Morphological Evaluation of Head and Face in North Indian Population

P.C. Srivastava*, A.K. Kapoor, U.S. Sinha***, B.C. Shivkumar******
*Assist. Professor, ****Associate Professor, Dept of Forensic Medicine, Rohilkhand Medical College & Hospital, Bareilly, U.P. ** Professor & Head, Dept of Pharmacology, Rohilkhand Medical College & Hospital, Bareilly, U.P. *** Professor & Head, Dept of Forensic Medicine, M.L.N. Medical College, Allahabad, U.P.

Abstract

Forensic anthropology plays a vital role in not only identification such as racial identification, sex and age but also in identification of skeleton. Various ecological, geographical and ethnical factors as well as age and gender determine the dimensions of human body. Cephalometry was undertaken on 1600 healthy volunteers of either sex of age group 0-40 years. The dominant head form was dolichocephalic (47.62%) followed by mesocephalic (41.31%). Brachycephalic was rare in both sexes. Male dolichocephalics predominated. The correlation between age and sex in dolichocephalic, mesocephalic, and brachycephalic was highly significant (p value <0.01). There was a preponderance of hyperleptoprosopic (39.88%) followed by leptoprosopic (30.87%). Hyperleptoprosopic males dominated. Hypereuryprosopic (1.5%) was rare. The correlation between age and sex for euryprosopic, mesoprosopic and hyperleptoprosopic was highly significant. Majority exhibited transverse frontoparietal index 70–90. Lesser number of volunteers showed a low or high transverse frontoparietal index. 76.12% individuals exhibited nasal index 50–70. 25.87% females exhibited 60–70 nasal index with larger representation by children below 10 years, whereas males (27.31%) dominated 50–60 nasal index. The correlation between age and sex for nasal index 50–80 was found highly significant. The dominant transcraniofacial index was 80–100 represented by 71.69% individuals. The females more frequently represented 80–90 index and males still a higher index. The correlation between age and sex for all ranges of transcraniofacial index was found highly significant. Overall, lower zygomaticofrontal index 70–80 was more frequent in males whereas a higher index 90–100 was more common in females. The correlation between zygomaticofrontal index ranging 70–100 was found highly significant. 57.12% individuals represented 70–80 zygomaticomandibular index. The correlation between age and sex for zygomaticomandibular index ranging 60–100 was found highly significant.

Key words: Cephalometry, Craniofacial forms, Cephalic index, Prosopic index, Nasal index.

Correspondence
Dr. A.K. Kapoor, Prof. & Head, Dept. of Pharmacology, Rohilkhand Medical College, Bareilly, U.P.

P.C. Srivastava, A.K. Kapoor, U.S. Sinha, B.C. Shivkumar

Introduction

Evaluation and measurement of human body dimensions are achieved by physical anthropometry.1 The human body dimensions are affected by ecological, biological, geographical, racial, gender and age factor.2

Forensic anthropology though a neglected branch, yet plays a vital role in not only identification such as racial identification, sex and age but also in identification of skeleton including age, sex, height and race during disasters. Thus Forensic anthropology is of great asset in all disaster victims' identification operation. Although identification of a person is job of police yet medical evidences may play a vital role for identification of both living and dead. It sometimes constitutes the only evidence which establishes the identity of a person. Identification of a living person is necessary in criminal cases like absconding soldiers and criminals, persons accused of assault, murder or rape, interchange of newborn babies in hospitals, in cases of impersonation, etc. In civil cases identification may be required in cases like marriage, inheritance, passport, insurance claims, disputed sex, etc. The question of identity also arises in certain special situations like victim of accident and fires, in mass tragedies such as rail or plain crash, etc.

Biologically based racial typologies are of great value for facial reconstruction, where recognisability is a major aim. The skull is the best part of the skeleton to be used for identification of racial affinity, both morphologically and osteometrically.3 It can not be overemphasized that correct determination of age, sex and race are prerequisites to all aspects of craniofacial reconstruction, superimposition and identification.3 This emphasises the necessity of some methods and measurements of skull**.** Cephalometric methods can also be used as an indicator for population differences.4 Additionally, forensic anthropology can usefully contribute in disputed paternity since by using

anthropometric, anthroposcopy and dermatoglyphy along with serology the reliability becomes very high.5 Besides, anthropometric studies are integral part of craniofacial surgery and syndromology where standard ethnic or racial data are desirable.

In Forensic Anthropology, broadly speaking only three major groups of racial affiliation are encountered. Traits useful in assessment of racial affiliation include the overall morphology of the skull – its length, breadth and height; the shape of the face, the width of the zygomatic arches; the shape of the orbits, interorbital breadth, and the size, shape and degree of the guttering of the nasal aperture.6 Unfortunately there is a paucity of information in respect to measurements of different indices.

The present study has been undertaken to study certain craniofacial indices in different age groups of both sexes in healthy Indian population of Uttar Pradesh and the findings thus obtained will be evaluated for whether any correlation existed between different indices and age and sex of an individual or whether any diversity of cephalometry and facial shapes existed in healthy volunteers of different age groups of either sex or whether the findings will be useful for the identification.

