Original Article

Craniofacial anthropometric measurements of adult Indians in Angles Class I malocclusion

ABSTRACT

Context: The study was done on Adult Indians ranging from an age group of 18–25 years inhibiting Angles Class I malocclusion.

Aims: The objective of the study was to establish the craniofacial anthropometric norms for the young adult (18–28 years) Indians.

Subjects and Methods: The study group consisted of 150 healthy volunteers with equal number of male and female subjects who had no history of mixed racial parentage. Twenty-one linear measurements were studied from 28 landmarks over six craniofacial regions by two different operators.

Statistical Analysis Used: Sample *t*-test was used to study the significance of the difference of each average level of all craniofacial parameters between male and female groups. Chi-square test was used to study the statistical significance of difference of the craniofacial indices between males and females.

Results: The minimum measurements were contributed by female subjects in most of the craniofacial parameters, except for the eye fissure height (ps-pi) and nose prominence (sn-prn). There is a gender difference in all the measurements except the eye fissure width and nose prominence (independent *t*-test; $P < 0.05$). The Indians exhibit some North American White Caucasians (NAWC) features in all regions.

Conclusions: This study establishes the craniofacial anthropometric norms of the Indians over 21 parameters. Males, in general, have a significantly higher measurement than females in most of the craniofacial parameters. The Indians do exhibit some NAWC like features.

Key words: Anthropometric parameters; craniofacial anthropometry; craniofacial measurements; facial index; nasal index.

Introduction

Anthropometry is the science of measuring the human body and its parts.[1] Anthropometric measurements from the head and face together are called Craniofacial Anthropometry. Anthropometry describes the morphology, including size, shape, and proportions of human face and its parts using certain measurements defined on the basis of specific landmarks.[1]

Craniofacial anthropometric measurements can be used together with cephalometry, computed tomography scans, and magnetic resonance imaging in diagnosis and treatment planning of various malocclusions and craniofacial anomalies. Measurement of the craniofacial complex is also important in studies of human growth and to study population variations.

While there has been a report on the craniofacial anthropometry in Indian newborns and infants,[2] there is no

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comprehensive data on the adult Indian population. The most extensive data on the adult Indian so far have been reported by Farkas *et al*.[3] where 14 measurements were recorded from various parts of the craniofacial complex.

The aim of the present study was to establish the craniofacial norms for the Indian population so that it will help to add a baseline data for craniofacial measurements and indices of the adult Indian population in literature of craniofacial anthropometry of adult Indians.

Subjects and Methods

The study group consisted of samples of 150 young adult Indians residing in India, with equal number of female and male subjects. Their age ranged from 18 to 28 years. The participants who volunteered were generally healthy and exhibited no craniofacial abnormalities either acquired through road traffic accidents or other forms of trauma, congenital or developmental discrepancies and had no history of plastic or reconstructive surgery.

All the participants exhibited with Angles Class I malocclusion with straight profile.

Standard anthropometric instruments such as Digital sliding caliper, spreading caliper, measuring tape, and a modified sliding caliper were used in this study to record the measurements.

Twenty-one linear measurements were taken from 28 landmarks over six craniofacial regions as shown in Table 1. Every measurement was taken twice by the different examiner to eliminate inter- and intra-operator error. A Mean of two readings was taken. This methodology and evaluation of indices of the craniofacial region were adapted from Hajnis *et al*.[4] To avoid errors in locating landmarks that were used for more than one measurement (e.g., nasion, subnasale), these landmarks were marked on the skin.

The landmarks used in this study were standard landmarks used in craniofacial anthropometric study, namely, vertex (v), glabella (g) or nasal eminence, opisthocranion (op), ophyron (on), and eurion (eu) on the head. Zygion (zy), nasion (n), subnasale (sn), stomion (sto), and gnathion (gn) or menton on the face. Endocanthion (en), exocanthion (ex), palpebrale superius (ps), and palpebrale inferius (pi) on the eye. Alare (al) and pronasale (prn) on the nose. Cheilion (ch), Labiale (or labrale) superius (ls), and labiale (or labrale) inferius (li) on the orolabial region. Superaurale (sa), subaurale (sba), preaurale (pra), postaurale (pa) on the ear.

