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Gender Prediction from Nasal Anthropometry among Malaysian Telugus in Peninsular Malaysia for Identification

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Abstract **Original Research Article**

Background*:** Forensic science is an applied science being used in crime scene investigation. Forensic investigators are working on developing a person's biological profile such as gender, stature and ethnicity. Anthropometry plays a crucial role in personal identification by measuring human body parts. ***Aim: This study aimed to determine gender from nasal anthropometry among the Malaysian Telugu population in Peninsular Malaysia. ***Methodology:*** The research involved 150 male and 150 female participants; all Malaysian Telugu individuals aged 18 to 60 years. Nasal anthropometric measurements were made, including nasal length, nasal width, nasal height, alar width, columella length, nasal bridge, and nasal depth using a Vernier calliper. The nasal index of both males and females was then calculated to estimate gender differences. ***Results:*** The results indicated significant gender differences in nasal dimensions, with males generally exhibiting larger nasal measurements than females. Notably, males had a mean nasal height of 6.3 cm compared to 5.5 cm for females, and a nasal width of 2.6 cm compared to 2.3 cm for females. The mean nasal index for males was 75.2, and for females it was 70.4. The p-value of the nasal index is ≤ 0.001 and the t-value is -3.96. The result is significant at P & It; 0.005, and nasal measurements show the differences between males and females. ***Conclusion:*** The nasal measurements of Malaysian Telugu males were found slightly higher than that of females, the nasal measurements are statistically significant between genders, therefore nasal measurements can be used to determine gender differences to solve the crime.

Keywords: Forensic science, Nasal anthropometry, Gender, Malaysian Telugu population.

INTRODUCTION

In forensic anthropology, accurately determining biological characteristics such as from skeletal remains becomes important for the identification of unknown individuals. Variations in human body organs have triggered the interest of scientists and as a result, anthropology was developed. Anthropometry is an accepted scientific tool for measuring the bones, fossils and living human body for personal identification forensically. Anthropologists are sincerely working on the determination of stature [1], gender [2], and living body weight [3], from various body parts and their impressions viz. the hand [4], fingerprint [5], nose [6], eye [7], foot [8], etc., The nose is the focal point of the face that plays a vital role in defining overall facial balance and proportion. The shape of the nose is due to the bones and cartilage. It is a beautiful organ with various convexities and concavities due to the distinctive characteristics of the underlying soft tissue, which results in differences in form and appearance [9]. Considering this aspect, forensic anthropologists view the organ forensically as physical evidence and started research to determine gender [10], and stature [6], for person identification, considering ethnicity. Hence the present study aimed to investigate the relationship between gender and nasal anthropometers among Telugu people born and living in Malaysia.

METHODOLOGY

The study was designed and conducted sample collection in Peninsular Malaysia. The study recruited 300 Telugu people, including 150 males and 150 females aged between 18 and 60 years. Only volunteering subjects were enrolled in this research. Subjects below 18 years old and accepted volunteers who had trauma of the nose, cleft lip, congenital nasal anomalies or surgery

marks were excluded politely from the study. On approval from the MSU ethical committee, following the standard procedure, the measurements were made using calibrated Vernier Calipers. Measurements were repeated until concordant values were obtained. Key measurements included nasal length, width, height, alar width, columella length, nasal bridge width, nasal depth, and nasal index.

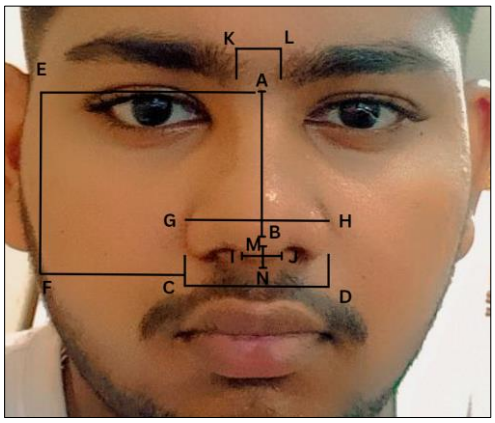

Figure 1: Landmarks of various nasal measurements

RESULT

From the Figure 1, various landmarks for nasal measurements. are defined in Table 1. Table 2 shows the descriptive statistics of nasal measurements, standard deviation and standard error of estimate among male and female Telugu population in Peninsular Malaysia.

