

Cephalic Index in Adult Jaunsari Tribe Population of Dehradun District of Uttarakhand- A Cross-sectional Study

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ABSTRACT

Introduction: Cephalic Index is an essential anthropometric index used to find out sexual and racial differences. Its knowledge is helpful in the diagnosis of patients and for medico-legal cases. This knowledge is also used to evaluate patients of various medical fields like paediatrics, craniofacial surgery, and medical investigations like imaging.

Aim: To study the parameters related to cephalic index of adult male and female population of Jaunsari Tribe of Dehradun district in Uttarakhand and to analyse the sex differences in these parameters.

Materials and Methods: It was a cross-sectional study, carried on 100 adult males and 100 adult females of more than 18 years of age, belonging to Jaunsari Tribe from March 2014 to April 2018. Head Length or Maximum Glabellar-occipital Diameter (g-op) (mm) and Maximum Head breadth (eu-eu) were measured. With the help of these measurements, the cephalic index was calculated.

Results: Maximum number of Jaunsari males (83%) and females (45%) had dolichocephalic heads, and the second most common type of head was mesocephalic in both males (17%) and females (26%). There was not a single case of hyperdolichocephalic in males, whereas 17% of females were hyperdolichocephalic. It can also be seen that there was not a single case of even brachycephalic and hyperbrachycephalic in male population whereas the female population had 7% and 5% brachycephalic and hyperbrachycephalic cephalic index respectively and not a single person of ultrabrachycephalic type of cephalic index was reported in both male and female population. All cephalic parameters, as well as the cephalic index itself, were statistically significantly different (p -value <0.001) in the male and female population of the Jaunsari Tribe.

Conclusion: Maximum number of Jaunsari males and females had dolichocephalic heads. This data may be used as a standard for future reference for the Jaunsari population and may also be helpful for clinicians, forensic and anthropological experts.

Keywords: Anthropometry, Female, Head, Male, Skull

INTRODUCTION

Cephalic index is an essential anthropometric index that is used to find out sexual and racial differences. Its knowledge is helpful in the diagnosis of patients and for medico-legal cases. This knowledge is also used while evaluating patients of various medical fields like paediatrics, craniofacial surgery, and in medical investigations like imaging. This knowledge also helps to study growth trends in different races/castes in a specific geographical area. There are various equipments that are used either as protective equipment, e.g., helmet, goggles or for other use, e.g., headphone, etc. have to be designed in specific size and shape based on the cephalic index of concerned population [1]. An individual is identified by his or her unique personality based on his or her distinguishing characteristics from other individuals. It becomes easier to investigate an individual's death when one's identity is known. Usually, forensic anthropologists, forensic pathologists, and forensic odontologists work in association to examine and authenticate historic and prehistoric remains. In natural calamities like tsunami, mass disasters, war casualties with substantial skeletal remains, or in conditions of mass burials, forensic anthropology is quite useful. It is also helpful in investigations, dealing with living individuals like mixing up of babies in the hospital nursery, establishing individual's identity during immigration, thieves, burglars, robbers, and human trafficking, etc., [1].

Cephalic index forms the basis of classification of different shapes of head into dolichocephalic (cephalic index up to 74.9), mesocephalic (cephalic Index: 75-79.9), and brachycephalic (cephalic Index: 80-84.9) [2]. Importance of cephalic index and comparison of crania of different populations with many essential differences like nutritional, racial, geographic, ethnicity, etc., has been emphasised

[3]. It may be used as an indicator of cranial growth, development, and abnormal cranial evaluation both in male and female paediatric cases [4,5]. Human remnants that were found in some parts of Europe were initially classified on the basis of the cephalic index but in the late 19th, and early 20th century classification became closely associated with the development of racial anthropology as a result of prehistorians attempt to use ancient remains to explain population movements in terms of racial categories [6]. Measurement of the skull for the location of specific topographical relation, the most relevant anthropometric entity is cranial index when measured on the skull and cephalic index when measured on living individuals. Many workers have measured cephalic index on the different populations without differentiating male and female heads [7,8].