Material and Methods

This cross sectional prospective study spanning for 2 years (July 2007 – June 2009) included locally available healthy volunteers mostly students residing in two different cities of U.P. The males and females were equally distributed and their age group ranged 0 – 40 years. In cases of children, parents had given consent to participate in the study. The exclusion criteria included mixed marriages to other population in two earlier generations, malocclusion, dental restoration and prosthetics. Subjects who have trauma of the nose, prior plastic or reconstruction surgery of face or cleft lips were also excluded in the study.

Following instruments were used for exact numerical evaluation of the features and traits namely anthropometer, small spreading calliper, large spreading calliper, small sliding calliper, and flexible tape.

Precautions which were taken while taking measurements included: (i). When sliding or spreading callipers were used pressure was avoided on points touching the skin. (ii). The measurements were taken in mm/centimetre. (iii). Most measurements were taken with subjects in standard erect position clearly described by Krogman.7
Various measurements were recorded according to the international agreements for the unification of craniometric and cephalometric measurements by Hrdlicka.8
The measurements taken were as follows:

1. Maximum cranial length or greatest anteroposterior diameter: This comprised of the maximum glabello-occipital diameter of the vault. Landmarks included:
Anteriorly: The most prominent point of the glabella.
Posteriorly: The most prominent point on the occipital bone.

2. Maximum cranial breadth or the greatest transverse diameter: This comprised of the greatest horizontal and transverse diameter which can be found on the vault by the spreading calliper. It included the maximum breadth of the skull above the supramastoid and zygomatic crests.

3. Lowest frontal breadth or minimal frontal diameter: This included the shortest horizontal diameter between the two temporal crests on the frontal bone.

4. Bizygomatic distance: The distance between two zygomatic arches. With callipers the greatest diameter was found out.

5. Nasal breadth: The maximum transverse breadth of the alae of the nose was measured without exertion of any pressure on the external surface of the alae of the nose.

6. Nasal length or Nasal height: Landmarks for the measurements were superiorly the nasion and inferiorly the middle of line connecting the lowest point on the centre of the skin.

7. Facial length: was measured with the landmarks superiorly nasion and inferiorly the lowest point on the centre of the chin.

8. Bigonial breadth: The gonials or the points of the angles formed by the ascending branches with the body of the lower jaw were measured.
A total of seven indices were calculated as follows. The indices were determined on the basis of international anatomical discription.9 Depending upon these indices the types of head and face were classified.

a. Length Breadth Index (Cephalic Index)
= Maximal Cranial Breadth X 100/
Maximal Cranial Length

b. Transverse Fronto-parietal Index
= Least Frontal Breadth X 100/Maximum Head Breadth

c. Nasal Index
= Nasal Breadth X 100/ Nasal Length

d. Facial Index
= facial Length X 100/ Bizygomatic Distance

e. Zygomatic Frontal Index
= Least Frontal Breadth X 100/ Bizygomatic Distance

f. Transverse Craniofacial Index
= Bizygomatic Breadth X 100/
Maximum Head Breadth

g. Zygomatico-mandibular Index
= Bigonal width X 100/ Bizygomatic Distance

Statistical Analysis**:** was done by using Chi-square test and calculating p value.

Results

Table-1 depicts age and sex wise distribution of cephalic index. Total sample was classified into dolichocephalic, mesocephalic and brachycephalic based on cephalic index ranging between ?70 – 74.9, 75 – 79.9 and 80 – 84.9 respectively. Of the three classified groups dolichocephalic constituted 47.62% of the sample size followed by mesocephalic 41.31% and brachycephalic constituted a miniscule of 11.07%. There were 762 dolichocephalic individuals of whom males were 469 and females 293 suggesting a predominance of male. However in <10 years age group females (n=58) predominated males (n=2). Amongst 661 mesocephalic, females were 349 (21.81%) and males 312 (19.5%) and in 10 – 40 years age group the number of mesocephalic females predominated over male mesocephalic. Similarly in brachycephalics there was a predominance of females (n = 158) over males (n = 19). Curiously no brachycephalic male was

Table 1: Age and Sex wise distribution of Cephalic Index

Age Yrs.	Dolichocephalic (< 70 - 74.9)		Mesocephalic (75 – 79.9)		Brachycephalic (80 – 84.9)	
	M n (%)	F n (%)	M n (%)	F n (%)	M n (%)	F n (%)
< 10	2 (0.12)	58 (3.62)	198 (12.38)	101 (6.31)	- -	41 (2.56)
10 - 20	179 (11.19)	70 (4.38)	21 (1.31)	79 (4.94)	- -	51 (3.19)
20 - 30	117 (7.31)	22 (1.37)	64 (4)	130 (8.12)	19 (1.19)	48 (3)
30 - 40	171 (10.69)	143 (8.94)	29 (1.81)	39 (2.44)	- -	18 (1.13)
Total	469 (29.31)	293 (18.31)	312 (19.5)	349 (21.81)	19 (1.19)	158 (9.88)
Chi-square value	705.75		87.23		34.98	
p-value	<0.01		<0.01		<0.01	

noted in <10 – 20 years and 30 – 40 years age group. P value <0.01 signifies correlation between age and sex in dolichocephalic, mesocephalic and brachycephalic as highly significant.

