The Professional Medical Journal
www.theprofesional.com
DOI: 10.17957/TPMJ/15.2792

ORIGINAL PROF-2792

A CEPHALOMETRIC STUDY IN SOUTHERN PUNJAB

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Article received on:
28/01/2015
Accepted for publication:
06/07/2015
Received after proof reading:
09/09/2015

ABSTRACT… Background: Morphological characteristics of various races and population groups usually appear in geographical knots and clusters. Standardized cephalometricrecords are immensely valuable for clinical and forensic purposes.In spite of its clinical significance no data is available about the cephalic indices and prevalence of cephalic phenotypes in Southern Punjab. **Objectives:** This study was undertaken to record baseline cephalometric data, cephalic indices and craniotypes. **Study design:** A cross-sectional population study. **Place and duration of study:** The study was carried out at the Multan Medical and Dental College, Multan and took about fourteen months to complete. **Material and methods:** The study was conducted on 672 adult individuals (430 males and 242 females) from in and around the city of Multan in Southern Punjab. Linear measurements of the head including maximum cranial length (glabella-inion length), maximum cranial breadth (maximum bi-parietal diameter) and maximum auricular head height were recorded using a digital spreading caliper. Results of measurements were expressed as mean ± SD. Comparison of the mean values and various proportions between sexes was performed. The horizontal, vertical and transverse cranial indices were calculated using these measurements. Craniotyping was based on the ranges in various cephalic indices. **Results:** Differences regarding the mean of cranial length, cranial breadth and height were significantly larger in males as compared to females ($P<0.001$). The mean vertical, horizontal and transverse cephalic indices in the males and females were 79.13 ± 5.56, 78.31 ± 5.19, 103 ± 7.78 and 78.32 ± 6.40, 78.32 ± 4.67, 100 ± 8.67 respectively.Most of the samples depicted craniotypes as mesocephalic and dolichocephalic both in the males and the females. **Conclusion:** The study provides baseline cephalometric data from a population of Southern Punjab that may have its potential in clinical application and future research.

Key words: Cephalometry, cephalic index, craniotypes, cranial measurements.

Article Citation: Khan MA, Chaudhry MN, Altaf FMN. A cephalometric study in southern Punjab. Professional Med J 2015;22(9):1203-1207. **DOI:** 10.17957/TPMJ/15.2792

INTRODUCTION

Morphological features of different races and ethnic groups are not randomly distributed but appear in geographic clusters.[1]Methods currently availed for metric evaluation of the craniofacial form includes anthropometry, cephalometry, ultrasound, computed tomographic, scanning magnetic imaging and optical surface scanning. Arguably, cephalometry remains the most useful technique in the investigation of the craniofacial morphology because of its validity and practicality.[2]On the basis of cephalic index (CI) head shapes can be grouped into four categories: dolichocephalic, brachycephalic, mesocephalic and hyperbrachycephalic.[3,4]

Standardized cephalometric records are helpful in making a comparison between patients and the normal population[5]and are useful in pediatrics, forensic medicine and plastic and orodental surgery.[6] Since geographic, racial and dietary differences exist amongst different population groups information about morphometric characteristics becomes important for purposes of comparison. Such knowledge is also very useful in studies pertaining to primate phylogeny. Age and population specific data on cranial morphometry are not only useful in clinical practice as indicators of growth and development but also in determining changes in size and shape or abnormalities of the crania.[7]

Notwithstanding the forensic importance and clinical significance of morphometric data and

whereas several studies are available from different countries the cephalic indices and prevalence of cephalic phenotypes in Southern Punjab has not been studied. This study was therefore undertaken to record baseline cephalometric data, cephalic indices and craniotypes for clinical use and future reference.

MATERIAL AND METHODS

It was a cross-sectional study conducted on 672 adult individuals (430 males and 242 females) that volunteered from in and around the city of Multan in Southern Punjab. Consent of the participants and approval from the ethical committee were obtained. Healthy subjects who had no apparent craniofacial deformity and belonging to different socio-economic strata were selected. The age of the subjects ranged between 20 and 56 years. Following linear measurements were recorded:

1: *Maximum Cranial Length (MCR):* It is the straight distance between the glabella (a prominent point at the root of the nose and the inion (a prominent point on the occipital bone), both in the median sagittal plane. One tip of the calipers was placed at the glabella and then the other tip of the calipers was allowed to slip posteriorly onto the occipital bone in the median sagittal plane to reach the maximum posteriorexpanse of the skull.