Table 1: Landmarks and definitions for various nasal measurements

Landmarks	Parameter	Description
A - B	Nasal length (NL)	The distance from the nasal root to the nasal tip.
C - D	Nasal width (NW)	The horizontal distance across the widest part of the nose is typically measured at the nostrils.
E - F	Nasal height (NH)	The vertical distance from the base of the nose to the highest point of the nasal dorsum.
G - H	Alar width (AW)	The distance between the outermost edges of the nostrils is often used to assess the width of the nasal base.
I - J	Columella (CL)	The strip of tissue separates the nostrils at the base of the nose, extending from the nasal tip to the upper lip.
K - L	Nasal bridge (NB)	The bony upper part of the nose lies between the eyes and supports the overlying soft tissue.
M- N	Nasal depth (ND)	The distance from the nasal tip to the plane of the face indicates how far the nose protrudes.

Table 2: Descriptive statistics of nasal measurements (in cm) in the male and female Telugu population in Peninsular Malaysia

Variable	Male (N=150)					Female (N=150)				
	Min	Max	Mean (cm)	SD	SEE	Min	Max	Mean (cm)	SD	SEE
NL	5.0	7.1	5.8	0.40	0.03	4.3	6.1	5.2	0.37	0.03
NW	2.0	3.1	2.6	0.18	0..01	1.8	2.8	2.3	0.18	0.01
NH	5.3	7.5	6.3	0.37	0.03	3.5	6.6	5.5	0.46	0.04
AW	2.6	3.8	3.2	0.20	0.02	2.1	3.4	2.8	0.21	0.02
CL	2.0	2.9	2.4	0.19	0.02	1.7	2.6	2.1	0.19	0.02
NB	1.9	3.2	2.4	0.21	0.02	1.5	2.6	2.1	0.18	0.01
ND	2.1	3..0	2.6	0.18	0.01	1.8	3.0	2.4	0.18	0.01
NI	68.9	81.7	75.2	2.70	0.22	53.2	72.7	70.4	3.97	0.32

N: Sample size; Min: Minimum; Max: Maximum; SD: Standard deviation; SEE: Standard error estimation; NL: Nasal length; NW: Nasal width; NH: Nasal height; AW: Alar width; CL: Columella; NB: Nasal bridge; ND: Nasal depth; NI: Nasal index.

The variables viz. Nasal length (NL), nasal width (NW), nasal height (NH), alar width (AW), columella length (CL), nasal bridge (NB), nasal depth (ND), and nasal index (NI), were examined statistically investigated. The standard error of estimate (SEE) is an indicator to show how accurate, the prediction might be and thus predicts the deviations of the estimated value from the actual value. The SEE shows a lower value for

males (0.01-0.03) and females (0.01-0.04), and thus the gender variations can be effectively determined in the study population. The standard deviation (SD) values are also found to be low and a significant gender difference can be achieved. The Nasal Index (NI) is an important parameter that calculates the ratio of nasal width to nasal height, multiplied by 100. Nasal index and its determinants are influenced by racial, ethnic, regional and climatic conditions. It also provides information about the shapes of the nose.

Levene's test for equality of variance (F value) examines whether the variances of nasal measurements differ considerably among the genders. The independent t-tests show significant gender differences in nasal measures among the Telugu community in Peninsular Malaysia.

The correlation coefficient (R) between gender and nasal length (NL) is 0.641 ($p < 0.001$), indicating R values are positive and significant to show gender variation from nose anthropometry in the study population.

