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NASOFACIAL ANTHROPOMETRIC PARAMETERS AND ITS RELEVANCE IN COVID 19: A CROSS SECTIONAL STUDY

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ABSTRACT **Context-** Nasofacial anthropometry is the measurement of facial and nasal parameters for racial and gender determination, forensic reconstructions, quantification and treatment of nasofacial abnormalities. Anthropometry also plays a pivotal role in industrial and fashion design, ergonomics and architecture. In these pandemic times, when mask etiquette has become the norm, it is imperative to ergonomically design facial masks to custom fit individuals. 'One size fits all' does not serve the purpose as air leaks waiver the use of these masks completely. Hence revising nasofacial anthropometric baseline data of populations has become more relevant than ever. **Aim-** To assess the nasofacial parameters of males and females of Lucknow population. **Subjects & methods-** The present cross sectional study was conducted in the Department of Oral & Maxillofacial Pathology, BabuBanarasi Das College of Dental Sciences, Lucknow where 200 subjects with an age group of 18- 35 years were assessed. Nasal, Facial, Philtrum and Columella parameters were recorded using vernier calipers. **Statisical analysis-** Student's T test was applied to compare two independent groups and Chi square test was applied to compare categorical groups. **Results and conclusions**- Our study found that hyperleptoprosopic face and mesorrhine nose was predominant in both genders with a definite increase in dimension among males; confirming sexual dimorphism. Literature review confirmed similarity of face types in places closer to India and variations in farther areas. To conclude, facial type may be majorly dependent on genetic descent and nasal type on environmental factors. Taking into account the huge Indian immigrant population worldwide, results of our study will provide baseline data to researchers.

KEYWORDS : nasofacialanthropometry, hyperleptoprosopic, mesorrhine, sexual dimorphism, COVID 19

INTRODUCTION:

Anthropometry is a noninvasive technique for assessing size, proportions, and composition of human body (WHO).[1] The growth and development of humans are affected by multitude of factors like geography, race, ethnicity, gender, and age.2,3,4 Environmental factors such as climate could influence nasofacial features and therefore vary among populations.[5] Facial appearance is hugely dependent on proportion and position of frontonasal, maxillary and mandibular processes.[6] Anthropometric data on distribution of body dimensions in different populations not only helps in gender differentiation but also plays a prime role in ergonomic engineering and fashion designs that aid to optimize product dimensions in case of masks and respirators.[7]

International migration has made this world a global village making it imperative for medical professionals to be aware of differences in facial characteristics among ethnic groups; especially those whose work involves aesthetics and correction of facial anomalies.8 Ergonomic design of respirators, masks, helmets and face shields are dependent on nasofacial dimensions that differ across races and genders.[9] With COVID 19, use of well fit mouth masks has become a necessity. Constantly evolving human features emphasize the need of anthropometric studies to be undertaken from time to time. Hence we conceptualized this study with the aim to assess the nasofacial anthropometric data among the population of Lucknow.

Methodology

The present cross sectional study was conducted in Babu Banarasi Das College of Dental Sciences, Lucknow in 200 subjects within the 18-35year age group. This age group was selected, as age negligibly affects the facial parameters in subjects above 18 years. Ethical clearance was taken prior to commencement of the study. Random sampling was done. Healthy individuals with no visible disfigurement of face were included in the study after an informed consent. Subjects with disfigured face / trauma of the nose / congenital facial malformations and history of having undergone facial reconstructive surgeries were excluded. Age was recorded from the date of birth mentioned in the records. All measurements were recorded using vernier calipers with 0.01mm accuracy with the subject seated on a chair with the head in the anatomical position (Image 1 & 2). Facial muscles were relaxed in order not to alter the size of the nose or philtrum. To reduce technical and inter-observer errors, each parameter was measured twice; average of which was recorded by a single observer.

