

Significance of Cephalic Index in Race Determination

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ABSTRACT

Introduction: Significance of cephalic index regarding our population is to identify the category of our race, into which type of cephalic index does it fall.

Aims and objectives: To categorize our community into a type of population, whether they fall into dolicocephalic, mesocephalic or brachycephalic cranial index.

Study Design: Descriptive study

Place and Duration of study: This study was conducted at the Anatomy and Forensic departments of Aziz Fatimah Medical College, Faisalabad and Anatomy department of Punjab Medical College, Faisalabad from October 2011 to March 2012.

Materials and Methods: This research was conducted upon 100 dried skulls, which were of adult size including both males and females. Measurements were noted making use of Vernier's caliper. Length of skulls was measured as from summit of glabella anteriorly to the farthest occipital point, posteriorly. Breadth of skulls was measured as a line drawn perpendicular to maximal length of skull i.e. from the points of maximum parietal convexities. Then cephalic index was calculated for each skull.

Results: In our study we measured the maximum length and maximum breadth of 100 skulls and worked out the cranial indices of each skull present in our sample. We also calculated the percentage of different categories of skulls like dolicocephalic, mesocephalic and brachycephalic in our sample. Moreover, we also calculated the mean value, standard deviation, confidence interval CI, mean standard error, degree of freedom df, t and p values of the cranial indices, using SPSS software.

Conclusion: Punjabi population in Pakistan is predominantly Dolicocephalic as shown in our study. This study can be used for future references in race determination.

Key words: cranial index, dolicocephalic, mesocephalic, brachycephalic, glabella, occipital point, parietal convexities.

INTRODUCTION

Most of the population of the world has been divided into three types on the basis of cephalic index as Dolicocephalic (Australians, South Africans), Mesocephalic (Chinese, Europeans) and Brachycephalic (Mongols). Cephalic index is calculated from skulls as follows.

$$\text{Cephalic index} = \frac{\text{Max. Breadth of skull}}{\text{Max. Length of skull}} \times 100$$

Cephalic index in dolicocephalic people ranges between 70-75, in mesocephalic between 75-80 and in Brachycephalic its value is >80.¹²

Forensic importance of cephalic index is in race determination and hence in identity of the humans. Cephalic index could be helpful in identifying race of an individual, particularly in air accidents where different passengers were traveling and belonged to different countries of the world. In air crashes, due to burning, dead bodies get skeletonized and craniometry is very helpful in human identification. Similarly cephalic index can be applied in any other situations where identity of an unknown, unclaimed dead body is to be proved in addition to other parameters.⁵ Forensic importance of cephalic index particularly in Pakistan is

that a known group of door to door wandering beggars, who are dressed in green clothes and possess small heads, small foreheads with typical faces and are mentally retarded. These small headed and mentally retarded beggars are produced in an astonishing manner by fixing iron rings around the heads in early infancy, causing retardation of growth of skull bones and hence mental retardation.¹⁶

MATERIALS AND METHODS

Inclusion criteria: All intact skulls of adults were included in our study, which were present in Anatomy and Forensic departments of Aziz Fatimah Medical College, Faisalabad and Anatomy department of Punjab Medical College, Faisalabad.

Exclusion criteria: Decayed skulls and skulls of children were excluded from our study.

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$$\text{Cranial index} = \frac{\text{Max. Breadth of skull}}{\text{Max. Length of skull}} \times 100$$

RESULTS

In our study we measured the maximum length and maximum breadth of 100 skulls and worked out the cranial indices of each skull present in our sample as shown in table 1.

We also calculated the percentage of different categories of skulls like dolicocephalic, mesocephalic and brachycephalic in our sample as shown in table 2. Moreover, we also calculated the mean value, standard deviation, confidence interval CI, mean standard error, degree of freedom df, t and p values of the cranial indices, using SPSS software as shown in table 3.

