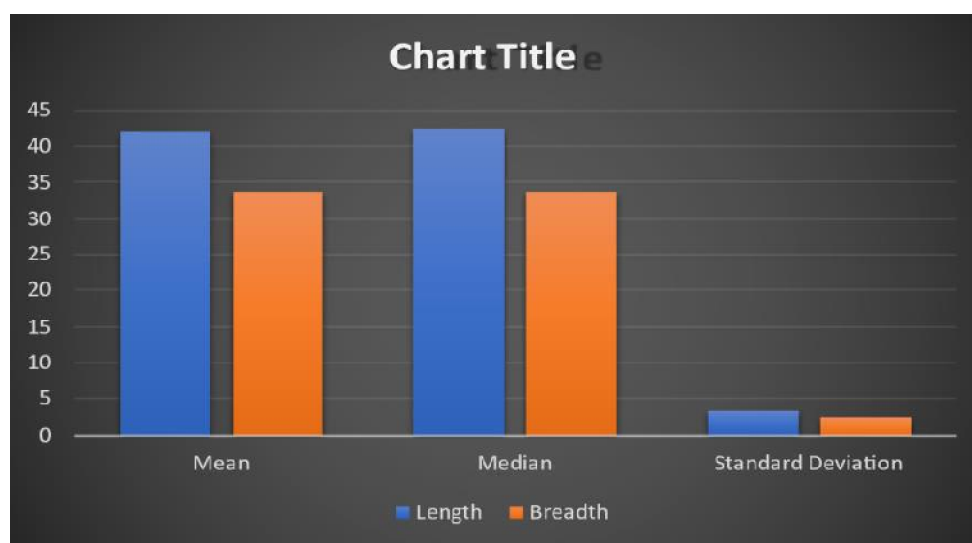


Figure 2: Shows the nasal parameters of the female sample

Table No 3: Shows the age-wise of the Male sample

Age	No. of subjects
18-19	25
20-21	20
22-23	39
24-25	16

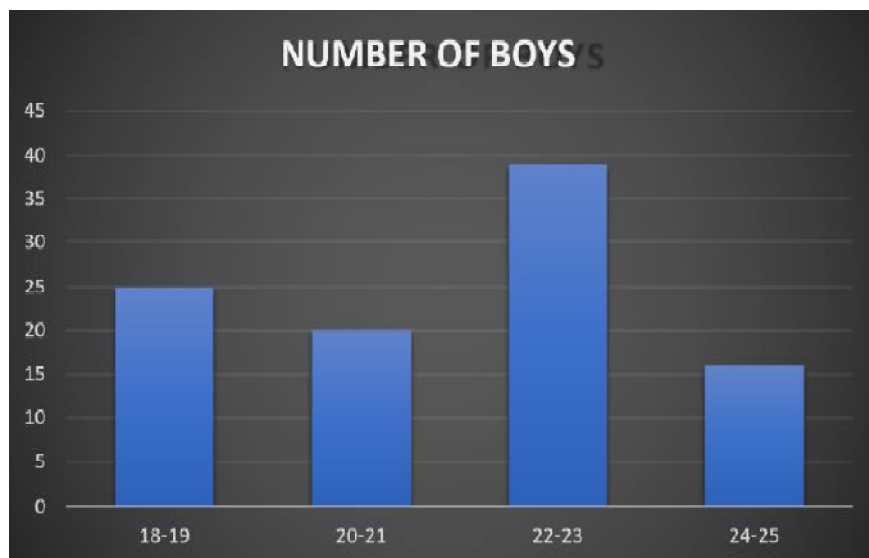


Figure 3: Shows the age-wise distribution of the male sample

Table No 4: Shows the nasal parameters of the Male sample

	Height	Breadth
Mean	44.18	35.90
Median	44.70	35.29
Standard Deviation	4.24	4.09