IMAGE 1: image shows recording facial parameters
IMAGE 2: image shows Recording nasal parameters

Methodology for recording nasofacial parameters:
Points of measurements were marked and recorded (Fig 1)
Facial measurements (Fig 2)

FIGURE 1: Figure illustrates facial points of measurements (FH=nasion(n) to gnathion(gn), FW = zygoma(zy) to zygoma(zy), NH = nasion(n) to subnasale(sn) , NL=nasion(n) to pronasale(pn), NW = ala(al) to ala(al))

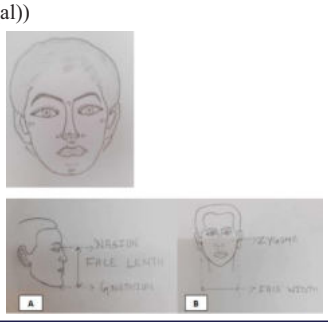


FIGURE 2: Figure illustrates Facial measurement- A. Facial Length- nasion to gnathion; B. Facial Width=zygoma to zygoma

Height of face: Straight distance between nasion and gnathion.
Width of face: Distance between zygion and zygion.
Facial Index = (Facial length / Facial width) X 100.

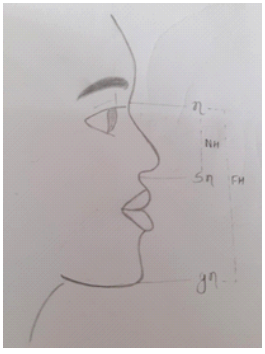


FIGURE 3: Figure illustrates Nasal height and facial height points of measurement - NH = Nasion(n) to Subnasale(sn), FH = Nasion(n) to Gnathion(gn))

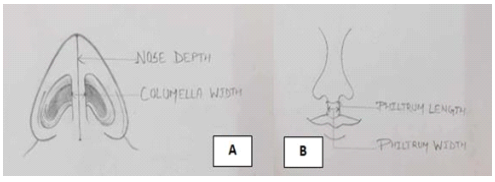


FIGURE 4: Figure illustrates Nasal Measurement: A. Columella Width=Measured at middle portion of columella with caliper; B. Philtrum Length= From base of columella to midline depression of vermillion border, Philtrum Width= junction of vertical ridge of philtrum and vermillion border of upper lip.

Nasal and philtrum measurements (Fig 3 & 4)

Height of Nose: Distance from nasion to sub nasale.
Length of Nose: Distance between nasion to tip of nose in line with upper edge of both nostrils.

Depth of Nose: Distance from base of Columella to tip of nose in line with upper edge of both nostrils.

Width of N ose: Distance from ala to ala (most lateral point on each alar contour).

Width of Nasal Columella: Measured at middle portion of columella.
Nasal index = (Nasal width / Nasal Height) X 100.

Length of Philtrum: From base of Columella to the midline depression on vermillion border.

Width of Philtrum: Distance between two points marked at junction of vertical ridge of philtrum and vermillion border of upper lip.

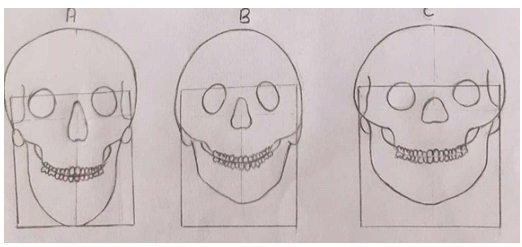


FIGURE 5: Figure illustrates types of face (A-Leptoprosopic; B-Mesoprosopic; C-Euryprosopic)

Face type based on Banister's classification10 (Fig 5)
Hypereuryprosopic (very broad, short face): X - 79.9.
Euryprosopic (broad, short face): 80 – 84.9
Mesoprosopic (average face, round): 85 – 89.9
Leptoprosopic (tall, narrow face): 90 – 94.9
Hyperleptoprosopic (very tall, narrow face): 95 – X

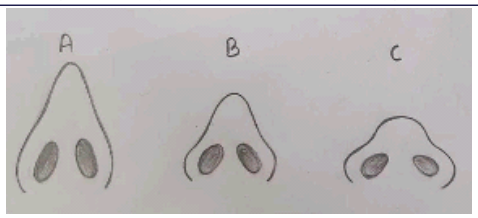


FIGURE 6: Figure illustrates types of nose (A-Leptorrhine; B-Mesorrhine; C-Platyrrhine)

Nose type based on classification by Wai MM1 et al and Hegazy AA11 et al: (Fig 6)
Hyperleptorrhine (excessively tall and narrow) ≤54.9
Leptorrhine (tall and narrow) 55.0–69.9
Mesorrhine (medium) 70.0–84.9
Platyrrhine (broad and flat) 85.0–99.9
Hyperplatyrrhine (excessively broad and flat) ≥100.

