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Original Research Article

Sexual Dimorphism and Ethnic Variations in Facial Index: A Study Done On North Indian Adults

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ABSTRACT

The total facial index exhibits sexual differences and different shapes of face. The present work was undertaken to determine the face type and whether facial variations were subjected to sexual dimorphism. Facial length and breadth were measured using sliding and spreading calipers. Mean face length was 112.84 mm for males and 108.84 mm for females; face breadth 124.70 mm for males and 121.51 mm for females. The mean facial index was 90.68 for males and 89.73 for females, Sexual dimorphism was observed in most parameters with linear measurements and index being more in Males. Males had leptoprosopic face whereas Females had mesoprosopic face. This information will be highly important for Plastic surgeons, Forensic Scientists, Anatomists, Human Biologists, Criminologists & Physical Anthropologists.

Key Words: facial index, sexual dimorphism, leptoprosopic, anthropometry, reconstructive

INTRODUCTION

Variation is one of the most important phenomena occurring in humans, and is attributed to many factors such as mutation and natural selection. Many studies have emphasized the importance of anthropometric measurements as a means of studying variation in human populations as well as veritable tools in forensic science for crime detection. [1] Culture, customs, traditions, dress, and geography are several factors that distinguish ethnic groups across the world. However, the most obvious difference between individuals of varying ethnic groups is physical appearance. From the neck down to the toes, we are all very similar; however it is the facial structure and skin tone that most noticeably differentiates one ethnic group from another. [2] Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and are manifestation of the internal structure and tissue components which in turn, are influenced by environmental and genetic factors. [3] Measurements of the human face as part of the body have been performed since the Greek era, and many aspects of ancient measurements can be found in modern clinical anthropometry. The main difference between human measurements in classic

times and modern anthropometry is the denial of realistic sizes and proportions in former times. Human forms and canons were depicted in a way the artist or scientist preferred, rather than how they objectively were. For reconstructive and cosmetic surgery, realistic sizes and proportions are assessed using anthropometric techniques and used as guidelines to correct deformities or disproportions. [4] The face is defined as the front part of the head between the ears and the chin, and to the hairline. The anterior part of the head includes the forehead, eyes, nose mouth and chin. [5] The shape of the face is determined by underlying bone, thickness and distribution of the underlying fat as well as the facial muscles. [6] The face is the most variable part of the body. It permits distinction between races, ethnic groups, sexes and even members of the same family. [7] The variations in the facial morphology arise through a differential growth and they help us in distinguishing one person from another. These are controlled by a number of factors which include genetic heritage, climate and environment in which we live. Very few researchers from India have worked on these facial features with respect to population and environment. [8] The facial framework is expressed by Facial Index (Prosopic Index) which is the ratio of the facial length to facial width multiplied by 100. [9] It is a very useful anthropometric tool to find out racial and sexual differences and also give a clue to genetic transmission of inherited characteristics from parents to their off spring. [10] Measurement of total facial index is important for studies of human growth, population variation and aesthetic surgery. The importance of seeing the face 'in proportions' has been emphasized by many surgeons. All medical specialties interested in improving facial appearance need to measure the face to quantify the desired facial changes. [11]

MATERIALS & METHODS

A cross sectional study was carried out on 600 Adults (300 Males and 300 Females) of North Indian origin. The age group of the study group was between 18-40 years. Prior informed consent was obtained from the subjects in writing. They were chosen by simple random method. Those with trauma of the face, prior plastic or reconstructive surgery of face or cleft lips and other congenital facial malformations were excluded. Digital sliding calipers and spreading calipers was used for the measurement of face length and face breadth respectively. Each measurement was taken thrice to ensure accuracy. Subject was made to sit on chair in a relaxed condition for taking measurements. Three somatometric landmarks were used to measure face length and face breadth and facial index was calculated. Facial length is the distance between nasion and gnathion. Nasion is the intersection of naso frontal suture with the mid sagittal plane. Gnathion is the most anterior and lowest median point on the lower jaw. Facial breadth was measured as bizygomatic breadth. Bizygomatic breadth is the distance between the most laterally placed points on the zygomatic arches.