Table-2 depicts age and sex wise distribution of facial index (Prosopic Index). Based on this index individuals were classified into five categories namely hypereuryprosopic (<75-79.9), euryprosopic (80 – 84.9), mesoprosopic (85 – 89.9), leptoprosopic (90 – 94.9) and hyperleptoprosopic (>95). Interestingly only 24 females within the age of 20 years were categorised as hypereuryprosopic whereas 84 females below the age of 10 years were categorised as euryprosopic. The dominant facial form was hyperleptoprosopic type followed by leptoprosopic, and the rare facial form was hypereuryprosopic. In hyperleptoprosopic there was a predominance of males (n = 368) over females (n = 270). Interestingly in the age group less than 10 years none of the females was classified as hyperleptoprosopic whereas 164 males were hyperleptoprosopic under the age of 10 years. There were 494 leptoprosopic individuals who were almost evenly representing male and female. Out of 303 mesoprosopic, 190 were females. There was no male mesoprosopic less than 10 years of age. The correlation between age and sex for euryprosopic, mesoprosopic and hyperleptoprosopic was found to be highly significant (p value <0.01) whereas correlation between age and sex for leptoprosopic was found to be significant (p value <0.05) and that for hypereuryprosopic was found not significant (p value >0.1).

Table 2: Age and Sex wise distribution of Facial Index (Prosopic Index)

Age Yrs.	Hypereury prosopic <75 – 79.9		Eury prosopic 80 – 84.9		Meso prosopic 85 – 89.9		Lepto prosopic 90 - 94.9		Hyperlepto-prosopic >95	
	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)
< 10	-	16(1)	-	84(5.25)	-	63(3.94)	36(2.25)	37(2.31)	164(10.25)	-
10 – 20	-	8(0.5)	-	-	77(4.81)	9(0.56)	81(5.06)	48(3)	42(2.63)	135(8.44)
20 – 30	-	-	30(1.87)	-	18(1.12)	77(4.81)	40(2.5)	29(1.81)	112(7)	94(5.88)
30 - 40	-	-	27(1.69)	-	18(1.12)	41(2.56)	105(6.56)	118(7.38)	50(3.13)	41(2.56)
Total	-	24(1.5)	57(3.56)	84(5.25)	113(7.06)	190(11.88)	262(16.37)	232(14.5)	368(23)	270(16.88)
Chi-square value	0.38		107.07		152.69		9.18		206.04	
p-value	>0.1		<0.01		<0.01		<0.05		<0.01	

Table-3 depicts age and sex wise distribution of transverse frontoparietal index. Majority of volunteers 1270 (79.38%) exhibited a transverse frontoparietal index ranging 70 - 90. A total of 36 (2.25%) individuals exhibited an index of 50 – 60 and 33 (2.06%) individuals showed an index of 90 – 100. Interestingly none of the females exhibited a transverse frontoparietal index ranging 50 - 60 and none of the males exhibited a transverse frontoparietal index ranging 90 – 100. Regarding correlation between age and sex for transverse frontoparietal index ranging from 70 - 80 and 80 – 90 was found to be highly significant (p<0.01), whereas correlation between age and sex for transverse frontoparietal index 60 - 70 was found significant (p<0.05) and that between 50 – 60 and 90 – 100 was not found significant statistically (p>0.1).

Table-4 represents age and sex wise distribution of nasal index. Interestingly only 20 individuals showed nasal index ranging 40 – 50 and they were all females in the age group of 30 – 40 years. A majority of 1218 (76.12%) individuals exhibited nasal index ranging 50 – 70. Females (n = 414) dominated 60 – 70 index with more incidence in children below 10 years and in young adult females aged 20 – 30 years, whereas males (n = 437) dominated 50 – 60 index value. Interestingly nasal index ranging 80 – 100 was represented only by the females under the age group of 20 years. The correlation between age and sex for nasal index ranging 50 – 60, 60 – 70 and 70 – 80 was found to be highly significant (p value <0.01) whereas correlation between age and sex for nasal index ranging 40 – 50, 80 – 90 and 90 -100 was not found significant (p value >0.1).

Table-5 shows age and sex wise distribution of transcraniofacial index. There was a predominance of females (n= 116) in respect to transcranoifacial index ranging 70 – 80 and this was more obvious in children <10 years of age and in the age group of 20 – 30 years. A majority of 1147 (71.69%) individuals represented transverse craniofacial index ranging 80 – 90 and 90 – 100. For transcraniofacial index 80 -90, out of 698 volunteers there were 468 females. Interestingly in the age group 30 – 40 years none of the males exhibited a transcraniofacial index ranging 80 – 90. Regarding transcraniofacial index 100 – 110 out of 281 individuals there were 260 males suggesting male preponderance. Interestingly none of the females in the age group >10 - 30 exhibited a transcraniofacial index ranging 100 – 110. Regarding correlation between age and sex for all categories of transcraniofacial index i.e. 70 - 80, 80 – 90, 90 – 100 and 100 – 110 was found highly significant (p value <0.01).

Table - 6 depicts age and sex wise distribution of zygomaticofrontal index. A total of 482 individuals represented 70 – 80 zygomaticofrontal index whereas 704 individuals represented zygomaticofrontal index ranging 80 – 90. Only 32 individuals that too females showed zygomaticofrontal index ranging 100 – 110. None of the children below the age of 10 years and individuals in 30 – 40 years of age group showed a high 100 – 110 zygomaticofrontal index. The correlation between age and sex for zygomaticofrontal index ranging 70 – 80, 80 – 90 and 90 – 100 was found to be highly significant (p value<0.01) whereas the correlation between age and sex for zygomaticofrontal index 100 – 110 was not found significant (p value >0.1).