Statistical Analysis
Student's T test was applied to compare two independent groups and Chi square test was applied to compare categorical groups. P value <0.05 was considered statistically significant. Analysis was done using SPSS software (windows version 22.0).

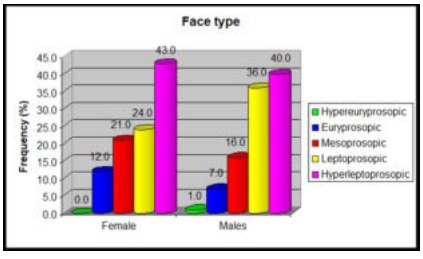
Results:
Data was tabulated and statistically analyzed. Facial length and width showed significantly higher measurements in males (table 1)

Facial index however did not show significant difference indicating that the common face type was seen in almost same number of males (40%) and females (43%).

Table 1: Summary of facial parameters of two sex groups

Facial parameters (mm)	Females (n=100)	Males (n=100)	Mean diff	t value	P Value
Facial length	94.44 ± 8.28	105.15 ± 7.54	10.71	9.56	<0.001
Facial width	102.61 ± 6.65	114.07 ± 8.11	11.46	10.92	<0.001
Facial index (%)	92.14 ± 6.96	92.45 ± 7.21	0.31	0.31	0.758

Common face type was hyperleptoprosopic in both genders followed by leptoprosopic, mesoprosopic, euryprosopic and hypereuryprosopic (graph1).



GRAPH 1: Graph illustrates FACE TYPE - In both genders hyperleptoprosopic face type is the common followed by leptoprosopic, mesoprosopic, euryprosopic and hypereuryprosopic.
Nasal height, length, depth, width, columella width as well as philtrum width and length showed significantly higher measurements among males.

Common nose type was mesorrhine in both sexes followed by platyrrhine, leptorrhine and hyperplatyrrhine in males & leptorrhine, platyrrhine and hyperplatyrrhine in females respectively. (table 2)

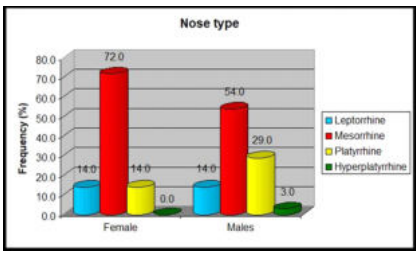
Nasal index in males and females showed significant difference with considerably less number of females (54%) having the common nose type (mesorrhine) as compared to males(72%).

Table 2: Summary of nasal parameters of two sex groups

Nasal parameters (mm)	Females (n=100)	Males (n=100)	Mean diff	t value	P Value
Nasal height	42.79 ± 4.48	47.33 ± 4.12	4.55	7.47	<0.001

Nasal length	37.18 ± 4.58	42.74 ± 4.59	5.56	8.56	<0.001
Nasal depth	12.62 ± 3.99	15.96 ± 3.73	3.34	6.11	<0.001
Nasal width	32.66 ± 3.96	38.02 ± 5.13	5.36	8.28	<0.001
Columella width	6.18 ± 2.10	7.81 ± 1.98	1.64	5.67	<0.001
Philtrum length	9.41 ± 2.98	10.43 ± 2.72	1.02	2.52	0.013
Philtrum width	8.78 ± 2.46	10.24 ± 2.52	1.45	4.12	<0.001
Nasal index (%)	76.47 ± 6.62	80.42 ± 9.43	3.96	3.43	0.001

The second common nose type in males was platyrrhine type (29%), which indicated significant difference when compared to females who revealed 14% of platyrrhine noses (graph2).



GRAPH 2: Graph illustrates NOSE TYPE - Mesorrhine nose type is common in females followed by "leptorrhine", "platyrrhine, and "hyperplatyrrhine". Mesorrhine nose type was also common in males followed by "platyrrhine", "leptorrhine" and "hyperplatyrrhine".