Prosopic index (PI):- It is defined as the ratio of the maximum face length to maximum face breadth multiplied by 100

Prosopic Index: - $\frac{\text{Maximum Face Length (N-Gn)}}{\text{Maximum Face Breadth (Zy-Zy)}} \times 100$

<79.9 Hypereuryprosopic "very short broad face type"
80.0-84.9 Euryprosopic "short broad face type"
85.0-89.9 Mesoprosopic "medium or intermediate face type"
90.0-94.9 Leptoprosopic "Long narrow face type"
> 95 Hyperleptoprosopic "Very long narrow face type" [12]

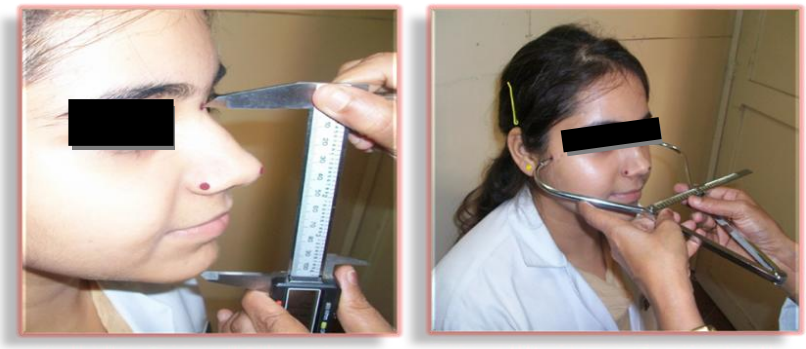

Fig 1& 2: Showing the facial landmarks and the measurements being taken.

OBSERVATIONS & RESULTS

Table 1: Facial Parameters & Prosopic Index of Males & Females

S. No	Parameters	Males (Mean)	S.D	Females (Mean) Mean±S.D.	S.D.	p value
1.	Face Length N-Gn	112.84	6.23	108.84	5.21	<0.001*** HS
2.	Face Breadth Zy-Zy	124.7	7.61	121.51	7.3	<0.001*** HS
3.	Prosopic Index N-Gn x100 Zy-Zy	90.68	5.29	89.73	6.10	<0.05* NS

p value>0.05 Not Significant (NS)
p value<0.05 * Significant(S)
p value<0.01 ** Very Significant(VS)
p value<0.001 *** Highly Significant(HS)

Facial Measurements:

Face length: In the present study the mean morphological face length in males was 112.84 mm with a range of 98.56 - 129.96 mm. In females it was 108.84 mm with a range of 86.17 - 129.67 mm. Sexual dimorphism was found to be statistically significant($p<0.001$). Face breadth: The mean bizygomatic breadth in the study population was 123.15mm with a mean value of 124.70 mm for males and 121.51mm for females. Range of face breadth was 104 - 148 in males and 104 - 141mm in females with significant differences between the two sexes ($p<0.001$). Prosopic Index: The mean Prosopic index in the study was 90.13 with a mean of 90.68 for males and 89.73 for females. Range of Prosopic index was 76.54 - 99.92 in males and 69.49 - 109.58 in females. Males showed higher values of prosopic index with significant statistical difference between the two sexes ($p<0.05$).With the help of total facial index the study group is divided into different phenotypes of face according to Banister's classification.