Table 1: Measurement definition using various landmarks on the head, face, orbit, nose, orolabial region, and ear

Landmark	Measurement definition	Region
eu-eu	Width of the head	Head
g-op	Length of the head	
v-n	Height of the head	
zy-zy	Face width	Face
n-gn	Face height	
n-sto	Upper face height	
sn-gn	Lower face height	
en-en	Intercanthal width	Orbit
ex-ex	Biocular width	
ex-en (left/right)	Eye fissure length	
ps-pi (left/right)	Eye fissure height	
n-sn	Nose height	Nose
al-al	Nose width	
sn-prn	Protrusion of the nasal tip	
ch-ch	Mouth width	Orolabial
sn-sto	Upper lip height	
sn-ls	Cutaneous upper lip height	
ls-sto	Upper vermillion height	
sto-li	Lower vermillion height	
pra-pa (left/right)	Ear width	Ear
sa-sba (left/right)	Ear length	

Sa: Superaurale, sba: Subaurale, pra: Preaurale, pa: Postaurale, sto: Stomion, li: Labiale (or labrale) inferius, ls: Labiale (or labrale) superius, sto: Stomion, ch: Cheilion, sn: Subnasale, al: Alare, n: Nasion, sn: Subnasale, prn: Pronasale, ps: Palpebrale superius, pi: Palpebrale inferius, ex: Exocanthion, en: Endocanthion, gn: Gnathion, zy: Zygion, op: Opisthocranium, g: Glabella, eu: Eurion

The entire data were statistically analyzed using Statistical Package for Social Sciences (SPSS version 11.5, IBM) for MS Windows. An independent *t*-test was performed to evaluate if there was any significant difference in the measurement between genders. A value of $P < 0.05$ was set as being statistically significant. Chi-square test was used to study the statistical significance of the difference of the craniofacial indices between males and females.

Results

Measurements of 150 individuals (75 males and 75 females) were recorded. Craniofacial measurements (21 in all) were compared between males and females, between Indians, Malaysian Indians, and North American White Caucasians (NAWC's).[5] All measurements were recorded in millimeters (mm). Mean values, standard deviation, and two-tailed significance are shown in Table 2.

Analysis of parameters in Table 2 as expected showed statistically significant differences between males and females in the anthropometrical measurements used to characterize the craniofacial region, although in three measurements statistically significant differences were not obtained. Higher

Table 2: Gender-wise distribution and comparison of craniofacial measurements in the study groups

Region	Craniofacial parameters (mm)	Mean±SD		*P*
		Male (*n*=75)	Female (*n*=75)	
Head	eu-eu	155.1±5.7	151.9±6.0	0.001*
	g-op	186.2±7.9	176.9±9.7	0.001*
	v-n′	93.3±9.5	89.8±9.3	0.022
Face	zy-zy	133.7±5.1	126.7±4.8	0.001*
	n′-gn′	120.5±6.2	111.8±6.1	0.001*
	n′-sto	74.9±6.4	71.4±7.9	0.003*
	sn-gn′	65.6±7.1	60.3±4.3	0.001*
Orbit	en-en	31.9±1.9	30.6±2.5	0.001*
	ex-ex	97.9±6.2	95.1±4.5	0.002*
	ex-en	33.2±2.6	32.7±3.6	0.318
	ps-pi	8.9±1.3	9.4±6.1	0.521
Nose	n′-sn	56.5±3.3	54.8±4.3	0.006*
	al-al	38.3±2.9	34.9±3.2	0.001*
	sn-prn	18.7±2.4	18.5±2.3	0.492
Orolabial	ch-ch	49.5±4.5	46.2±3.4	0.001*
	sn-sto	19.2±3.5	18.5±2.9	0.024
	sn-ls	12.9±3.4	11.9±2.5	0.045
	ls-sto	7.5±1.9	6.6±1.4	0.002*
	sto-li	9.7±1.8	9.0±1.5	0.006*
Ear	pra-pa	33.5±3.6	31.8±2.4	0.001*
	sa-sba	59.7±2.8	56.7±3.2	0.001*