Table 3: Age and Sex wise distribution of Transverse Frontoparietal Index

Age Yrs.	Hypereury prosopic 50-60		Eury prosopic 60-70		Meso prosopic 70-80		Lepto prosopic 80-90		Hyperlepto-prosopic 90-100	
	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)
< 10	36(2.25)	-	164(10.25)	77(4.81)	-	123(7.69)	-	-	-	-
10 –20	-	-	20(1.25)	-	180(11.25)	75(4.69)	-	112(7)	-	13(0.81)
20 –30	-	-	-	-	68(4.25)	62(3.87)	132(8.25)	138(8.63)	-	-
30 –40	-	-	-	-	58(3.62)	159(9.94)	142(8.88)	21(1.31)	-	20(1.25)
Total	36(2.25)	-	184(11.5)	77(4.81)	306(19.12)	419(26.19)	274(17.13)	271(16.94)	-	33(2.06)
Chi-square Value	0.0		9.06		200.76		201.94		0.0	
p- value	>0.1		<0.05		<0.01		<0.01		>0.1	

Table 4: Age and Sex wise distribution of Nasal Index

Age Yrs.	Hypereury prosopic 40-50		Eury prosopic 50-60		Meso prosopic 60-70		Lepto prosopic 70-80		Hyperlepto-prosopic 80-90		Lepto prosopic 90-100	
	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)	M n(%)	F n(%)
< 10	-	-	157 (9.81)	39 (2.44)	43 (2.69)	122 (7.62)	-	20 (1.25)	-	-	-	19 (1.19)
10 - 20	-	-	122 (7.63)	-	78 (4.87)	87 (5.44)	-	104 (6.5)	-	9 (0.56)	-	-
20 - 30	-	-	48 (3)	46 (2.87)	71 (4.44)	124 (7.75)	81 (5.06)	30 (1.88)	-	-	-	-
30 - 40	-	20 (1.25)	110 (6.87)	58 (3.63)	32 (2)	81 (5.06)	58 (3.63)	41 (2.56)	-	-	-	-
Total	-	20 (1.25)	437 (27.31)	143 (8.94)	224 (14)	414 (25.87)	139 (8.69)	195 (12.19)	-	9 (0.56)	-	19 (1.19)
Chi-square Value	0.0		84.31		19.06		145.04		0.0		0.0	
p-value	>0.1		<0.01		<0.01		<0.01		>0.1		>0.1	

Table 5: Age and Sex wise distribution of Transcraniofacial Index

Age Yrs.	70 - 80		80 – 90		90 - 100		100 - 110	
	M n (%)	F n (%)	M n (%)	F n (%)	M n (%)	F n (%)	M n (%)	F n (%)
< 10	38 (2.38)	80 (5)	162 (10.12)	120 (7.5)	-	-	-	-
10–20	18 (1.12)	8 (0.5)	22 (1.38)	130 (8.12)	100 (6.25)	62 (3.88)	60 (3.75)	-
20–30	-	28 (1.75)	46 (2.88)	120 (7.5)	92 (5.75)	52 (3.25)	62 (3.87)	-
30–40	-	-	-	98 (6.13)	62 (3.87)	81 (5.06)	138 (8.63)	21 (1.31)
Total	56 (3.5)	116 (7.25)	230 (14.38)	468 (29.25)	254 (15.87)	195 (12.19)	260 (16.25)	21 (1.31)
Chi-square value	29.43		150.29		15.06		17.4	
p-value	<0.01		<0.01		<0.01		<0.01	

Table 6: Age and Sex wise distribution of Zygomaticofrontal Index

Age Yrs.	70 - 80		80 – 90		90 - 100		100 - 110	
	M n (%)	F n (%)	M n (%)	F n (%)	M n (%)	F n (%)	M n (%)	F n (%)
< 10	124 (7.75)	84 (5.25)	76 (4.75)	58 (3.62)	-	58 (3.62)	-	-
10–20	158 (9.87)	-	42 (2.63)	56 (3.5)	-	122 (7.63)	-	22 (1.38)
20–30	62 (3.88)	-	82 (5.13)	44 (2.75)	56 (3.5)	146 (9.13)	-	10 (0.62)
30–40	34 (2.12)	20 (1.25)	166 (10.37)	180 (11.25)	-	-	-	-
Total	378 (23.62)	104 (6.5)	366 (22.88)	338 (21.12)	56 (3.5)	326 (20.38)	-	32 (2)
Chi-square value	111.65		15.35		58.47		0	
p-value	<0.01		<0.01		<0.01		>0.1	

Table - 7 represents age and sex wise distribution of zygomaticomandibular index. A total of 250 individuals represented zygomaticomandibular index ranging 60 – 70 and males outnumbered females. A total of 914 individuals represented zygomaticomandibular index ranging 70 – 80 and the sex distribution was almost evenly poised. The high zygomaticomandibular index ranging 90 – 100 was represented by only 49 individuals and females outnumbered males. The correlation between age and sex for zygomaticomandibular index ranging 60 – 70, 70 – 80, 80 – 90 and 90 – 100 was found highly significant (p value <0.01).