Table No.1: Maximum length and maximum breadth of 100 skulls

Length range in cms	Breadth range in cms	Range of Cranial indices	Type of cranial index
16.4-19.5	11.7-13.7	65-74.57	Dolicocephalic
17-18.9	12.9-14.8	75.27-79.78	Mesocephalic
17-18.1	13.8-14.7	80-82.94	Brachycephalic

Table No.2: % age of different categories of skulls

Type of Cranial index	Percentage
Ultradolicocephalic	-----
Hyperdolicocephalic	
Dolicocephalic	57%
Mesocephalic	35 %
Brachycephalic	8 %
Hyperbrachycephalic	-----
Ultrabrachycephalic	-----

Table No.3: Standard Deviation

Mean $\pm$ standard deviation	Reference range CI	Df degree of freedom	T value $t_{\text{obt}} = \frac{\bar{x} - \mu}{s/\text{nsqr}}$	P value
73.56 $\pm$ 3.88	72.79-74.32	99	73.56-76.9/ .388=-8.6	<.0001
			T _{crit} = 1.66	

DISCUSSION

Our study signifies the importance of cranial indices in Punjabi population for future references for forensic investigative procedures to determine the race of the individuals. Our study indicates that most of the skulls in our sample fall into the dolicocephalic category

(57%). The second most common category in our population is mesocephalic, which is 35% in our study. The brachycephalic types of skulls are among the least common categories in our population (8%).

Variations in cephalic index between and within population have been attributed to a complex interaction between genetic and environmental factors as indicated in the study of Obikili, E.M. et al.¹In another study conducted by Oladipo, G.S. and E.J. Olotu, they reached the conclusion that most of the population of Ijaw and Igbo tribes of Nigeria are of mesocephalic variety. They are of the opinion that this data would prove beneficial for Anthropologists, Geneticists, forensic experts and medical practitioners in future.^{2,3} In another study conducted in Gujarat of India, the mean cephalic index in both sexes is 80.81, ranging from 71.10 to 89.77 which is contrary to our study in which we found the mean cranial index to be 73.56. This may be because of different ethnicity, geographical environment, habitat, nutritional circumstances and influence of inheritance of our sample.⁴In another study conducted in India, northern regions showed predominance of mesocephalic phenotype in both the sexes. Mean cephalic index of the students of northern Indian origin was studied using spreading caliper and the finding was 79.72.⁶The mean cranial indices from male and female skulls examined in another study carried out by Seema, Mahajan A, Ghandi D. were 72.64 $\pm$ 3.22 and 72.06 $\pm$ 2.97 respectively. All the skulls belonged to dolicocephalic category which is consistent with our study.^{7,8,9}

In another study conducted in Africa the mean cephalic index between the sampled populations was 77.95 $\pm$ 4.34 cm. There was an observed significant effect of age on cephalic index ($p < 0.01$) but gender showed no significant effects on cephalic index. The values for the three selected tribes did not differ significantly from one another nor differ from the population mean ($p < 0.05$). The mean male and female cranial index values were 77.67 and 78.14, respectively.¹⁰In another study conducted in Tehran brachycephalic index was found in most of the students.¹¹ Anthropometric studies are conducted on the age, sex and racial/ethnic groups in certain geographical zones.¹³ Lobo S. W. et al studied 267 (157 males & 110 females) subjects of Gurung village, Nepal. The mean cephalic index for male was 83.10 $\pm$ 6.08 and for female was 84.60 $\pm$ 5.14. Most of their subjects belonged to brachycephalic group. The mean head length for male is 18.0 $\pm$ 0.85 cm and for female is 17.4 $\pm$ 0.78 cm.¹⁴Another study shows that majority of male of Andhra region are dolicocephalic or mesocephalic and female are mesocephalic. Cephalic index of the female is 2-3 point higher than the male in Andhra region population. This study will serve as basis of comparison for future studies on Andhra region population.¹⁵ Brachycephaly and hyperbrachycephaly were found in 168 mentally challenged children taken

from 'Aashakirana' a school for mentally challenged at Davangere (Karnataka).¹⁶ Currently, the development of computed tomography and medical imaging techniques is widely accepted as a standard protocol for clinical diagnosis and surgical treatment planning. It enables 3D reconstruction and assesses craniofacial morphometric data both inner and outer anatomical landmark for the craniometric study.^{17,18} Odokuma et al. (2010) among the Urhobos, Ibos and Edos ethnic groups of Nigeria studied cranial index of dead remains recovered from Southwestern region of Nigeria and this will no doubt form a baseline data for subsequent studies especially as regards the populations from which the skulls were sourced. In another study the results showed a significant effect of cranial volume on the measured ethnic groups at 0.05 level of significance. While the Ibo's had an average cranial volume of 1273.39 cm³, that of the Urhobo's was 1255.89 and 1310.08 cm³ for the Edo people. Also the cranial capacity of male (1334.34 cm³) was significantly different from that of female (1204.54 cm³) in all the studied tribes, male being larger than that of female $p < 0.05$.¹⁹

In our study, mean cranial index was found out to be 73.56 ± 3.88 . The t_{obt} is more than the t_{crit} , this means that the mean of population is not equal to 76.9 so we reject the null hypothesis. As p value is less than 0.05 so it is statistically significant.²⁰

CONCLUSION

Punjabi population in Pakistan is predominantly Dolicocephalic as shown in our study. This study can be used for future references in race determination.