Sa: Superaurale, sba: Subaurale, pra: Preaurale, pa: Postaurale, sto: Stomion, li: Labiale (or labrale) inferius, ls: Labiale (or labrale) superius, sto: Stomion, ch: Cheilion, sn: Subnasale, al: Alare, n: Nasion, sn: Subnasale, prn: Pronasale, ps: Palpebrale superius, pi: Palpebrale inferius, ex: Exocanthion, en: Endocanthion, gn: Gnathion, zy: Zygion, op: Opisthocranium, g: Glabella, eu: Eurion, SD: Standard deviation

values in males were observed in the parameters used to characterize the head: Maximum head breadth, maximum head length, and head circumference.

Measurements of face showed that males in comparison with females had wider and taller face heights. Comparing measurements from the orbital region it was found that the intercanthal width and binocular width were larger in males, whereas eye fissure length was similar in males and females and eye fissure height was larger in females as compared to that of males as shown in Table 2.

Wider noses with increased nose height were observed in males as compared to that of females. All the craniofacial measurements were compared between Indians, Malaysian Indians, and NAWC [Table 3].

Analysis of the results given in Table 3 showed almost no statistically significant difference between Indians and Malaysian Indians except for certain measurements such as height of the head, eye fissure height, nose height, upper and lower vermilion height, and ear height. There was no significant statistical difference in most of the craniofacial measurements if compared between Indian females and Malaysian Indian females. Only in four parameters such as width of head, binocular width, nose width and upper vermilion height, higher statistically significant values were observed. In general, it can be noted that the minimum measurements were all contributed by the female Indians except for the eye fissure height (ps-pi) and nose prominence (sn-prn).

A $P < 0.05$ was noted in all measurement except for the eye fissure length (ex-en), eye fissure height (ps-pi), and nasal prominence (sn-prn) indicating that there is a gender difference in all the measurements.

Discussion

This study focused on craniofacial anthropometrical measurements of healthy Indian population having no obvious dysmorphological features and no known family history of genetic defects. This research was oriented to identifying the average craniofacial parameters that can assist in the diagnosis of genetic pathology and orthodontic treatment planning for young adults. We are confident that our data is comparable to Farkas *et al*.'s study and Ngeow and Aljunid study data even though we were not calibrated with this group of researchers as their study was developed with their input and were based on the methods they employed.[3,5] Within the limitation of methodology and sample size differences we believe it is not wrong to suggest that our findings indicate that the Malaysian Indians were not different from their Indian counterparts. We also undertook the task to compare our finding with that of Farkas *et al*.'s data on the NAWC's young adults. The NAWC's was chosen instead of other Asian ethnic groups because of recent finding in Farkas *et al*.'s study, who found that the Indians present some Caucasian features. This is not surprising, considering that the Indians belong to the subgroup of Caucasoid called Indo-Dravidian (Indo-European). Also as expected, sexual dimorphism was found to be statistically significant in almost all parameters that include head and face. Many investigators have shown significant differences in craniofacial complex among ethnic and racial groups.[6,7] The similarities between most of the craniofacial parameters can be explained by the inherited genetic lineage which is widely accepted explanation in the scientific community. Several other investigators also suggested that genetic factors exert a substantial influence on the individual difference in body shape and configuration.[8] Therefore, they would be considered in developing standards for various populations. One of the biggest comparative data on the various ethnic groups/races in the world was published in 2005 by the late

Table 3: Comparison of different craniofacial anthropometric norms between different studies and present study