Table 7: Age and Sex wise distribution of Zygomatiomandibular Index

Age Yrs.	**60 – 70**		**70 – 80**		**80 - 90**		**90 - 100**	
	M n(%)	**F n(%)**	**M n(%)**	**F n(%)**	**M n(%)**	**F n(%)**	**M n(%)**	**F n(%)**
< 10	43 (2.69)	63 (3.94)	157 (9.81)	99 (6.19)	-	38 (2.37)	-	-
10–20	144 (9)	-	56 (3.5)	78 (4.88)	-	100 (6.25)	-	22 (1.37)
20–30	-	-	52 (3.25)	158 (9.87)	131 (8.19)	32 (2)	17 (1.06)	10 (0.63)
30 – 40	-	-	156 (9.75)	158 (9.87)	44 (2.75)	42 (2.63)	-	-
Total	187 (11.69)	63 (3.94)	421 (26.31)	493 (30.81)	175 (10.94)	212 (13.25)	17 (1.06)	32 (2)
Chi-square value	114.43		64.98		196.42		21.19	
p-value	<0.01		<0.01		<0.01		<0.01	

Discussion

Physical anthropometry deals with measurement of human body dimensions. Various ecological, geographic and ethnical factors as well as age and gender determine the dimensions of human body.10 Cephalometry is an important branch of anthropometry.11 Measurement of human body or cephalometry is used in identification, forensic medicine, plastic surgery, orthodontics and to examine difference between races.12 The identification of unknown individual is one of the most important justifications for maintaining biological based racial typologies.13 Diagnosing race, sex or age incorrectly makes identification absolutely impossible.13 This calls for the need for an experienced forensic anthropologist because adult modern human population shows significant differences in both facial size and shape.

The skull is the bony structure of skeleton which includes the cranium, skeleton of the face and the mandible or lower jaw. Skull bones vary in the thickness, size and shape in relation to each other and between different individuals.14 Anatomically human beings exhibit considerable geographic variations in reference for facial skeleton and that adult modern human population shows significant differences in both facial size and shape.15 This in turn reflects on various indices. Further under the influence of localised factors different bones and/or different parts of the same bone may grow independently to some degree.15 Diets and environmental conditions under which the group lived may have also been responsible for the observed similarities or differences in their skull.14 Still there are certain universal traits of the skull that influence appearance regardless of geographical or racial differences.3

Craniofacial anthropometry data can be utilised for comparing healthy and diseased population, children and adults or members of different races as well as for sex differentiation. The rate of craniofacial growth was demonstrated to be uneven i.e., the periods of accelerated growth of these structures and the periods of retarded growth alternate16 and that is particularly pronounced in certain period during life. Workers in the field demonstrated that the major and fastest changes took place after birth and during puberty. The growth and development of craniofacial structure is influenced by internal (genetic) and external factors (climate, air pollution, economic condition and time) and long term evolutionary changes. Since numerous factors affect the growth and development of craniofacial structures, we may assume the existence of differences in head and face morphology between members of different races, males and females and individuals of different age groups.

Dimensions of newborn's body can be the basis for all changes in anthropometric indices. Moreover, these also govern the newborn's health evaluation.17 During growth the facial skeleton changes dramatically in shape as well as in size both local and systemic factors can influence the growth and development of facial skeleton.
Cephalic index is a very important parameter in craniotyping. The heterogeneity of cephalic index in different races is probably governed by inheritance. Environment is undoubtedly an effective determinant as well. Yet, it can be concluded that it is actually the genotype of the population which dictates its response to environmental stimuli.10,11,18 Moreover, in addition to inheritance, geographical factors play a certain role.10,11,18

In the present study cephalometry was undertaken on same race population residing in same geographical region and 1600 healthy volunteers of either sex to determine head and face phenotype in different age group (0 – 40 years). The study depicted a preponderance of dolichocephalic head form (47.62%) followed by mesocephalic head form (41.31%) based on cephalic index in both sexes. The brachycephalic head forms were less common (11.07%) and were predominantly represented by females (9.88%). There was no hyperbrachycephalic head form in either sex. Similarly based on facial index (prosopic index) there was a preponderance of hyperleptoprosopic (39.88%) followed by leptoprosopic (30.87%) facial form. The rare face type was hypereuryprosopic type (1.5%) and that too was represented by females under the age of 20 years. In hyperleptoprosopic males dominated. In the age group less than 10 years, 164 male children were hyperleptoprosopic whereas none of the female child was hyperleptoprosopic. Males and females were almost equally distributed in leptoprosopic. In mesoprosopic females outnumbered males. The bizarre presentation of cephalic index in the same race population is probably due to changes of anthropometric indices with age and sex. This is an expected observation since the study subjects included newborns as well as growing young children of both sexes who were encountering different environment and dietary patterns.