The Jaunsari Tribe has got the highest number of people in the state of Uttarakhand. They have got the body features resembling that of both the Mongols and Indo-Aryan groups who have settled in the Himalayan provinces [9]. They are different than other tribal communities because of their minimal or no interaction with the external world. Because of this, they have relatively maintained their unique traditions and cultures, which have been a point of interest for researchers of different fields. The Jaunsaris [10], with their facial features, clearly distinguish them from other people of Garhwal, living close by.

The study was planned to study parameters related to the cephalic index in the adult Jaunsari Tribe of District Dehradun, Uttarakhand. With objectives: 1) To check the parameters pertaining to cephalic index of adult male and female population of Jaunsari Tribe of Dehradun district in Uttarakhand; 2) To analyse the sex differences in these parameters.

MATERIALS AND METHODS

A cross-sectional study was conducted on 200 adult population of Jaunsari Tribe consisting of 100 male and 100 female individuals of more than 18 years of age, after due ethical clearance and their informed consent between March 2014 to April 2018. The Institutional Ethical Committee has approved this study project via IEC/IM/03/RC02.

Inclusion criteria: Individuals of more than 18 years of age, individuals belonging to the Jaunsari Tribe of Dehradun district, apparently, healthy individuals with no visible signs of facial and bony abnormalities like kyphosis, lordosis were included in the study.

Exclusion criteria: Individuals below 18 years of age, individuals of Jaunsari Tribe other than Dehradun district were excluded from the study.

Chakrata and Kalsi, were selected, out of six tehsils of Dehradun district, for this study because Jaunsari tribes are mainly inhabiting these two tehsils of Dehradun district. Equal numbers of randomly selected male and female individuals were taken from randomly chosen villages of Chakrata (Lakhwar and Hartar) and Kalsi (Jari and Koti). The unique selection was based on the voter list available at the tehsil office of Chakrata and Kalsi.

Study Procedure

The methodology for anthropometric measurements was adopted from Singh IR and Bhasin MK (1968) [11]. Subjects were asked to sit on a low stool of about 40 cm height for taking head and face measurements. The landmarks were marked on the body by skin marking pencil. The participants were positioned to avoid any strain to their head in Frankfurt-Horizontal Plane so that their tragion and infra orbitale are in the same horizontal plane. The subject was advised not to change his position while measurements were taken. Head Length or Maximum Glabello-occipital Diameter (g-op) (mm) and Maximum Head breadth (eu-eu) were measured. With the help of these measurements, the cephalic index was calculated. A spreading caliper was used to measure different parameters.

Head length or maximum glabello-occipital diameter (g-op):

It measures the straight distance between Glabella (g) (It is point of the protuberance of lower forehead above nasal root and between eyebrow ridges intersected by mid-sagittal plane) and opisthocranium (Op) - (It is the most posterior point on the posterior protuberance of the head in the mid-sagittal plane) [11] as shown in [Table/Fig-1a].

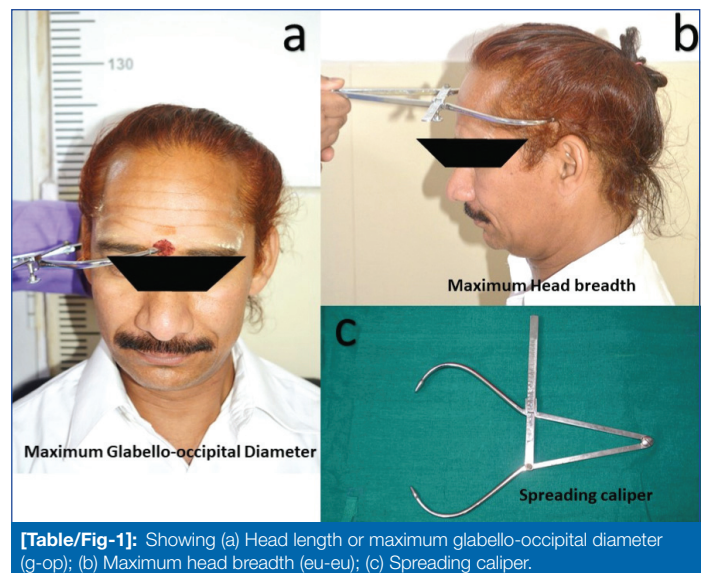
Maximum head breadth (eu-eu): It measures the straight distance between two eurya (eu) (most laterally placed point on the side of the head). It is maximum breadth taken at the right angle to the mid-sagittal plane of the head [11] as shown in [Table/Fig-1b]. The landmark used in head breadth must lie in the horizontal plane. The spreading caliper (as shown in [Table/Fig-1c]) was held in front of the subject in such a manner that the joint of the caliper is in the mid-sagittal plane of the head. Then tips of the caliper were slid from forward to backward and vice versa in a zig-zag manner. Maximum reading was taken. It was noted that the line joining the two tips of the caliper must be at a right angle to the mid-sagittal plane.