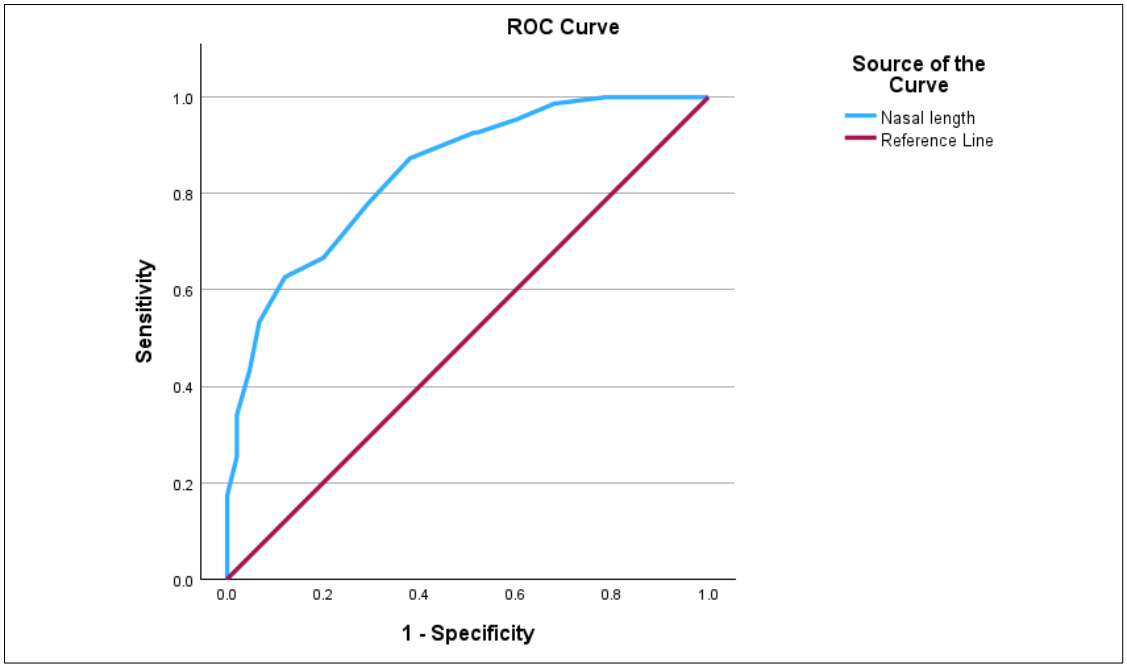

Figure 2: ROC curve of nasal length in prediction of gender

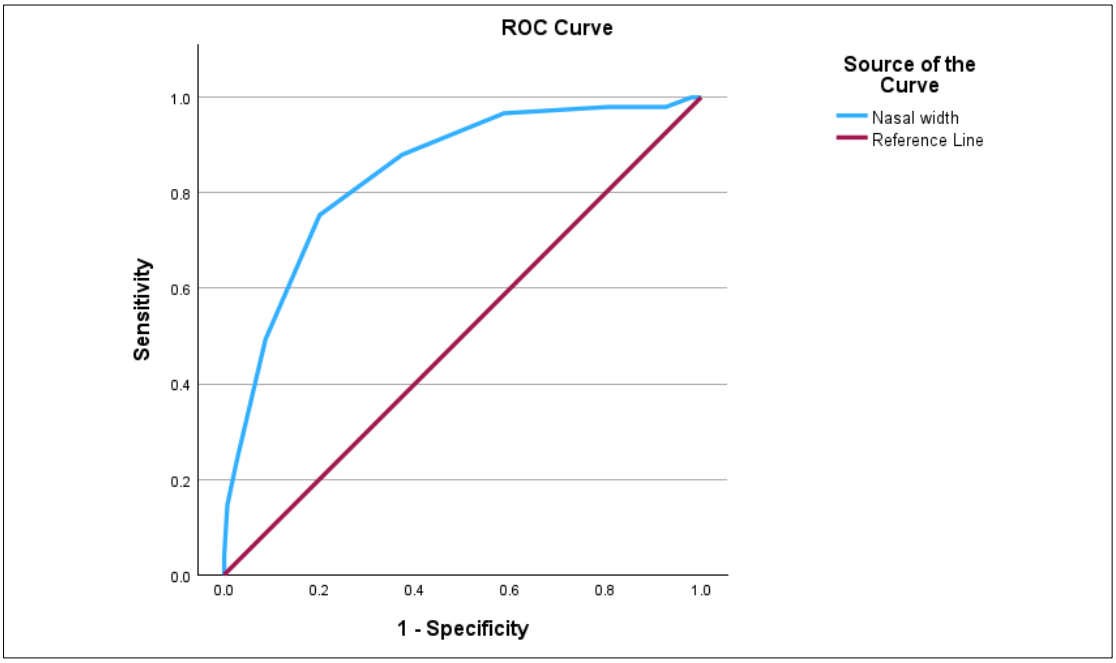

Figure 3: ROC curve of nasal width in prediction of gender

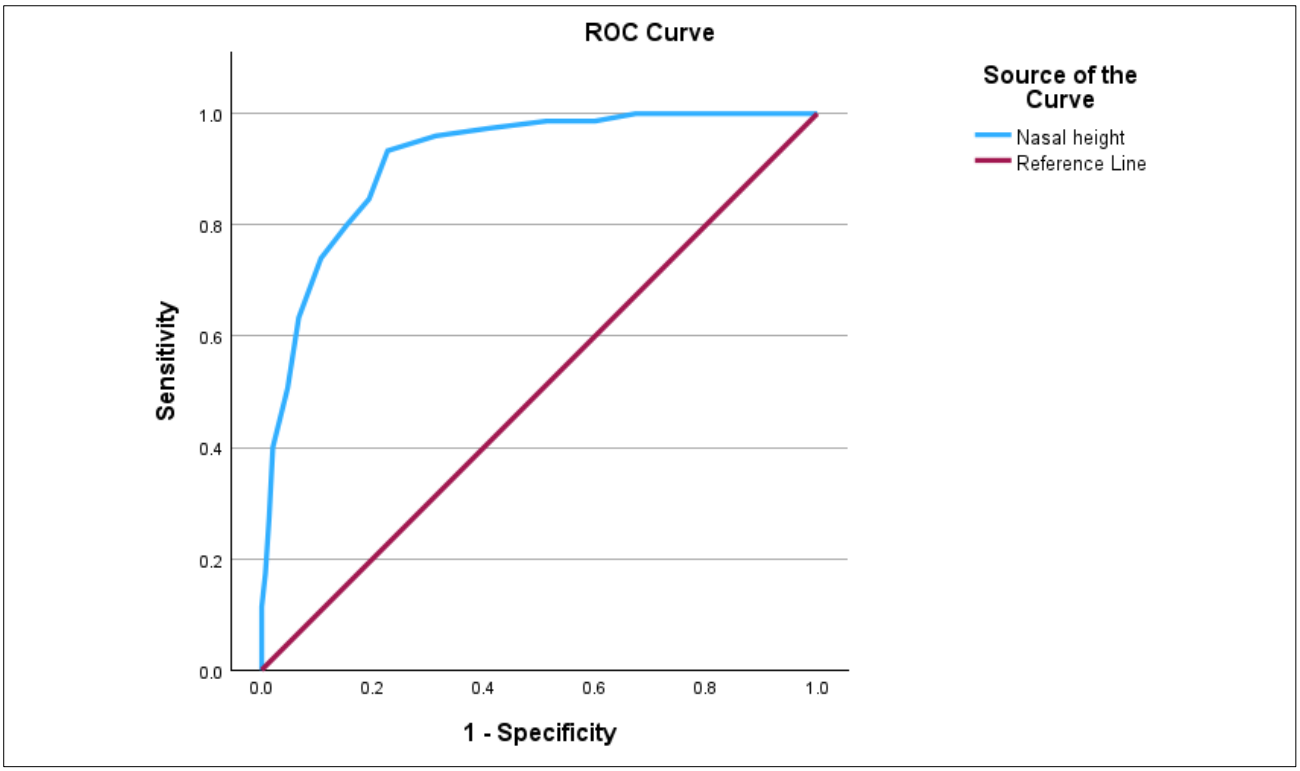

Figure 4: ROC curve of nasal height in prediction of gender

For better understanding, the ROC (Receiver Operating Characteristic) curve was performed for nasal length, nasal width and nasal height for gender prediction. The significant Area under the Curve (AUC) values, along with the sensitivity and specificity metrics at different cutoff points, indicate that nose measures can be dependable indicators of gender.

