Morphometric Study of External Nose for Sex Determination and Ethnic Group Differentiation

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Abstract

Background: External nose is one of the anatomical structures that give a look in an individual's face. The size and shape of the nose vary from one individual to another individual.

Aim: To determine the sex based on morphometry of external nose.

Materials and Methods: This cross-sectional study was done on 100 Malaysians and 100 South Indians of age group (20 to 30 years). The morphometric measurements of the external nose such as nasal length (NL), nasal breadth (NB), nasal height (NH), nasal depth (ND), width of columella (WC), nostril breadth (NB), alar length (AL) and alar width (AW) were measured using digital caliper by standard procedure.

Results: The nasal width was found to be larger in Malaysian females as compared to that of Indian females. The nasal height was found to be larger in Indian males followed by Indian females and vice versa in Malaysian population. When compared among the population the nasal length was lengthier in Indian population and in Malaysian males when compared to Malaysian females. Alar length slight difference was found between male and female of both the population when compared on both the sides. The alar width was found to be more in Indian population when compared to Malaysian population. The nostril breadth was found to be wider in Malaysian population when compared to the Indian population.

Conclusion: The present study shows that their do exist gender difference in nasal morphometry and nasal index of both males and females.

Key words: *Nasal morphometry, Nasal index, Indian population, Malaysian population.*

Introduction

The external nose is one of the anatomical structures which continue to get modified and enlarged throughout our life even after the attainment of skeletal maturity.[1]

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External nose is one of the anatomical structure that give a look to an individual's face. The size, shape and proportions of the nose provide beauty as it is at the center of the face. The shape of the external nose varies from one to another considerably.[2] Ethnic variation do exist which can be identified on careful examination of different features of nose. Every race has their specific nasal features as in case of Caucasian, Africans or Asians.[3] The unique shape of the nose among the race, ethnic and sex is more important for a forensic expert. The morphometry of external nose provides a baseline data to interpolate the ethnic and racial differences.[4,5] Anthropometric parameters vary with age, sex, and ethnic background, and several authors have documented the normative values which may serve as references for forensic experts.[6] A sound knowledge on the anatomy of

human nose is essential for plastic surgeons undertaking esthetic repair and reconstruction of noses.[7] Congenital anomalies, pre- and postnatal abnormalities in nose dimensions and shape can be found in various genetic disorders. Individuals with Down's syndrome during prenatal ultrasonography findings shows absence of nasal bone or hypoplasia, coupled with a flat facial profile.[8,9] Thus, the morphometry of external nose gains its importance in many fields. As the morphometry of external nose is essential for sex determination and ethnic variations the following study was designed and carried in two different races.

Aim and Objectives

The aim of the study is to determine the sex based on morphometry of external nose.

Primary Objective:

Ø To compare the morphometric data of external nose between right and left side.

Secondary objective:

Ø To compare and correlate the morphometry of external nose among two groups of population - South Indian vs. Malaysians.

Materials and Method

The study participants include 100 Malaysians (50 males and 50 females) and 100 South Indians (50 males and 50 females) of age group (20 to 30 years). An informed consent was taken before starting the measurements of eternal nose. This present cross-sectional study was a part of facial morphometry analytic study which was approved by Institutional Ethical Committee; reference (VMKVMC/IEC/18/02) of Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Salem. The present study was carried out in 2 constituent colleges, VMKV Medical College & Hospitals, Salem, TamilNadu and Penang International Dental College, Salem Campus. In both the population group the volunteer participants were chosen by random sampling method. Volunteers with any anomalies on external nose were excluded from the study. Various morphometric measurements of external nose such as nasal length (NL) nasion to pronasale (fig. 1), nasal breadth (NB) between 2 alacrepidon, nasal height (NH) nasion to subnasale, nasal depth (ND) pronasale to subnasale, width of collumella (WC) between 2 alare, nostril breadth (NB) nasion medial to nasion lateral, alar length (AL) pronasale to alacrepidon and alar width (AW) alacrepidon to nasion posterior (fig. 2) were measured using digital caliper.[10]

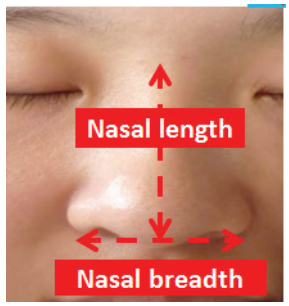

Figure .1 Nasal length and nasal breadth

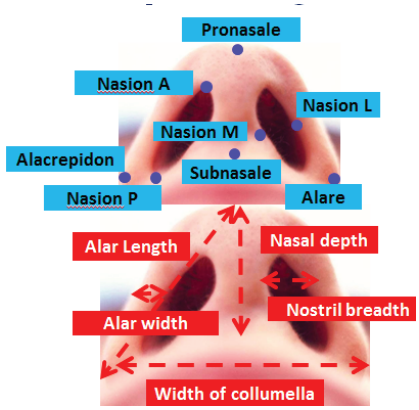

Figure. 2Various anatomical landmarks and nasal morphometry

Statistical Analysis

The data's were tabulated and analyzed by One way ANOVA to find out the significance among the sex and populations and Post HOC pairwise comparison for comparison among the groups. The analysis was done using the online graph pad calculator (Free version).