Cephalic Index [11]

$$\frac{\text{Maximum Head breadth}}{\text{Maximum Head length}} \times 100$$

STATISTICAL ANALYSIS

Data of all the desired morphometric parameters were subjected to appropriate statistical tests (mean, standard deviation, range-value)



[Table/Fig-1]: Showing (a) Head length or maximum glabello-occipital diameter (g-op); (b) Maximum head breadth (eu-eu); (c) Spreading caliper.

by using Statistical Package for the Social Sciences (SPSS) software version 23.0 (IBM). The p-values were calculated by using mean, Standard Deviation (SD) and unpaired t-test was used.

RESULTS

[Table/Fig-2] shows that the maximum population (45% males and 46% females) was having the medium type of head length.

From [Table/Fig-3], it is evident that the maximum number of Jaunsari males (83%) and females (45%) have a dolichocephalic head, and the second most common type of head is mesocephalic in both males (17%) and females (26%).

S. No.	Type	Range in male	Percentage	Range in female	Percentage
1	Very short	≤169	3	≤161	5
2	Short	170-177	17	162-169	21
3	Medium	178-185	45	170-176	46
4	Long	186-193	20	177-184	20
5	Very long	≥194	15	≥185	8

[Table/Fig-2]: Range variation of head length of Jaunsari population.

S. No.	Type	Range in male	Percentage	Range in female	Percentage
1	Hyperdolichocephalic	≤79	0	≤71.9	17
2	Dolichocephalic	71-75.9	83	72-76.9	45
3	Mesocephalic	76-80.9	17	77-81.9	26
4	Brachycephalic	81-85.4	0	82-86.4	7
5	Hyperbrachycephalic	85.5-90.9	0	86.5-91.9	5
6	Ultrabrachycephalic	≥91	0	≥92	0

[Table/Fig-3]: Range variation of head breadth of Jaunsari population.

It can be seen from [Table/Fig-4] that the majority of males (58%) and females (67%) were having a very narrow type of head.

It can be seen from [Table/Fig-5] that all cephalic parameters, as well as the cephalic index itself, were statistically significantly different in the male and female population of the Jaunsari Tribe.

S. No.	Type	Male (mm)	Percentage	Female (mm)	Percentage
1	Very narrow	≤139	58	≤134	67
2	Narrow	140-147	31	135-141	27
3	Medium	148-155	11	142-149	6
4	Broad	156-163	0	150-157	0
5	Very broad	≥164	0	≥158	0

[Table/Fig-4]: Range variation of cephalic index according [11] (Maximum Head breadth/Maximum Head Length).

S. No.	Parameters	Female Jaunsari Mean±SD	Male Jaunsari Mean±SD	Range of parameters Female Jaunsari		Range of parameters Male Jaunsari		p-value
				Min	Max	Min	Max	
1	Head length (g-opi)	172.32±11.19	183.95±8.17	164	208	110	192	<0.001
2	Head breadth	131.92 ± 5.97	138.93±6.49	124	155	119	149	<0.001
3	Cephalic Index	76.03±1.28	75.52±0.57	68.36	80.67	73.81	77.01	<0.001

[Table/Fig-5]: Comparison of cephalic parameters of male and female Jaunsari population.