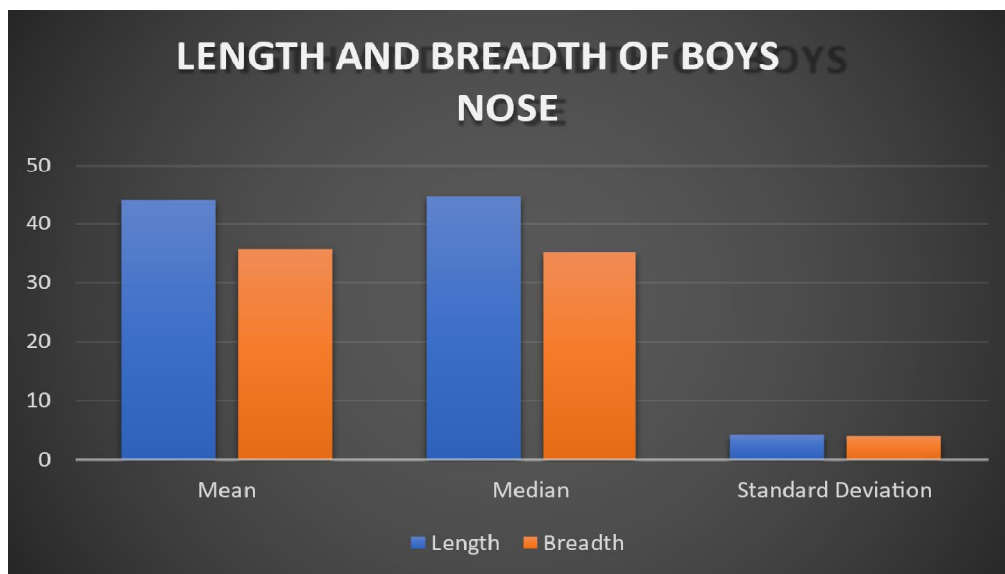


Figure 4: Shows the nasal parameters of the Male sample

Table No 5: Differences between the Nasal Index of Male and Female samples

	Male	Female
Mean	81.7255	80.5878
Median	79.835	80.21
Standard Deviation	11.1178887	7.572085308

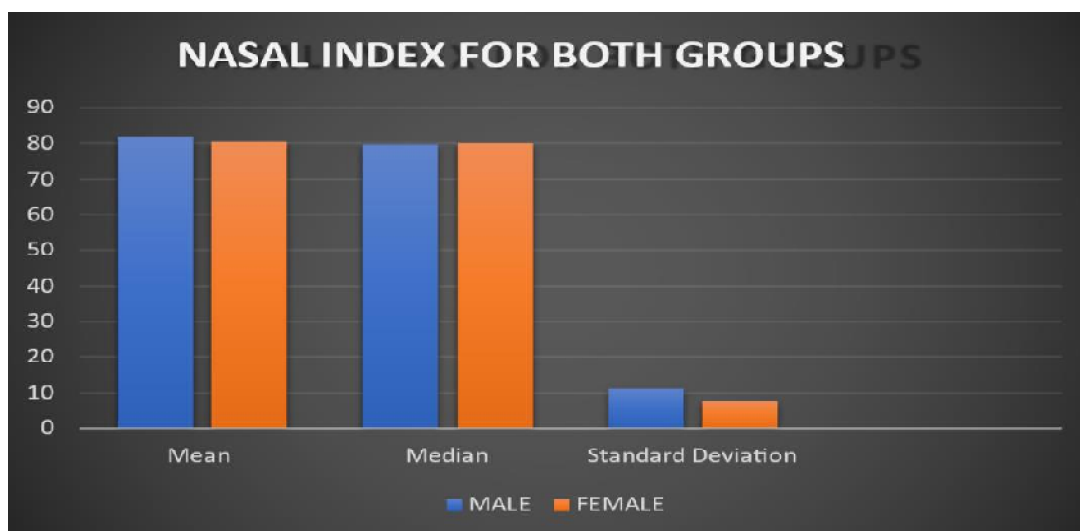


Figure 5: Differences between the Nasal Index of Male and Female samples in terms of mean, median and standard deviation