REFERENCES

- Obikili EM, Ohaegbulem C, Ekanem TB, Ualigwe KWE, Singh SP. Cephalic index in a young adult Nigerian population. *J Exp Clin Anat* 2004; 3(2):4-7.
- Oladipo GS, Olotu EJ. Anthropometric comparison of cephalic indices between the Ijaw and Igbo tribes. *Global J Pure Appl Sci* 2006;12(1):137-138.
- Oladipo GS, Paul CW. Anthropometric comparison of cephalic indices between the Urhobo and Itsekiri ethnic group of Nigeria. *Global J Pure Appl Sci* 2009;15(1):65-67.
- Shah GV, Jadhav HR. The study of Cephalic Index in students of Gujarat. *J Anat Soc Ind* 2004;53(1): 25-26.
- Rao NG. Text Book of Forensic Medicine & Toxicology. 2nd ed. Japee brothers Medical Publisher (P) Ltd; 2010.p.93-94.
- Anitha MR, Vijayanath V, Raju GM, Vijayamahantesh SN. Cephalic Index of North Indian Population. *Anatomica Karnataka* 2011;5(1):40-43.
- Seema, Mahajan A, Ghandi D. Cephalometric study of adult human skulls of North Indian origin. *Int J Bas & Appl Med Sci* 2011; 1(1): 81-83.
- Adejuwan SA, Salawau OT, Eke CC, Akinlosotu WF, Odaibo AB. A craniometric study of Adult human skulls from South Western Nigeria. *A J Med Sci* 2011; 3(1): 23-25.
- El- Feight IMA, Ahmad S, Ahmed M. Automatic localization of craniofacial landmarks for assisted cephalometry. *Pattern Recognition* 2004;37:609-621.
- Odokuma EI, Igbigbi PS, Akpuaka FC, Esibenu UB. Craniometric patterns of three Nigerian Ethnic Groups. *Afr J of Biotech* 2010; 9(10): 1510-1513.
- Abolhasanzadeh A, Farahani MR. Standard international classification of head shapes of 22-24 years old in Tehran. *J Res Med* 2003; 26(4): 281-5.
- Williams P, Dyson M, Dussak JE, Bannister LH, Berry MM, Collins P, et al. Gray's anatomy. 38th ed. London: Elbs with Churchill Livingstone; 1995. p. 607-612.
- Del sol M. Cephalic index in a group of mapuche individuals in the IX Region of Chile. *Int J Morphol* 2005;23(3): 241-6.
- Lobo SW, Chandrashekhar TS, Kumar S. Cephalic index of Garung Community of Nepal An anthropometric study. *KUMJ* 2005;3(11): 263-265.
- Mahajan A, Khurana BS, Batra APS. The study of cephalic index in Punjab students. *J Punj Acad Foren Med & Toxi* 2009; 9(2): 15-17.
- Math SC, S Patil R. Study of Cephalic Index & Associated Etiological Factors in Mentally Challenged Children. *Anatomica Karnataka* 2011; 5(3): 66-71.
- Park HK, Chung JW, Kho HS. Use of hand-held laser scanning in the assessment of craniometry. *Forensic Sci Int* 2006; 160: 200-206.
- Rooppakhun S, Piyasin S, N. Vatanapattimakul Y, Kaewprom K. Sitthiseripratip. Craniometric study of thai skull based on three dimensional Computed Tomography (CT) Data. *J Med Assoc Thai* 2010; 93(1): 90-98.
- Odokuma EI, Igbigbi PS, Akpuaka FC, Esigbenu UB. Craniometric patterns of three Nigerian ethnic groups. *Int J Med Sci* 2010; 2(2): 34-37.
- Ganguly P. Variation in physique in North India in relation to urbanization and economic status. *Bulletins et Mémoires de la Société d'anthropologie de Paris*. 1974; 1(1) 3-43.

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