S. No.	Population groups/Regions studied	Mean cephalic index	Number of subjects studied	Study/Authors
1	Bhills	76.98 (Mesocephalic)	100	Bhargav I and Kher GA (1960) [17]
2	Barelas	79.80 (Mesocephalic)	100	Bhargav I and Kher GA (1961) [7]
3	K. Vangaja	79.50 (Mesocephalic)	100	Basu A (1963) [18]
4	Gujarati	80.42 (Mesocephalic)	302	Shah GV and Jadhav HR (2004) [19]
5	Punjabi	85.53 (Brachycephalic)	256 Male	Mahajan A et al., (2009) [20]
		85.53 (Brachycephalic)	144 Female	
6	Mumbai	81.28 (Brachycephalic)	50 Male	Khair S et al., (2013) [1]
		75.22 (Dolichocephalic)	50 Female	
7	North Indian population	73.75±3.56	45 (Male skull)	Kumar A and Nagar M (2015) [21]
		75.22±5.15	35 (Female skull)	
8	South Indians	77.98 (Mesocephalic)	93	Raveendranath V and Manjunath KY (2010) [2]
9	Nepalese medical students	75.82 (Dolichocephalic)	158 Male	Pandey N et al., (2016) [3]
		78.36 (Mesocephalic)	134 Female	
10	North Indian population	80.52 (Mesatic cephalic)	250 Male	Seema and Verma P (2016) [22]
		84.32 (Brachycephalic)	250 Female	
11	Central Indian population	70.36 (Hyper Dolichocephalic)	Male	Kamble NB and Kamble D (2020) [23]
		68.72 (Hyper Dolichocephalic)	Female	
12	Jaunsari Tribe-Uttarakhand	75.52 (Dolichocephalic)	100 Male	Present study (2021)
		76.03 (Mesocephalic)	100 Female	

[Table/Fig-6]: Comparison of studies on cephalic index among various population groups [1-3,7,17-23].

DISCUSSION

Different authors have reported racial variations in the cranium [12-14]. Several factors have been attributed to variations in cephalic indices within the population and between the populations. Kasai K et al., have written the effect of food habits on the craniofacial form [15]. It has been reported that these differences are commonly resultant of a complex interplay between environmental and genetic factors [15,16].

[Table/Fig-6] shows a comparative representation of different cephalic indexes reported by several authors in various populations of different regions [1-3,7,17-23]. Bhargav I and Kher GA reported the mean cephalic index of 76.98 in Bhills [17]. In Barela's population, it was found to be 79.80 [7]. Basu A studied the cephalic Index of K.Vangaja and found it to be 79.50 [18]. The mean cephalic index of the Gujarati population was reported to be 80.42 [19]. Mahajan A et al., reported the mean cephalic index to be 85.53 in both male and female Punjabi population [20]. Khair S et al., reported the mean cephalic indexes of male and female Mumbai students to be different, 81.28 and 75.22, respectively [1]. In the south Indian population, it was found to be 77.98 [2]. In Nepalese medical students, it was reported to be different in male and female students. It was 75.82 and 78.36 in male and female students respectively [3], which was in accordance to the present study.

Brachycephaly is relatively rare in Negroid race, while dolichocephaly is rare in Mongoloid race. Still, paleontology and available data point to early man to be dolichocephalic who became brachycephalic in a later stage because of repeated mutations and other factors [3]. It can be seen from [Table/Fig-6] that Nepali male and female students are dolichocephalic and mesocephalic, respectively, so are the Jaunsari male and female population. It is also evident that the Jaunsari population does not resemble Toto with any other population except Nepalese. This striking resemblance might be due to similar geographic and environmental factors.

As the study deals with the population of Jaunsari Tribe only, to overcome it and other associated limitations, a further, more robust research is recommended in taking appropriate and adequate sample representative of the whole state of Uttarakhand so that the anthropometric data obtained can be generalised.

Limitation(s)

It does not represent the population of Uttarakhand, so it can't be generalised for people of the rest of the state. The study has just focused on measuring anthropometric parameters related to the cephalic index and parameters related to it. Still, it has not focussed on the factors responsible for this anthropometric presentation.

As it is not a representation of the whole population, it cannot be generalised. No comparison can be made between Kumaon and Garhwal population as it has focussed on a particular tribe of Garhwal.

CONCLUSION(S)

The present study has provided valuable data for this particular community which can be used for further studies and as anthropometric standards in the future to find out any changes in the existing population. All cephalic parameters, as well as cephalic index itself, were statistically significantly different in the male and female population of Jaunsari Tribe, so it should be kept in mind while designing protective equipment like helmet goggles or for other use, e.g., headphone, etc., for this population.