t-test for the Nasal Index of Male and Female subjects

Difference score calculation Nasal Index of Female sample

N1: 100

$$df1 = N - 1 = 100 - 1 = 99$$

M1: 80.59

SS1: 5676.31

$$s21 = SS1 / (N - 1) = 5676.31 / (100 - 1) = 57.34$$

Nasal Index of Male sample

N2: 100

$$df2 = N - 1 = 100 - 1 = 99$$

M2: 81.73

SS2: 12237.14

$$s22 = SS2 / (N - 1) = 12237.14 / (100 - 1) = 123.61$$

T-value Calculation

$$s2p = ((df1 / (df1 + df2)) * s21) + ((df2 / (df2 + df2)) * s22) = ((99 / 198) * 57.34) + ((99 / 198) * 123.61) = 90.47$$

$$s2M1 = s2p / N1 = 90.47 / 100 = 0.9 \quad s2M2 = s2p / N2 = 90.47 / 100 = 0.9$$

$$t = (M1 - M2) / \sqrt{(s2M1 + s2M2)} = -1.14 / \sqrt{1.81} = -0.85$$

Results

The t-value is -0.84578. The p-value is .199349. The result is not significant at $p < .05$.

Results

SUBJECT	MALE	FEMALE
Mean nasal breadth	35.90mm	33.73mm
Mean nasal height	44.18mm	43.13mm
Mean Nasal Index	81.72mm	80.58 mm
Overall P Value	0.199349	

Discussions

In our present research study, we included 200 students of both genders aged between 18 to 25 years. The results table reflects the mean of nasal breadth, nasal height, and nasal index between participants. This indicates that there is a slight difference in mean nasal height and nasal breadth among male and female participants, whereas the mean nasal index indicates that there is not much difference. These results indicate that the most common nose type in the male and female populations is observed to be mesorrhine and platyrrhine. Thus, the alternative Hypothesis 1 stating that “There is a significant difference in Nasal index between males and females” is rejected.

When a comparative study is done between the present study and the previous research papers, namely “**Sexual Dimorphism of the Nasal Index, nasal breadth, and Nasal Height among young Kashmiri Population**”, this study conclude that the nasal height was less in females (13.97 ± 2.01) as compared to males (36.17 ± 20.9 mm). The predominant nasal type among the Kashmiri female population is hyper platyrrhine and mesorrhine^[3].

In the research paper “**Anthropometric study of nasal indices in four Indian states**”, it is observed that the nasal index of overall males and females was 73.09 ± 0.46 and 72.85 ± 0.36 . Hence, the study concludes that all four states have either a leptorrhine or mesorrhine type of nose in common. The nasal index of males is observed to be significantly higher than in females. The study also found that leptorrhine nose was prevalent in Kerala and Jammu & Kashmir states^[8].

Through these observations, it is concluded that the most common nasal types are observed to be mesorrhine, platyrrhine, and leptorrhine. In these studies, it is observed that the nasal height, breadth, and nasal index of the males is higher than that of the female population.

Conclusions

From the results and discussions of the present study, it is stated that regardless of sexual dimorphism, it is hypothesized that ethnic groups in the same climatic zones will have similar nasal indices. Anthropometric data of the nose obtained from the results of the research study would be useful in the fields of forensic medicine, for identification of the gender, naso-facial dysmorphology, and in the reconstruction of facial and nasal surgeries. More research studies are

needed in various fields of anthropometry within the population. Our research study results suggest that the nose is a useful anthropometrical tool in forensic science for the classification of fossil fuels and the determination of gender. Even though there is no significant difference in nasal index, the mean nasal height and mean nasal breadth differ in male and female populations. This study indicates differences in the nasal index of both males and females, but the mesorrhine type of nose is same for both genders of population of Garden city university in Bangalore with little higher value in male population. This can be useful in various branches of medicine such as reconstructive surgery, forensic medicine, and medicolegal assessment of individuality and race.

Scope for Enhancement

This study opens the scope for further research on detailed gender identification and differentiation based on the nasal index and nasal parameters. Race, genetic factors, and ethnic diversity can be determined by further studies and research. Further research can be done on the nasal uniqueness of an individual to determine the individuality likewise the fingerprints.

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