2: *Maximum Cranial Breadth (MCB):* It is the maximum biparietal distance. The calipers tips were slid downwards along the lateral sides of the parietal bones to achieve the maximum width.

These measurements were taken using a digital calipers (Mitutoyo, Japan) to the nearest 0.01 mm.

3: *Maximum Auricular head Height (MAH):* It is the distance between bregma (the highest point of the vortex) and the external acoustic meatus. Todd's head spanner was used to record measurements on both sides.

Measurements were taken three times and their mean was recorded as the final observation. The Statistical Package for Social Sciences (SPSS), 15th version was used to analyze the data and the results were expressed as mean ± SD. The mean values were compared for males and females for different measurements using the 't' test and the 'z' test. P value < 0.05 was considered statistically significant.

The following cranial indices were calculated using the above measurements[8]:

A: *Horizontal cephalic index (HCI)* = Maximum cranial breadth/ Maximum cranial length x 100%.

B: *Vertical cephalic index (VCI)* = Maximum auricular head height/ Maximum cranial length x 100%.

C: *Transverse cephalic index (TCI)* = Maximum auricular head height/ Maximum cranial breadth x 100%.

Craniotyping was based on the ranges in horizontal,vertical and transverse cephalic indices as follows:[8,9]

- According to the horizontal cephalic index (HCI) headshapes were classified as
  - Dolichocephalic (71.0 < HCI >75.9),
  - Mesocephalic (76.0 < HCI > 80.9),
  - Brachycephalic(81.0 < HCI > 85.90) and
  - Hyperbrachycephalic (86.0 < HCI);
- According to the vertical cephalic index (VCI) head shapes were classified as
  - Chamaecephalic (57.9 > VCI),
  - Orthocephalic(58.0 < VCI > 62.9) and
  - Hypsicephalic (63 < VCI);
- According to the transverse cephalic index (TCI) head shapeswere classified as
  - Tapeiocephalic (78.9 > TCI),
  - Metriocephalic79.0 < TCI > 84.9) and
  - Acrocephalic (85.0 < TCI).

RESULTS

The mean ages of the subjects (male: 42±12.31; female 37±14.43) were not significantly different between the two sexes. However,the differences among the male and female group of subjects regarding the mean maximum cranial length (MCL), maximum cranial breadth (MCB) and maximum auricular head height (MHH) were found to be significantly more in the males as compared to the females.

Parameter	Male Mean ± SD (n = 430)	Female Mean ± SD (n = 242)	Combined Mean ± SD (n = 672)
Cranial length	188.03 ± 9.71*	173 ± 7.87	180.30 ± 8.84
Cranial breadth	151.72 ± 6.33*	144.14 ± 5.42	148 ± 5.76
Auricular head height	144 ± 9.87*	139 ± 7.98	141 ± 8.43
Horizontal cephalic index (HCI)	79.13 ± 5.56*	78.32 ± 6.40	78.54 ± 5.55
Vertical cephalic index (VCI)	78.31 ± 5.19	78.32 ± 4.67	78.27 ± 6.43
Transverse cephalic index (TCI)	103 ± 7.78*	100 ± 8.67	101.81 ± 8.02

Table-I. Cranial dimensions and cephalic indices
**P< 0.05*

The mean cephalic indices: horizontal (HCI), vertical (VCI) and transverse (TCI) in the males and the females were found to be 79.13 ± 5.56, 78.31 ± 5.19, 103 ± 7.78 and 78.32 ± 6.40, 78.32 ± 4.67, 100 ± 8.67 respectively (Table-I). Thus male subjects in our sample had a significantly higher HCI and TCI than females ($p<0.001$). The vertical cephalic index, however, did not exhibit any difference in significance between the two sexes.