Face and nose type was the same in males and females although parameters showed significant difference indicating definite sexual dimorphism.

Discussion

The role of nasofacial anthropometry in forensic victim identification, smile design, gender and racial identification is widely documented. Type of face and nose are noticeable traits that differ amongst populations owing to genetic and environmental factors.[1] Over the years, lifestyle changes, nutrition, and ethnic mixing have lead to changes in distribution of body dimensions, which necessitates regular updating of anthropometric data. Sexual dimorphism was also an important component to assess as it aids in victim identification during disasters and design of gender specific logistics.[12]

Indians are a diverse lot, with Dravidian descent in the south, Aryan descent in the north, Mongoloids in the north- east etc. Past invasions by Persian Mughals and later by British, French and Portuguese, led to interethnic marriages and a conglomerate social fabric.[13] With the onset of COVID-19, mask wearing became a norm, which lead to a surge in manufacture of respirators and surgical masks. Nasofacial anthropometric parameters will add to ergonomics in bulk manufacturing of these accessories for a certain population. We therefore took an initiative to revise baseline anthropometric data, by evaluating nasofacial parameters in the city of Lucknow.

Face is the first noticeable feature in an individual, which define a person, his origins and descent giving him a unique identity. In our study, the mean facial width and facial length were significantly higher in males. Males exhibit a higher rate and longer span of growth.[14] The mid-childhood and adolescent growth spurts tends to occur approximately two years later for boys than girls. The extra years of growth prior to adolescence, slightly greater adolescent growth rates and lengthier adolescent period in males, explains the sexual dimorphism in craniofacial dimensions.[15]

The mean facial index though failed to show any significant difference between genders with both showing a predominant hyperleptoprosopic face. Mane et al[16] recorded similar results among Indians. Hyperleptoprosopic faces are long with more vertical than horizontal dimensions. Our study was done in Lucknow, a north Indian city with an Aryan descent. It is also interesting to note that Lucknow has a strong signature of Mughal invasion in terms of food, culture and monuments as 'Nawabs of Awadh', the yesteryear rulers were of Persian/Iranian lineage; which reiterates the fact that our sample is an inter-ethnic gene pool. Jaberi KR et al[17] and Dodangreh et al[18] reported similar findings from present day Iran.

Documented literature suggests that long narrow faces could result in increased turbulence and more resistance inside respirators. Hence our sample population may need specially designed masks/ respirators for effective use. Masks, which don't fit well, can leak air leading to increased infection spread. We strongly believe that mass production of these accessories should be population/ region specific or loco-regional. India being a diverse population revealed subtly different face types in different regions that can be assessed from Table 3.

TABLE 3:Facial anthropometric studies in Indian population.

Studies (indian)	Study population	Facial parameters
Shah S et al; 2012	Gujrat	Mesoprosopic in males Euryprosopic in females
Chhabra N et al; 2012	North Indians	Mesoprosopic in females Leptoprosopic in males
Prasanna et al; 2013	South & North Indians	Hyperleptoprosopic
Ashwani Cet al; 2014	South & North Indians	Leptoprosopic
Kataria DS et al; 2015	North Indians	Mesoprosopic
Chettri MN et al; 2017	Sikkim	Hyperleptoprosopic females
Gupta S et al; 2019	Haryana	Mesoprosopic
Present study	Lucknow	Hyperleptoprosopic

Chettri[19] conducted a study in Sikkim with the population grouped as Nepali, Bhutias, Lepchas and Sherpas; all of who had hyperleptoprosopic faces. Chettri's study is important, as there is considerable inter-ethnic mixing between Indians living in the border areas of Uttar Pradesh and North Eastern states like Sikkim with Nepal. Lucknow, our area of study is the capital of Uttar Pradesh and therefore explains the similarity between our study and theirs.

Prasanna et al[20] and Ashwani C et al[21] found hyperleptoprosopic and leptoprosopic faces among north and south Indians respectively; although reports of Kataria[22] were slightly different (mesoprosopic in both sexes) which may be due to regional variations among sample populations.