Results

The morphometric data was collected and analyzed by one way ANOVA to find out the significance among the population and Post HOC pairwise comparison to compare between the sexes.

Table 1. Nasal Morphometry in Indian and Malaysian Population

Population	Sex	Nasal Width (cm)	Nasal depth (cm)	Nasal height (cm)	Nasal length (cm)	Width of Collumella (cm)
Indian	Male	3.7±0.7	1.81±0.3	4.9±0.5	4.05±0.7	1.5±0.03
	Female	3.4±0.9	1.7±1.0	4.7±0.5	4.14±1.4	1.4±0.03
Malaysian	Male	3.9±0.06	1.84±0.09	4.63±0.7	3.77±0.1	3.4±1.4
	Female	3.96±0.05	2.07±0.2	4.78±0.09	4.1±0.1	3.2±0.5
P value		0.89#	0.97#	0.98#	0.98#	0.10#

*Values are expressed as Mean ± SEM, n = 100 in each population with 50 males & 50 females, # - non significant, * - significant, P value *P<0.05, Statistical analysis – Independent t test & One Way ANOVA.*

The nasal width was larger in Malaysian females as compared to that of Indian females. Nasal breadth was found to be larger in Malaysian population when compared to Indian population (Table 1). The nasal width was found to be larger in Malaysian females and males followed by Indian males and females (Table 1). The nasal height was found to be more in Indian males followed by Indian females and vice versa in Malaysian population (Table 1). When compared among the population the nasal length was found to be lengthier in Indian population and Malaysian males when compared to Malaysian females. The data were not statistically significant when compared among the population (Table 1 & 2).

Table 2. Post HOC Pairwise Comparison of Nasal Morphometry in Indian and Malaysian Population

	Nasal Width	Nasal depth	Nasal height	Nasal length	Width of Collumella
Malaysian M vs Malaysian F	NS	NS	NS	NS	NS
Malaysian M vs Indian M	NS	NS	NS	NS	NS
Malaysian M vs Indian F	NS	NS	NS	NS	NS
Malaysian F vs Indian M	NS	NS	NS	NS	NS
Malaysian F vs Indian F	NS	NS	NS	NS	NS
Indian M vs Indian F	NS	NS	NS	NS	NS

*M – Male, F – Female, vs – versus, n = 100 in each population with 50 males & 50 females, NS - non significant, S - significant, P value *P<0.05, Statistical analysis – Post HOC Pairwise Comparison.*

Nasal index was calculated by using the formula width of nose/ length of nose X 100.[10] The nasal index showed the gender difference in Indian population (Male - 91.35 and female - 82.12) whereas in case of Malaysian population it showed a wide difference (Male – 103.4 and female – 96.6)

Alar length slight difference was found between male and female of both the population when compared on both the sides. The alar width was found to be more in Indian population when compared to Malaysian population and the difference was found to be statistically significant when compared on both sides. The nostril breadth was found to be more in Malaysian population when compared to the Indian population but was not statistically significant when compared on both sides. The alar length and nostril breadth was not statistically significant whereas the alar width was statistically significant when compared among the population (Table 3 & 4).

Table 3. Morphometry of External nose in Indian and Malaysian population

Population	Sex	Alar length (cm)		Alar width (cm)		Nostril breadth (cm)	
		Rt	Lt	Rt	Lt	Rt	Lt
Indian	Male	3.15±0.3	3.1±0.4	5.2±0.1	6.3±0.1	1.2±0.3	1.2±0.2
	Female	2.8±0.5	2.8±0.7	4.7±0.5	4.9±0.4	1.2±0.6	1.3±1.2
Malaysian	Male	3.2±0.07	3.17±0.07	1.51±0.03	1.52±0.03	2.01±0.1	2.02±0.0.1
	Female	2.5±0.1	3.0±0.05	1.5±0.03	1.43±0.03	2.2±0.06	2.17±0.06
		0.30#	0.92#	0.001***	0.001***	0.068#	0.58#