Okanlwan et al19 reported that dolichocephaly is common in black race. Contrary to our observation Bharti et al18 reported the dominant head form brachycephalic in a study on Indo-Aryan inheritance in the temperate part of the India whereas Nakashima20 reported the dominance of hyperbrachycephalic in a school of girls in North Kyushu. Farkas et al16 and Hajnis et al21 calculated the cephalic index for young person of both sexes for all three races i.e. the caucaceans, negroid and mongolese races. Their result showed that North American Whites have a mesocephalic head type; African Americans have dolichocephalic type while hyperbrachycephalic type predominated among Chinese. Grbesa et al22 reported Syrians to have a brachycephalic head form.

Cakirer et al23 observed that leptoprosopic facial types were more often associated with dolichocephalic head forms and euryprosopic facial forms were more often associated with brachycephalic head forms. In contrast, our findings suggested hyperleptoprosopic facial types were more often associated with dolichocephalic head forms, and leptoprosopic facial type with mesocephalic head forms.

Apostolu et al24 while studying 616 school children (352 boys and 264 girls) from three cities of Epir region (Western Greece) in the age group of 11 – 18 years old observed that overall mesocephalic head form was present in higher frequencies in comparison with all other categories according to sex and age. Further in 11- 12 years of boys group mesocephalic (46.27%) and dolichocephalic (37.31%) were more frequent. The morphological head index in this group was characterised as euryprosopic and nasal index leptorhinic (49.25%) and mesorhinic (46.27%). Girls (12 - 15) were more frequently leptoprosopic (35.98%) and mesorhinic (97.88%). The boys (13 – 16 years) were mesoprosopic (32.64%) and leptorhinic (46.03%).
Heidari et al12 observed that in Sistani and Baluchi subjects, who were the residents of Iran, mean and standard deviation of cephalic index were 78.4 ± 4.15 and 81.94 ± 4.99, and prosopic indices were 83.22 ± 4.02 and 84.86 ± 5.15 respectively. Based on the cephalic index, the dominant and rare head type in Sistani group was mesocephalic (41.3%) and hyperbrachycephalic (6%) and in Baluchi group was brachycephalic (42%) and dolichocephalic (5.5%) respectively. Furthermore, according to the prosopic index the dominant and rare face type among Sistani were euryprosopic type (50.8%) and hyperleptoprosopic (0.5%) and in Baluchi group were euryprosopic (37%) and hyperleptoprosopic (2.5%) respectively. The authors observed that differences in terms of head and face type indices between these two groups were statistically significant.

Regarding sex wise distribution of cephalic index, present study observed a predominance of males in dolichocephalic and predominance of females in brachycephalic whereas in mesocephalic head forms both males and females were almost equally distributed. No such comparable data for Indian population were available in literature to comment. It can be stated in reference to cephalic index that majority of female children (n = 58) below 10 years represented dolichocephalic head form as compared to male children (n = 2). Further, female children below 10 years (n = 41) solely represented brachycephalic head form whereas none of the male child represented brachycephalic head form. This was despite the fact that the study subjects were of similar age and similar geographical and climatic situation. This clearly suggested a definite sex correlation in cranial index of children.

In young adults (10 – 20 years) there was a predominance of dolichocephalic head forms in males as compared to females whereas only females represented brachycephalic head forms. Similarly in 30 – 40 years age group brachycephalic head form was present only in females. Comparable studies in respect to sex wise distribution in similar race could not be found.

Heidari et al12 observed that newborns of Sistani (Fars) and Baluchi were perfectly alike in their craniofacial morphology. Heidari et al11 observed that in male newborns the two native dominant head forms were hyperbrachycephalic and brachycephalic both 37% in Sitani subject versus 37.3% and 35.3% in Baluch; In contrast firstly, we have not observed any hyperbrachycephalic head form and secondly there was a sex wise difference in cephalic index of newborns and children. Mesocephalic type with 38.2% was dominant and hyperbrachycephalic type with 7.40% was rare in Turkman's male newborns. Dominant and rare types of cephalic index in Fars were mesocephalic (36.5%) and hyperbrachycephalic (8.9%) respectively.10 There was no significant difference between dominant and rare type in two racial groups.

In the present study all the five groups of facial indices were represented in the different age groups amongst both sexes. The dominant facial form was hyperleptoprosopic followed by leptoprosopic and the rare facial form was hypereuryprosopic. It was observed that only female children and young adults (below 20 years of age) represented hypereuryprosopic index and there was no male. Moreover, below 10 years of age only female children showed euryprosopic and mesoprosopic facial index. Thus it can be concluded that under 10 years of age only female child showed hypereuryprosopic, euryprosopic and mesoprosopic facial index and that none of the male child represented these indices. It was interesting to note that below 10 years male child represented hyperleptoprosopic facial form and none of the female child showed hyperleptoprosopic facial form. During growth female adults represented leptoprosopic and hyperleptoprosopic form in 20 – 30 years and 30 – 40 years age group and none of the females represented hypereuryprosopic or euryprosopic facial forms in these age groups. Hypereuryprosopic type (34.60%) and hyperleptoprosopic type (0.90%) were dominant and rare types in Turkman's male newborns. The dominant and rare type of faces in Fars male new-borns were hypereuryprosopic (71.9%) and hyperleptoprosopic (2.5%) respectively.10