DISCUSSION

Malaysian Telugu people are of full or partial Telugu descent who were born in or immigrated to Malaysia. Most Malaysian Telugus are descended from migrants from Madras Presidency (India) during the colonial period. Historically most Malaysian Telugus originated from Visakhapatnam, Vizianagaram and Srikakulam regions of what is now Andhra Pradesh state in India. Most Telugu came to Malaysia as crop labourers, some were professionals and traders. They speak Telugu language and form a minority (around 300,000) among Malaysian Indians and many of them now can speak Tamil also. The "Telugu Association of Malaysia" serves to represent the interests of the Malaysian Telugu population, first formed in Perak in 1955 and in 1963 it was renamed "Malaysia Telugu Sangam" [12]. One of the protruding parts of the face is the nose, which shows variables in its size and shape, because of food habits, climatic conditions, region and ethnicity [13]. Table 3 shows the variations in nasal height, nasal width and nasal index of the Telugu population from other populations like South Indian, Malaysian Indian, Malay, and Malaysian Chinese. Some investigators neglected physical evidence, other than fingerprints, considering it unimportant [14].

Table 3: Comparison of nasal height, nasal width, and nasal index of the present study with other populations

Population	Gender	Nasal height (Mean ± SD)	Nasal width (Mean ± SD)	Nasal Index (Mean ± SD)
South Indian [6]	Male	4.57 ± 0.35	3.65 ± 0.27	80.30 ± 8.24
	Female	4.38 ± 0.40	3.31 ± 0.28	76.32 ± 9.74
Malaysian Indian [11]	Male	5.14 ± 0.43	4.01 ± 0.37	77.92 ± 6.63
	Female	4.74 ± 0.33	3.52 ± 0.24	74.62 ± 7.90
Malay [11]	Male	4.37 ± 0.33	3.88 ± 0.36	89.38 ± 10.63
	Female	4.40 ± 0.32	3.64 ± 0.24	83.37 ± 9.76
Malaysian Chinese [11]	Male	4.55 ± 0.26	3.94 ± 0.37	86.85 ± 8.11
	Female	4.43 ± 0.31	3.52 ± 0.22	79.70 ± 6.64
Malaysian Telugu (Present study)	Male	6.3 ± 0.37	2.6 ± 0.18	75.20 ± 2.70
	Female	5.5 ± 0.46	2.3 ± 0.18	70.40 ± 3.92

The table shows that the Nasal Index (NI) of the Malaysian Telugu is the lowest value for both males (75.20) and females (70.40) than other populations. The NI of Malay males show the highest value (89.38) than any other population in the table. Similarly, the nasal height and nasal width reflect the ethnic variation. Thus, ethnicity plays a vital role in forensic anthropology whenever dealing with the estimation of stature, gender and body weight from human body parts (nose, eyes, ears, face, hand, finger, toe, foot etc.,) and their impressions left at the crime scenes (footprint [15], fingerprint, handprint, toe print [16], etc.,). Rarely animals [17], and their impressions [18], found at the crime scenes form a piece of valuable forensic evidence that can be used to solve the crime. Currently, criminals are so intelligent in misguiding the investigation through their simulation and fabrication activities [19], but can overcome through keen crime scene observation and sincere forensic investigation.

CONCLUSION

The research concluded that the nose is also one of the valuable physical evidence and can be utilised for gender determination, followed by person identification. This finding should be applied only to the Malaysian Telugu population and can not be generalised to any other populations either in Malaysia or any other country.

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