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Variation in features of cephalic index among seven different tribal population of northeastern states of India

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Abstract

Cephalic index is an important parameter for deciding race and sex of an individual whose identity is unknown. The human body dimensions are affected by ecological, biological, geological, racial, sex, and age factors. In the present study, two hundred eighty (280) subjects comprising 20 males and 20 females of seven (7) different tribal population of northeastern states with age ranging from 20-30 years were included. Cephalic index was worked out by dividing the head breadth by head length and multiplying by 100 and the result was analyzed using Microsoft excel. The results of the present study show that seven different tribal population of North Eastern State of India can be classified as brachycephalic except Garo population, but even among them the value of cephalic index was found to be different for different population. The mean cephalic index of Garo population had the highest among the population, i.e. 85.39 and Khasi population had the lowest i.e. 80.97. There was a significant gender difference in the Cephalic Index. The data presented in the present report can be useful for anthropologists, an expert in forensic science and forensic investigation this study will serve as the basis of comparison for future studies.

Keywords: cephalic index, head breadth, head length, forensic investigation

Introduction

Cephalic index is also called as cranial index or Index of breadth is one of the important parameter that helps to differentiate between different human races. Anthropometry refers to measurements of living or dead humans for the purpose of understanding variation in their physical dimensions. All human beings in this world belong to the same species, *Homo sapiens*. No two individuals are the same in all their measurable traits, even genetically identical twins, differ in some respects. The human body dimensions are affected by ecological, biological, geological, racial, sex, and age factors [5]. Cephalic index is very useful anthropologically to find out racial differences [9]. It can also be utilized to find out sexual differences. Comparison of changes between parents, offspring and siblings can give a clue to genetic transmission of inherited character. Cephalic index is the ratio of the maximum breadth of head multiplied by 100 divided by its maximum length. By means of cephalic index persons can be classified into the following: Dolicocephalic: cephalic index between. 65-74. 9, Mesocephalic: cephalic index between 75-79. 9, Brachycephalic: cephalic index between 80-84. 9, Hyper brachycephalic: cephalic index between. 85-89. 9, Ultra brachycephalic: cephalic index above 90.0. It has also been reported that cephalic index is less than 2-3 (difference of 2.7) in individual with sickle cell anemia than normal individual. Dolicocephalic person have otitis media less often than brachycephalic person [10]. It has also been reported that individuals with Apert's syndrome are hyperbrachycephalic [3]. Anthropometric study of head is useful in designing various equipments of head and face like helmets, head phones, goggles etc by formulating standard sizes.

Materials and Method

There were total students of 280 samples (20 males and 20 females) of seven different tribal population of north eastern states were collected from different colleges and universities at Shilling. Students were selected because of the easy availability with the age group of 20-30 years and who were not having any history of inter caste, inter religion marriage of their

parents up till at least 3 generations were included. Individuals with any faciocranial abnormality were excluded from the study. The method use for assessing the cephalic index was Hardlika's method. All the measurements were taken with subjects sitting on a chair, in relaxed condition, straight and looking forward. The head length was measured with spreading caliper from glabella to Inion. Head breadth was measured as the maximum transverse diameter between the two euryons using spreading caliper. The anatomical landmarks, glabella (g), inion (I) and euryon (eu) were marked. The anatomical landmarks were defined as follows: Glabella: A point above the nasal root between the eyebrows and intersected by mid-sagittal plane. Inion: The distal most point placed on the external occipital protuberance in the mid-sagittal plane. Euryon: The lateral most point on the side of the head.

Procedure for analysis

Cephalic index was calculated as maximum breadth of head / maximum length of head X 100. The data was subjected to statistical analysis. The data of each subject was recorded in special form and analyzed statistically (p value). The data was entered in the computer and analyzed using Microsoft excel.



Fig 1: Measuring head length



Fig 2: Measuring head breadth

Results

From the collected data, statistics were analyzed, observations and results are presented in the tabular form.

Table 1: Statistical data of Arunachali Population

Variable	N	Min	Max	Mean	S D	S E	P value
Cephalic index (male)	20	76.12	89.94	82.20	4.07	0.91	0.1544
Cephalic index (female)	20	75.27	90.75	80.40	3.98	0.89	0.1544
Cephalic index (male&female)	40	75.27	90.75	81.30	4.13	0.92	-----
Head length of male (mm)	20	170	201	185.95	7.33	1.64	0.008
Head length of female (mm)	20	165	188	180.2	5.92	1.33	0.008
Head length of male & female (mm)	40	165	201	183.07	7.26	1.62	-----
Head breadth of male (mm)	20	143	163	152.65	5.38	1.20	5.87412E-06
Head breadth of female (mm)	20	140	157	144.7	4.38	0.98	5.87412E-06
Head breadth of male & female (mm)	40	140	163	148.67	6.32	1.41	-----