In the present study, majority of volunteers exhibited a transverse frontoparietal index ranging 70 – 90 and that both a low transverse frontoparietal index (50 - 60) or a high transverse frontoparietal index (90 - 100) was observed in lesser number of individuals. Our findings were partially corroborated by Sharma25 who reported in Punjabi families dominating nature of mesometopic type (70.4 – 74.9). It was further observed that in 36 male newborns, infants and children below 10 years transverse frontoparietal index ranged 50 – 60 and none of the female child below 10 years of age figured in this category. Besides, none of the male or female child represented a higher index ranging 80 – 90 and 90 – 100. Similarly none of the male or female child in the age group of 20 – 30 and 30 – 40 years exhibited a lower range (50 – 60 and 60 – 70) transverse frontoparietal index. Majority of the individuals both males and females in the age group of 20 – 30 and 30 – 40 years showed transverse frontoparietal index in the range of 70 – 80 and 80 – 90. In 30 – 40 year females predominantly exhibited index of 70 – 80. On the other hand males of this age group predominantly exhibited a higher index of 80 – 90. A higher index 90 – 100 was represented only by a miniscule of study subjects (2.06%). Such age and sex wise correlation of transverse frontoparietal index owing to limited comparable data needs further investigations.

Nasal index is one of the important anthropometric parameter for distinguishing racial and ethnic differences26,27 as well as sex of an individual.28 Variables that determine the shape of the nose include race, tribe and environmental climatic condition.29 On the basis of nasal height, breadth and nasal index three categories of nose are more commonly observed.26 (i). Platyrhine: having broad nose with nasal index of 85 and above represented by Bantus and Bushmen of Africa and major ethnic groups in southern Nigeria as well as indigenous Australians.30,31,32 (ii). Mesorhine: having medium nose with nasal index of 70 – 84.9 and (iii). Leptorhine: having long and narrow nose with a nasal index of 69.9 or less. Most Western Europeans are leptorhine. German’s nasal index is similar to that of General Western Europeans.33

In the present study the nasal index in the range 50 – 60, 60 – 70, and 70 – 80 was exhibited by 580, 638 and 334 subjects respectively. A lower (40 - 50) and a higher (80 - 100) nasal index was represented by a fairly lesser number of individuals. It was observed that majority of the North Indian populace represented a nasal index below 70 (n = 1238) hence they are leptorhine. Baruch et al34 observed while studying Tai-Phake males of Assam between 21 – 50 years that mesorhine nasal index was present in 50% of the subjects and leptorhine were 17.54% thus contrasting our observations. This was due to fact that Assam is a North East State of India.

Regarding sex differences it was observed that nasal index ranging 50 – 60 was more prevalent in males (n = 437) as compared to females whereas nasal index ranging 60 – 70 was more prevalent in females in the leptorhine category. Our observation in respect to sexual dimorphism contrasted those of Oladipo et al30 who reported that in platyrhine males having significantly higher nasal index than the females. A nasal index of 70 – 80 conforming to mesorhine was represented by 334 individuals and in this category females have predominance over males.

In the present study the dominant transcraniofacial index of 80 – 90 and 90 – 100 was represented by a majority of 698 and 449 individuals respectively. The females more frequently represented 80 – 90 index whereas the males more frequently represented 90 – 100 and 100 – 110 index. This correlation between males and females was found interesting and comparable data are lacking to have a fair comment.

Overall a lower zygomaticofrontal index (70 - 80) was more frequently represented by males whereas a higher index (90 – 100) was mostly represented by females. A still higher index of 100 – 110 though rare was solely represented by females (2%).

Regarding age and sex wise distribution of zygomaticomandibular index it was observed that majority of the individuals (n = 914) represented an index of 70 – 80. 387 individuals exhibited 80 – 90 index. A still higher index of 90 – 100 was exhibited only by 49 individuals. None of the males and females in the age group of 20 – 30 and 30 – 40 showed a lower index of 60 – 70. Similarly none of the child below 10 years showed a higher index of 90 – 100. The zygomaticomandibular index in the boys of 11 -12 years age group was determined with rubrications as short and very short and the adolescent boys and girls can be distinguished only by the different values of the zygomaticomandibular index.24

Concusion

In view of the small sample size in the present study in relation to population of India, we suggest more samples in future study for the measurement of craniometry indices so as to have major clinical implications and relevance for database; and to clinch a definite correlation between different indices and age and sex wise distribution pattern.

References

1. Chamella M. Biological Anthropology. Translated to Persian (Farsi) by Nadri A.First Edn. Gostar Publisher. Tehran. 1997; pp 75.
2. Mibodi IMA and Farhani MR. Study of normal range of anatomical dimension of one day old newborn by cephalometry. J Medical Council Islamic Republic Iran. 1996; 14(1): 1-8.
3. Vladimir N, Iscan MY, Loth SR. Morphologic and osteometric assessment of age, sex and race from the skull. In: Iscan MY, Helmer RP, editor. Forensic analysis of the skull. New York: Wiley-Liss Inc; 1993; 71-88.
4. Sanna E, G Palmas, N Tedeco, G Floris. The need of specific standards for head dimensions of urban Sardinian boys. Anthrop Anz J 2003; 61: 245-51.
5. Jacob T, Indriati E. Buku bacaan antropologi biologis. Yogyakarta: Dirjen Dikti Departemen Pendidikan Nasional; 1999/2000. h. 3-159.
6. Briggs CA. Anthropological assessment. In: Clement JG, Ranson DL (ed). Craniofacial identification in forensic medicine. Great Britain: Arnold; 1998; pp 49-61.
7. Krogman M. A handbook of the measurement and interpretation of height and weight in The Growing Child. Monographs of the society for research in child development. Evanston Ellinois, 1950; 3: 68.
8. Hrdlicka, A. Practical Anthropometry. 3d ed. Philadelphia: Wistar Institute, 1947; pp 191 - 201.
9. Williams P, Bannister LH, Berry MM, Collins P, Dyson M, Dussak JE and Ferguson MWJ. Gray’s Anatomy. In: Skeletal System. 38th Edn; 1995; Churchill Livingston, Landon, pp 607-12.