Our observations as for the shape of the head indicated a mixed pattern; according to the horizontal cephalic index most of the subjects fell in the mesocephalic category of craniotype followed by the dolicocephalic both for the males and the females (Table-II).Majority of subjects in our study indicated to be having hypsicephalic category both in the males and females. Although a small number of females indicated orthocephalics type of cranium, no males belonged to this category (Table-III). The dominant majority belonged to acrocephalics followed by metriocephalics in a small number, according to the analysis of transverse cephalic index. In our study we did not observe any Tapeiocephalic type of cranium(Table-IV).

Head shape	Male (%age)	Female (%age)	Combined (%age)
Dolichocephalic	34.1*	31.9	33.1
Mesocephalic	47.4	43.6	45.7
Brachycephalic	12.3	12.7	12.4
Hyperbrachycephalic	6.2	11.8	8.8

Table-II. Frequencies of the categories of head types according to horizontal cephalic index (HCI)
**P< 0.05*

Head shape	Male	Female	Combined
Hypsicephalic	100	97.6	98.4
Orthocephalic	0*	3.4	1.6
Chamaecephalic	0	0	0

Table-III. Frequencies of the categories of head types according to vertical cephalic index (VCI)
**P< 0.05*

Head shape	Male	Female	Combined
Metriocephalic	1.9*	3.7	2.6
Acrocephalic	98.1	96.3	97.4
Tapeinocephalic	0	0	0

Table-IV. Frequencies of the categories of head types according to transverse cephalic index (TCI)
**P< 0.05*

DISCUSSIONS

Racial characteristics of a population are expressed in phenotype skeletal morphology but their best and most obvious expression is in the skull.[10,11] Therefore cranial morphometry and hence the cephalic indices establish the most significant characteristics for defining the racial difference.[11,12] Our present study is the first of its kind to record useful data regarding the cephalic indices and craniotypes in an adult South Punjab population.

Comparison of CI between parents, offsprings and their siblings can give a clue towards genetic transmission of inherited characteristics. Skull measurements are also important for facial reconstruction in cases of disputed identity.[13,14] Cephalometry remains to be the most popular and use full method for investigating the craniofacial skeletal morphology.[15,16] The methods being simple and practicable can be easily applied for assessment of such characteristics to a

population.

The mean horizontal cephalic index found in our study was lower than those reported for the Turkman[17], Indians[18],Mapuche individuals in Chile[19], native Fars[20], European people in Mediterranean area[21], North Europeans[22], Japanese[23], and higher than in Iranians.[24] This observation reinforces the previous conclusion that racial variety exists in the cephalic indices of different populations.

In the present study mesocephalic was by far the commonest craniotype followed by dolicocephalic both in the male and female subjects. This is in contrast with observations recorded by Bhatia et al[25] in Indian population. According to Bharati et[26] al in tropical zones head from is longer(dolichocephalic), while in temperate zones the shape of head from is round (mesocephalic or brachycephalic). Genetic and environmental factors have been suggested for the presence of variations in cephalic indices amongst groups of population.[25,26]

In our study according to the vertical cephalic index hypsicephalic while according to the transverse cephalic index the acrocephalic were the predominant craniotypes. This data may provide useful record for later reference.

Cranial measurements are different because they depend upon different gene expression in various races and ethnic group and are therefore a reliable determinant. An interesting observation in this regard is the first generation of Japanese immigrants in Hawaii in which it was observed that they had a higher cephalic index than their parents.[27] Dietary habits have also been shown to modulate the craniofacial form of people.[28]

The cephalic indices and shapes presented here are valid only for adult population; skull dimensions vary with age and reach their maximum before twenty years. This data may be useful for forensic purposes and later research in this area. During interpretation of a skull radiograph baseline data is required for comparison especially so in cases where cerebral atrophy or hydrocephalus is suspected or an abnormal variation in skull is in question.

The study sample was taken mainly from the city of Multan and as such may not be representative of all the population in southern Punjab. Further work therefore is required with a larger sample and covering various rural and urban segments of the region.

CONCLUSION

The study provides baseline cephalometric data from adult population of Southern Punjab with its potential clinical and forensic application and may be useful reference for future research.

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