We further reviewed documented literature for face types from neighboring populations of the Indian subcontinent (table4) for various reasons. Nepal and India have an open border and over ages have intermingled socio-culturally. Present day Malaysia has large numbers of third to fourth generation Indian immigrants where Tamil and Punjabi Malays form a predominant part of their society. Sri Lanka has a majority of Tamils and Singhalese; where the former lot is of Indian origin. Pakistan was earlier a part of India and shares similar demographics. As already discussed, modern day Iran shares strong cultural signature in cities like Lucknow, Hyderabad and Delhi and therefore it is only natural to find similar reports by Azizi M[23] & Dodangreh[18].

Table 4: Facial anthropometric studies done in neighboring countries

Other studies	Study population	Facial parameters
Azizi M et al; 2014	Iran & Pakistan	Hyperleptoprosopic: Iran. Lepto/Mesoprosopic: Pakistan.
Yesmin T et al; 2014	Malays	Mesoprosopic
Wai et al; 2015	Malays, Chinese, Indians	Leptoprosopic for Malays and Indians Mesoprosopic in Chinese
Pandey N et al; 2015	Nepal	Mesoprosopic
Chandimal KM et al; 2015	Srilanka	Leptoprosopic
Dodangreh M et al; 2018	Iran	Hyperleptoprosopic
Shrestha R et al; 2019	Kathmandu, Nepal	Leptoprosopic
Madadi S et al; 2019	Iran	Mesoprosopic in males Euryprosopic in females
PRESENT STUDY	LUCKNOW	HYPERLEPTOPROSOPIC

Nose plays a pivotal role in esthetics. The complicated development of naso-maxillary complex from frontonasal and maxillary processes; leads to anomalies, which in turn increases the frequency of nasal corrective surgeries.[12] We found significantly higher measurements of all nasal and philtrum parameters in males. As already discussed, sexual dimorphism in nasal parameters may be due to differential growth rates as females reach skeletal maturity at an early age which probably is hormone- controlled[14]. Fusion of bony sutures follows a progressive pattern and is delayed in males.

The midface increases the most in height, next in depth, and least in width; with more vertical than anteroposterior growth; which explains why we found greater nasal height as compared to nasal depth and nasal width. In adolescents, sexual dimorphism increases throughout the midfacial complex, with differences of approximately 4mm in maxillary length (ANS-PNS), which may increase to 5 to 7 mm in late adolescent males.[15]

In our study, the predominant nose type was mesorrhine in both genders (72% in females; 54% in males); but we also noticed 29% platyrrhine nose in males which probably was not only due to the increased growth in males but also have an environmental basis. Type of nose is linked to evolutionary adaptation to environmental changes. According to Negus[24], populations adapted to dry climate have large, protruding external noses, downwardly directed nostrils and narrower skeletal apertures inducing turbulence to nasal air flow increasing air filtration and humidification within nasal passages while those with small, flat anteriorly directed external nares and shorter piriform apertures are better adapted to humid environments. Thomson and Buxton[25] reported platyrrhine noses in hot, moist climate, and leptorrhine noses in cold, dry climates. Hall[26] correlated nasal dimensions and oxygen consumption where size of the fleshy nose supports the amount of air that needs to be processed. Males, who consume relatively more oxygen during exercise, would be expected to have relatively broader noses or an extended nasal tip than females of the same population. As much of the energy required for breathing is expended in the nasal passages, a broader flatter nasal structure favors less turbulent airflow, which physiologically provides lower nasal airway resistance. In platyrrhine nose, inspired air passes through more horizontally placed nostrils and are directed towards the inferior portion of the nasal chamber to condition very warm air.[27]

Mesorrhine noses can be correlated with the tropical climate in India. Lucknow has 9 months of hot humid climate along with 3 months of dry cold weather. One has to spend more energy to inhale more oxygen due to the poor air quality in the area and such habitual changes might have a role to play in shaping the nose. This explains the broad noses in individuals with vertically slender faces. In addition, the second common nose type was platyrrhine in males. May be we are evolving towards a broader nose to ensure more oxygen availability from polluted environments.