Table 2: Distribution of Total Facial Index (Face Shapes of Present Study)

Facial Phenotypes	Range	Males		Females	
		No.	%age	No.	%age
Hypereuryprosopic	< 79.9	9	3	20	6.67
Euryprosopic	80.0-84.9	29	9.67	73	24.33
Mesoprosopic	85.0-89.9	90	30	83	27.67
Leptoprosopic	90.0-94.9	96	32	73	24.33
Hyperleptoprosopic	>95.0	76	25.33	51	17
Total		300	100	300	100

The most common type of face in males in present study was of Leptoprosopic type which was found in 96 (32%) subjects. Next in order of frequency was

Mesoprosopic type in 90 (30%) males, followed by Hyperleptoprosopic type in 76 (25.33%) males. The rare types found were Euryprosopic in 29 (9.67%) and Hypereuryprosopic in 9 (3%) male subjects. The most common type of face in females was of Mesoprosopic type which was found in 83 (27.67%) females followed by equally distributed Euryprosopic and Leptoprosopic types in 73 (24.33% each) subjects. Hyperleptoprosopic type of face was found in 51 (17%) females of present study followed by Hypereuryprosopic type which was rare and found in only 20 (6.67%) female subjects.

DISCUSSION

In this study direct morphometric measurements on face of North Indians were carried out. As anthropometric data are sensitive to distribution of age, race and occupation, anthropometric parameters of the face of 600 Adults (300 males & 300 females) of 18 to 40 years were measured. Data collected was subjected to statistical computation and findings have been discussed under the following headings.

Table 3: Comparison of mean face length of present study with other studies.

Authors	Population	No.	Sex	Mean ± S.D.	p value
Present study	North Indians	300	M	112.84 ± 6.23	
		300	F	108.84 ± 5.21	
Farkas et al [13]	Caucasians	109	M	124.7 ± 5.7	<0.001***
		200	F	111.4 ± 4.8	<0.001***
Farkas et al [13]	African Americans	50	M	125.6 ± 8.0	<0.001***
		50	F	116.5 ± 6.1	<0.001***
Xuetong et al [14]	Chinese	110	M	125.8 ± 6.57	<0.001***
		110	F	120.13 ± 5.05	<0.001***
Ngeow& Aljunid [9]	Malaysian Indians	100	M	116.4 ± 4.7	<0.001***
		100	F	126.7 ± 3.9	<0.001***

p value >0.05 Not Significant(NS)
p value<0.05 * Significant(S)
p value <0.01 ** Very Significant(VS)
p value<0.001 *** Highly Significant(HS)

In the present study the mean morphological face length was 112.84 mm in males and 108.84 mm in females. Sexual dimorphism was found to be statistically significant ($p<0.001$) as shown in Table 1 with males having longer faces than females. This agreed with the studies done by Farkas et al, [13] Xuetong et al [14] & Ngeow & Aljunid [9] documenting sexual dimorphism. The mean face length of males & females in the present study was statistically significantly ($p<0.001$) smaller than the values obtained by Farkas et al [13] on Caucasians & African Americans, Xuetong et al [14] on Chinese & Ngeow & Aljunid [9] on Malaysian Indians males & females due to different geographical, racial and ethnic factors.

In the present study the mean face breadth was 124.7 mm in males and 121.51 mm in females. Sexual dimorphism was found to be statistically significant ($p<0.001$) as shown in Table 1 with males having broader faces than females. This agreed with the studies done by Farkas et al, [13] Xuetong et al [14] & Ngeow & Aljunid, [9] documenting sexual dimorphism. Statistically significant ($p<0.001$) smaller values of face breadth in males & females of present study were found when compared with those obtained by Farkas et al [13] on Caucasians & African Americans, Xuetong et al [14] on Chinese & Ngeow & Aljunid [9] on Malaysian Indians males & females due to different geographical, racial and ethnic factors.

Table 4: Comparison of mean face breadth of present study with other studies.