*Values are expressed as Mean ± SEM, n = 100 in each population with 50 males & 50 females, # - non significant, * - significant, P value *P<0.05, Statistical analysis – Independent t test & One Way ANOVA.*

Table 4. Post HOC Pairwise Comparison of External nose in Indian and Malaysian population

	Alar length		Alar width		Nostril breadth	
	Rt	Lt	Rt	Lt	Rt	Lt
Malaysian M vs Malaysian F	NS	NS	NS	NS	NS	NS
Malaysian M vs Indian M	NS	NS	S	S	NS	NS
Malaysian M vs Indian F	NS	NS	S	S	NS	NS
Malaysian F vs Indian M	NS	NS	S	S	NS	NS
Malaysian F vs Indian F	NS	NS	S	S	NS	NS
Indian M vs Indian F	NS	NS	NS	S	NS	NS

*M – Male, F – Female, vs – versus, n = 100 in each population with 50 males & 50 females, NS - non significant, S - significant, P value *P<0.05, Statistical analysis – Post HOC Pairwise Comparison.*

Discussion

Racial origin can be identified by different features of nose. Each race such as Caucasian, Africans or Asians has got specific nasal features. Each race has its own special beauty [11]. In an Indian morphometric study, the mean width of the nose was 3.5 cm in total, 3.74 cm in male and 3.43 cm in female respectively. The width of the nose was significant when the male and female groups are compared.[11] In the present study the mean width / breadth was 3.7 cm in male and 3.4 cm in female similar to that of Snehal Deulkar et al study.[11] Kurulkar et al reported the width of nose as 3.56cm in male and 3.26 cm in female respectively in 200 adult Bombay populations and also reported that there is a similarity in columellar width between Chinese and Indians.[12]

Generally, surgeons plan the surgical procedures of external nose reconstruction based on their surgical case experiences, which includes the subjective as well as the objective factors.[13] The subjective factor includes the nasal esthetics varies depending on the ethnic background as well their geographical and cultural differences.[14] Springer et al., reported that there exist gender related effects with respect to the assessment of nasal shape in women as compared to men.[15] In a morphometry study, the narrow noses were predominated in 46 (78%) females than in 39 (70%) males and a total of 85 cases (74%) narrow nose among all subjects.[6]

Table 5 – Comparison of Nasal indices among various population of the world

Ethnicity	Nasal Index	Author
African American females	79.7	Porter et al. 2003. [16]
India-Raj puts*	71.60	Mulchand et al. 2004. [17]
Bantus	85.0	Nichani et al.2004. [18]
Caucasian Male Female	 65.5 64.2	Farkas et al.24 2005. [169]
Turkish males	59.4	Uzun et al. 2006. [20]
Nigerian Igbo Male Female	 95.9 90.8	Oladipo et al. 2007.[21]
Iran–Baluchestan female	59.2	Heidari et al. 2009.[22]
Ukwuani Male Female	 97.47 98.08	Eboh et al. 2011.[23]
Isokos	91.0	Anibor et al. 2011.[24]
Nepal mongoloid Male Female	 74.6 75.9	Koirala et al. 2014.[25]
Gujarati population India* Male Female	 80.00 76.00	Kanan et al. 2012 .[26]
Western Uttar Pradesh, India* Male Female	 75.86 72.08	Ray, et al. 2016.[27]
South Indian Population* Male Female	 84.99 67.75	Patil et al. 2014.[28]
South Indian Male Female	 91.35 82.12	Present Study
Malaysian Male Female	 103.4 96.6	Present Study

Ray et al reported that males have a significantly higher nasal index than females ($P < 0.05$) similar to that of the present study (Table 5).[27] This confirms the existence of sexual dimorphism in nasal parameters among south Indian and Malaysian population.

In a study done by Sforza et al.,[1] nostril breadth in male was 2.2cm and female was 1.9cm whereas in the present study it was 1.2 cm in both Indian male and female. In case of Malaysians it was found to be quite wider when compared to Indians, male (2.0 cm) and female (2.1cm). Ogah et al reported that the mean nasal length, width, height were higher in males than in the female as incase of the present study.[29] The existence of sex difference in morphometric measurements of nose were due to genetic the make-up and inheritance which can be manifested as sexual dimorphism in this study in both the populations.

Conclusion

The study shows that their do exist gender difference in nasal morphometry and nasal index of both males and females. This morphometric data's of this study including nasal index can serve as a baseline data for various purposes such as reconstructive nasal plastic surgery including rhinoplasty, medico legal aspects of identifying an individual along with other facial morphometric data's.

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