Mehta et al[28] found mild regional differences where nasal height was more among north Indians while nasal width was more among south Indians. They concluded that Indians on an average had a mesorrhine nose compared to leptorrhine nose in Caucasians and Orientals and platyrrhine nose in Africans.

One of the pioneer anthropometric studies carried out in India was by Sir Risley; who recorded that Aryo-Dravidians from Uttar Pradesh and Bihar have medium sized noses and Indo-Aryans from Punjab and Rajasthan have long narrow noses.[29] Decades have passed since Sir Risley's study; we may still have mesorrhine noses but with mean differences in nasal height and width.

With few exceptions, all Indian studies reported a mesorrhine nose type; which is in concordance to ours (table 5). The difference in findings reported by Singla M[30] may be because Jaunsaris are hill tribes habituated to cold weather. Chowdhary et al[31] reported variations in Jats, a genetically tall sect who are believed to be "high nosed, tall headed Aryans".[32] Nusrat et al[33] reported leptorrhine nose among Kashmiris which may be related to cold weather they live in or due to the widely believed fact that Kashmiris are descendants of the ten lost tribes of Israel. Table 7 signifies that Indians have mesorrhine noses predominantly which may be explained to a great extent to the hot humid weather.

Table 5: Nasal anthropometric studies done in Indian population.

Studies (Indian)	Study population	Nasal parameters
Chhabra N et al; 2012	North Indians	Mesorrhine
Chowdhary A et al; 2012	Jats, Sindhi of Rajasthan	Leptorrhine Jats Mesorrhine Sindhis
Sharma SK et al; 2014	Gwalior	Mesorrhine
Patil GB et al; 2014	South Indians	Mesorrhine Males Leptorrhine Females
Asharani SK et al; 2015	North and South Indians	Mesorrhine
Ray SK et al; 2016	Uttar Pradesh	Mesorrhine
Mehta et al; 2017	North; Central; West; South; and Himalayan region	North Indians- Leptorrhine South Indians- Broadest nose Himalayan-Shortest nose
B Sadhvi et al; 2018	South Indians	Mesorrhine males
Jabeen N et al; 2019	Jammu and Kashmir	Leptorrhine
Andhare P et al; 2020	Maharashtra	Mesorrhine
Singla M et al; 2020	Jaunsaris, Dehradun	Leptorrhine
Rohith MM et al; 2020	Gujrat	Mesorrhine
PRESENT STUDY	LUCKNOW	MESORRHINE

The studies enlisted in table 6 from neighboring populations also reported a mesorrhine nose type, which reiterates that nose type is dependent on environment to a greater extent.

Table 6: Nasal anthropometric studies done in neighboring countries

Other studies	Study population	Nasal parameters
Chandimal KM et al. 2014	Srilanka	Mesorrhine
Tahmasebi F et al. 2015	Iran	Leptorrhine
Wai et al. 2015	Malays, Chinese, Indians	Mesorrhine
Yadav SK et al. 2018	Nepal	Mesorrhine
Shrestha R et al. 2019	Nepal	Mesorrhine
Dhulqarnain AO et al. 2020	Nigeria & Iran	Mesorrhine: Nigeria Leptorrhine: Iran
PRESENT STUDY	LUCKNOW	MESORRHINE

Philtrum is a vital part of the upper lip, which has a symmetrical pair of paramedian vertical ridges bordering the central depression. Smoothening of philtrum and a thin upper lip are seen in fetal alcohol syndrome. Autistic people may have a broader philtrum.34 Only few studies are documented on philtrum and this is one of the first from India. We found sexual dimorphism in philtrum parameters with males having a wider and longer philtrum.

Conclusion

In this cross sectional study, we found that nasofacial dimensions were significantly higher in males showing a definite sexual dimorphism. Both genders exhibited predominantly hyperleptoprosopic face and a mesorrhine nose. Our findings reveal that face type is more dependent on genetic descent of the individual while nose type leaned more towards environmental factors. These findings emphasize the fact that masks and respirators need to be manufactured with loco-regional specifications. A study with larger sample size can throw more light into this area; and regular revision of anthropometric data is inevitable across populations.

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