Parameter	Gender	Mean±SD (in mm)		
		Present study	Malaysian Indians	NAWC (Farkas study)
Width of the head	Male	155.1±5.7	150.9±5.3	153.3±5.9
	Female	151.9±6.0	142.8±5.1	144.4±4.6
Length of the head	Male	186.2±7.9	185.4±6.8	193.7±7.6
	Female	176.9±9.7	172.7±5.8	184.9±7.0
Height of the head	Male	93.3±9.5	100.3±9.4	117.7±8.0
	Female	89.8±9.3	91.4±8.4	112.6±7.1
Face width	Male	133.7±5.1	136.3±4.8	139.1±6.3
	Female	126.7±4.8	126.7±3.9	131.1±5.3
Face height	Male	120.5±6.2	116.4±4.7	121.3±6.8
	Female	111.8±6.1	108.1±4.2	112.0±4.7
Upper face height	Male	74.9±6.4	73.0±4.1	74.0±4.2
	Female	71.4±7.9	69.6±3.1	68.9±3.6
Lower face height	Male	65.6±7.1	67.7±3.5	72.6±4.5
	Female	60.3±4.3	61.0±3.8	64.3±4.0
Intercanthal width	Male	31.9±1.9	31.7±1.9	32.9±2.7
	Female	30.6±2.5	30.5±1.7	32.5±2.1
Biocular width	Male	97.9±6.2	92.1±4.1	90.7±3.8
	Female	95.1±4.5	89.4±3.2	87.6±4.0
Eye fissure length	Male	33.2±2.6	30.7±1.6	31.3±1.4
	Female	32.7±3.6	29.6±1.4	30.7±1.8
Eye fissure height	Male	8.9±1.3	10.1±1.3	10.4±1.1
	Female	9.4±6.1	10.5±1.1	11.1±1.2
Nose height	Male	56.5±3.3	51.9±3.6	53.2±3.3
	Female	54.8±4.3	50.4±3.2	49.2±2.9
Nose width	Male	38.3±2.9	39.5±2.6	34.8±2.7
	Female	34.9±3.2	35.3±2.8	31.9±1.0
Protrusion of the nasal tip	Male	18.7±2.4	19.5±1.9	20.6±2.2
	Female	18.5±2.3	18.7±1.6	19.4±1.7
Mouth width	Male	49.5±4.5	47.3±3.3	53.5±3.6
	Female	46.2±3.4	45.9±3.0	49.8±3.2
Upper lip height	Male	19.2±3.5	21.6±2.0	21.8±2.2
	Female	18.5±2.9	19.4±1.7	20.1±2.3
Cutaneous upper lip height	Male	12.9±3.4	12.9±2.5	14.8±2.6
	Female	11.9±2.5	11.1±1.6	13.5±2.2
Upper vermillion height	Male	7.5±1.9	9.2±1.3	9.5±1.5
	Female	6.6±1.4	8.6±0.9	8.6±1.6
Lower vermillion height	Male	9.7±1.8	11.5±1.6	11.0±1.2
	Female	9.0±1.5	10.9±1.0	10.0±1.5
Ear width	Male	33.5±3.6	34.7±2.7	35.9±2.2
	Female	31.8±2.4	31.8±2.2	34.1±2.6
Ear height	Male	59.7±2.8	64.6±4.0	62.4±3.7
	Female	56.7±3.2	60.3±2.8	59.0±3.6

NAWC: North American White Caucasians

Professor Farkas. This international anthropometric project studied the facial morphology of 26 ethnic groups/races in the world.[3] Racial and Ethnic differences in facial traits of various races such as the American and European, Caucasian, Afro-American, Turkish, Arabs, Persian, Chinese, Vietnamese, and Thais have been reported by many researchers.[3-5] The study done by Farkas *et al*. included five Asian ethnic groups, of which one of them was Indian. He had taken only 10 parameters from the whole craniofacial region. Before this, there are only several publications in that highlight the craniofacial anthropometry of the Indians, and most of them either concentrate on newborns or infants[5,9,10] or specific regions of the craniofacial framework.[11]

Conclusions

The measurements from this study can provide the basic framework for estimating the craniofacial standards for Indian

population. Despite national heterogeneity, craniofacial measurements of the head and face, with only a few exceptions are similar in Indians and Malaysian Indians for both males and females. Anthropometrical measurements should be continued to establish craniofacial standards for diagnosis and treatment planning needs for Indian adults. This study establishes the craniofacial anthropometric norms of the Indians over 21 parameters.

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Conflicts of interest

There are no conflicts of interest.

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