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REFERENCES

- [1] Khair S, Bhandari D, Wavhal S. Study of cephalic index among the students of Mumbai region. *Indian J App Res.* 2013;3(11):64-66. 10.15373/2249555X/NOV2013/74.
- [2] Raveendranath V, Manjunath KY. An anthropometric study of correlation between cephalic index, cranial volume and cranial measurements in Indian cadavers. *Ind Sci Abstracts.* 2010;15(2):55-58.
- [3] Pandey N, Jha CB, Yadav G, Sah SK, Yadav P, Awasthi J. Study of cephalic Index in Nepalese medical students. *Int J Anat Res.* 2016;4(4):353-56.
- [4] Golalipour, MJ. The effect of ethnic factor on cephalic index in 17-20 yrs old females of North of Iran. *Int J Morphol.* 2006;24(3):319-22.
- [5] Krishan K. Anthropometry in forensic medicine and forensic science: Forensic anthropometry. *Int J Forensic Sci.* 2007;2(1):1.
- [6] Kondo S, Wakatsuki E, Shibagaki HA. Somato-metric study of the head and face in Japanese ado-lescence. *Okajimas Folia Anat Jpn.* 1999;76(4):179-85.
- [7] Bhargava I, Kher GA. A comparative anthropometric study of Bhils and Barelals of Central India. *J Anat Soc India.* 1961;10:26-33. (original Article is given).
- [8] Arslan SG, Gen CC, Odabas B, Kama JD. Comparison of face proportions and anthropometric norms among young adults. *Aesthetic Plast Surg.* 2008;32(2):234-42.
- [9] Anitha S, Vasukuttan KA. Book reviews published in Mathrubhoomi weekly for the period of 1960-70 a study. Available from: http://shodhganga.inflibnet.ac.in/bitstream/10603/13741/9/09_chapter%202.pdf.
- [10] Ansari MS, Singla M, Ravi KS. Facial anthropometry in adult Jaunsari tribe population of Dehradun District of Uttarakhand. *J Clin Diag Res.* 2019;13(4):AC01-03.
- [11] Singh IR, Bhasin MK. Somatometry. In: *A laboratory manual on biological Anthropology*, 1st edition. Kamla-Raj Enterprises, Delhi. 1968;149-193.
- [12] Williams P, Dyson, M Dussak JE, Bannister LH, Berry MM, Collins P, Ferguson MWJ. Gray's anatomy. In: *Skeletal system*. 38th Ed. London: Elbs with Churchill Livingstone; 1995. Pp. 607-12.
- [13] Oladipo GS, Olotu EJ. Anthropometric comparison of cephalic indices between the Ijaw and Igbo tribes. *Global J. Pure Appl Sci.* 2006;12(1):137-38.
- [14] Jansen AAJ. Weight-height, weight-for height and ceutelets Index of Akamba School and adults. *E Afr Med J.* 1984;61:273-82.
- [15] Kasai K, Richards LC, Brown T. Comparative study of craniofacial morphology in Japanese and Australian aboriginal population. *Hum Biol.* 1993;65(5):821-34.
- [16] Susanne C, Sharma PD. Multivariate analysis of head measurements in Punjabi families. *Ann Hum Biol.* 1978;5(2):179-83.
- [17] Bhargava I, Kher GA. An anthropometric study of Central India Bhils of Dhar district of Madhya Pradesh. *Journal of Anatomical Society of India.* 1960;9:14-19.
- [18] Basu A. Anthropometry of the Kayasthas of Bengal. *Journal of Anatomical Society of India* 1963;3:20-25.
- [19] Shah GV, Jadhav HR. The study of cephalic Index in students of Gujarat. *Journal of Anatomical Society of India* 2004;53(1):25-26. Available on net.
- [20] Mahajan A, Khurana BS, Seema, Batra APS. The study of cephalic index in Punjabi students. *Journal of Punjab Academy of Forensic Medicine & Toxicology.* 2009;9:66-70.
- [21] Kumar A, Nagar M. Morphometric estimation of cephalic index in North Indian population: Craniometrics study. *Int J Sci Res.* 2015;4(4):1976-82.
- [22] Seema, Verma P. The study of cephalic index in north Indian population. *Int J Morphol.* 2016;34(2):660-64.
- [23] Kamble NB, Kamble D. Anthropometric study of cephalic and facial indices among central Indian population. *Indian Internet Journal of Forensic Medicine & Toxicology.* 2020;18(1):12-18.

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