10. Golalipour MJ, Haidari K, Jahanshahi M and Farahani RM. The shape of head and face in normal male newborns in South-East of Capsian sea (Iran-Gorgan). J Anat Soc India, 2003; 52: 28-31.

11. Heidari Z, HR Mohamoudzadeh Sagheb, M Mohammadi, MH Noori Mugahi and A. Arab. Cephalic and prosopic indices: Comparison in one day newborn boys in Zahedan. J Fac Med 2004; 62: 156-65.

12. Heidari Z, Sagheb HRM and Mugahi MHN. Morphological evaluation of head and face in 18-25 years old women in Southeast of Iran. J Med Sci 2006; 6(3): 400-04.

13. Novita M. Facial, upper facial, and orbital index in Batak, Klaten, and Flores students of Jember University. Dental J 2006; 39(3): 116-19.

14. El-Najjar MY, McWilliams KR. Forensic Anthropology. Illinois USA: Charles C Thomas Publ; 1978. pp 15-143.

15. Vidarsdotir US, O'Higgins P, Stinger C. A geometric morphometric study of regional differences in the ontogeny of the modern human facial skeleton. J Anat 2002; 201(3): 211.

16. Farkas LG, Ngim RCK, Lee ST. Ann. Acd. Med. Singapore, 1988; 17: 319.

17. Golalipour MJ, Vakili MA and Ahmadpour M. The relation of weight and height with race, parity, age and kind of delivery of mother. J Quzvin University 2000; 16: 58-64.

18. Bharati S, S Som, P Bharati, TS Vasula. Climate and head form in India. Am. J Human Biol 2001; 13: 626-34.

19. Okanlwon AO, AB Ejiwanmi, MO Rosanwo and OO Ojo. Standard of craniofacial dimension for an African population. Eas Afr Med J 1990; 67: 254-59.

20. Nakashima T. Brachycephalization in the head form of school girls in North Kyushu. J Uoeh 1986; 8: 411-14.

21. Hajnis K, Farkas LG, Ngim RCK, Lee ST, Venkatadri G. Racial and ethnic morphometric differences in the craniofacial complex. In: Farkas LG (Ed), Anthropometry of the head and face. Raven Press, New York, 1994.

22. Grbesa D, Panijan RP, Kalaya MN, Gorsic I, Cavcic A, Zura N and Berberovic B. Craniofacial characteristics of Croatian and Syrian populations. Coll Anthropol 2007; 31(4): 1121-25.

23. Cakirer B, Hans MG, Graham G, Aylor J, Tishler PV, Redline S. The relationship between craniofacial morphology and obstructive sleep apnoea in whites and in African-Americans. Am J Respir Crit Care Med 2001; 163(4): 947-50.

24. Apostolu MP and V Angelova. Cephalometric characteristics of children from Epirus (Greece). Proceedings of the Balkan Scientific Conference of Biology in Plovdiv (Bulgaria) from 19th till 21st of May 2005. (Eds B. Gruev, M. Nikolova and A. Donev), 2005; 203-14.

25. Sharma PD. Family studies on transverse fronto-parietal index. Genetica. 1968; 39: 508-18.

26. Porter JP, Olson KL. Analysis of the African American female nose. Plast Reconstr Surg 2003; 111(2): 620-28.

27. Aung SC, Foo CL, Lee ST. Three dimensional laser scan assessment of the Oriental nose with a new classification of Oriental nasal type. Br J Plast Surg 2000; 53(2): 109-16.

28. Zhang XT, Wang SK, Zhang W and Wang XF. Measurement and study of the nose and face and their correlation in the young adult of Han nationality. Plast Reconstr Surg. 1990; 85(4): 532-36.

29. Last RJ. Anatomy Applied and Regional. 6th Edn. 1981; Churchill Livingstone. pp. 398-403.

30. Olapido GS, Olabiyi AO, Oremosu AA and Noronha CC. Nasal indices among major ethnic groups in southern Nigeria. Scientific Research and Essay. 2007; 2(1): 20-22.

31. Romo T and Abraham MT. The ethnic nose. Facial Plast Surg. 2003; 19(3): 269-78.

32. Risley HH (1915). The people of India. 2nd Edition. 1969; Edited by Crooke W; pp 395-99.

33. Apka AOC, Ugwu C, Maliki SO. Morphometric study of the nasal parameters in Nigerian I Agbos J Exp Clin Anat 2003; 2(2): 24-25.

34. Baruah T, Mondal S, Gharami AK and Adak DK. The Tai-Phake of Assam, India – A morphometric study and population comparison with neighbouring groups. Coll Antropol 2006; 30(3): 579-83.