Authors	Population	No.	Sex	Mean ± S.D.	p value
Present study	North Indians	300	M	124.7 ± 7.61	
		300	F	121.51 ±7.35	
Farkas et al [13]	Caucasians	109	M	139.1 ± 5.3	<0.001***
		200	F	130.0 ± 4.6	<0.001***
Farkas et al [13]	African Americans	50	M	139.0 ± 5.3	<0.001***
		50	F	130.5 ± 4.8	<0.001***
Xuetong et al [14]	Chinese	110	M	142.6 ± 5.11	<0.001***
		110	F	139.3 ± 4.36	<0.001***
Ngeow& Aljunid [9]	Malaysian Indians	100	M	136.3 ± 4.8	<0.001***
		100	F	126.7 ± 3.9	<0.001***

p value >0.05 Not Significant(NS)
p value<0.05 * Significant(S)
p value <0.01 ** Very Significant(VS)
p value<0.001 *** Highly Significant(HS)

Table 5: Comparison of mean prosopic index of present study with other studies

Authors	Population	No.	Sex	Mean ± S.D.	p value
Present study	North Indians	300	M	90.68 ± 5.29	
		300	F	89.73 ± 6.10	
Ngeow& Aljunid [9]	Malaysians Indians	100	M	85.5 ± 4.4	<0.001***
		100	F	85.4 ± 3.9	<0.001***
Farkas et al [9]	Caucasians	34	F	86.6 ± 3.6	<0.001***

p value>0.05 Not Significant(NS)
p value<0.05 * Significant(S)
p value<0.01 ** Very Significant(VS)
p value<0.001 *** Highly Significant(HS)

Facial framework is expressed by the facial index which is the ratio of facial length to facial width. Normally various facial types are encountered in every population so a certain number of people have thin, broad or small faces. The Prosopic index changes over time and the Prosopic index of children is lower than that of adults and while growing up they gain a longer and narrower face. The difference of the face shape in different populations indicates that the geographical factor similar to ethnic factor can affect the form of the face.

In the present study the mean Prosopic index was 90.68 in males and 89.73 in females. This index indicated a proportionately more balanced frame (mesoprosop) for the North Indian females (facial index 89.73 ± 6.10) but males had a face that was long (leptoprosop) in relation to its width (90.68 ± 5.29). Substantial statistical difference was found between the two sexes ($p<0.05$) as shown in Table 1. This coincided with the study done by Ngeow & Aljunid [9] where sexual dimorphism was found. Statistically significant ($p<0.001$) higher values of prosopic index in males & females of present study were found when compared with Ngeow & Aljunid [9] studies on Malaysian Indians males & females as depicted in Table 5. This may be due to different geographical and environmental climatic conditions and also due to sample size differences between the two studies as present study had 300 subjects of each sex and Ngeow & Aljunid [9] studies had 100 subjects of each sex. In females the values were also significantly higher ($p<0.001$) when compared with Farkas et al [7] studies on Caucasian females though both of them fall in the same mesoprosopic type of face. This could be due to dietary, environmental and climatic conditions. The values of prosopic index of males could not be

compared with Caucasian males due to non availability of data.

SUMMARY AND CONCLUSION

In this study significant differences were found in the facial measurements and prosopic index of males and females with values being higher in males. Based on this study the most common type of face found was of Leptoprosopic type in males and Mesoprosopic type in females and the rare type was Hypereuryprosopic in both sexes. It agrees with other authors on sexual dimorphism of facial features. These findings should be kept in mind when planning facial reconstructive surgery in men because the objective should be different than for women. The findings of present study were also compared with the studies done by Farkas et al on Caucasians & African Americans, Xuetong et al on Chinese & Ngeow & Aljunid on Malaysian Indians males & females. The anthropometric measurements obtained in this study were quite different from the findings of all above groups due to different racial and geographical factors. Thus it supports the notion that there appears to be substantial variability in facial morphology between different ethnic groups. The results offer clear evidence of the need for separate norms for North Indians. For years together the anthropometric measurements for surgical reconstruction were based on basic values for Western population which actually differs for Indians. The astute surgeon recognizes that patients of different ethnic descents differ in facial proportions and makes the appropriate adjustments. These results will be beneficial in facial reconstructive surgeries, maxillofacial surgeries, and in forensic medicine, with a word of caution, that these results are applicable to the population from which the data have been collected, due to inherent population variations in these dimensions, which may be attributed to genetic and environmental factors.

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