The minimum cephalic index for Arunachali population was found to be 75.27 and maximum cephalic index was found to be 90.75. The mean cephalic index was 81.30±4.13. The mean cephalic index for male was 82.20±4.07 and for female was 80.40±3.98. The difference between male and female cephalic index was significant (p > 0.05 & difference 1.80). The mean head length for Arunachali population was 183.07±7.26 mm. In the male the head length varies from 170 mm to 201 mm, the mean head length being 185.95±7.33 mm. In the female the head length varies from 165 mm to 188 mm, the mean head length being 180.2±5.92 mm. The difference

Between male and female head length was significant (p > 0.05 & difference 5.75 mm). The mean head breadth for Arunachali population was 148.67±6.32 mm. In the male the mean head breadth being 152.65±5.38 mm and for female 144.7±4.38. The difference between male and female head breadth was not significant (p < 0.05 & difference 7.95 mm). According to classification of cephalic index 19 (7 males & 12 females) subjects of Arunachali population were mesocephalic; 13 (7 males & 6 females) were brachycephalic; 7 (6 males & 1 female) were hyperbrachycephalic and 1 (0 males & 1 female) are ultrabrachycephalic.

Table 2: Statistical data of Garo Population

Variable	N	Min	Max	Mean	S D	S E	P value
Cephalic index (male)	20	78.6	89.94	84.79	2.93	0.65	0.17059
Cephalic index (female)	20	80.35	89.82	86.0	2.69	0.60	0.17059
Cephalic index (male & female)	40	78.6	89.94	85.39	2.82	0.63	-----
Head length of male (mm)	20	171	189	180.25	5.04	1.13	4.79054E-05
Head length of female (mm)	20	160	187	172.4	6.04	1.35	4.79054E-05
Head length of male & female (mm)	40	171	189	176.33	6.80	1.52	-----
Head breadth of male (mm)	20	141	163	152.8	5.77	1.29	0.009
Head breadth of female (mm)	20	139	156	148.2	5.12	1.14	0.009
Head breadth of male & female (mm)	40	139	163	150.5	5.92	1.33	-----

The minimum cephalic index for Garo population was found to be 78.6 and maximum cephalic index was found to be 89.94. The mean cephalic index was 85.39±2.82. The mean cephalic index for male was 84.79±2.93 and for female was 86±2.69.

The difference between male and female cephalic index was significant (P < 0.05 & difference 1.21). The mean head length for Garo population was 176.33±6.80 mm. In the male the head length varies from 171 mm to 189 mm, the mean head length being 180.25±5.04 mm. In the female the head

length varies from 160 mm to 187 mm, the mean head length being 172.4±6.04 mm.

The difference between male and female head length was not significant ($p < 0.05$ & difference 7.85 mm). The mean head breadth for Garo population was 150.5±5.92 mm. In the male the mean head breadth being 152.8±5.77 mm and for female

148.2±5.12. The difference between male and female head breadth was significant ($p > 0.05$ & difference 4.6 mm). In Garo population 2 (0 males & 2 females) were mesocephalic; 15 (9 males & 6 females) subjects were brachycephalic and 23 (9 males & 14 females) were hyperbrachycephalic.

Table 3: Statistical data of Khasi population

Variable	N	Min	Max	Mean	S D	S E	P value
Cephalic index (male)	20	72.77	85.95	80.04	3.67	0.82	0.08033
Cephalic index (female)	20	76.5	87.57	81.90	3.04	0.68	0.08033
Cephalic index (male & female)	40	72.77	87.57	80.97	3.49	0.78	-----
Head length of male (mm)	20	178	196	187.35	5.28	1.18	2.48196E-05
Head length of female (mm)	20	169	190	178.9	6.14	1.37	2.48196E-05
Head length of male & female (mm)	40	169	196	183.13	7.12	1.59	-----
Head breadth of male (mm)	20	140	161	149.85	5.82	1.30	0.03079
Head breadth of female (mm)	20	140	155	146.4	3.94	0.88	0.03079
Head breadth of male & female (mm)	40	140	161	148.13	5.26	1.17	-----

The minimum cephalic index for Khasi population was found to be 72.77 and maximum cephalic index was found to be 87.57. The mean cephalic index was 80.97±3.49. The mean cephalic index for male was 80.04±3.67 and for female was 81.90±3.04. The difference between male and female heads cephalic index was significant ($p > 0.05$ & difference 1.86). The mean head length for Khasi population was 183.13±7.12 mm. In the male the head length varies from 178 mm to 196 mm, the mean head length being 187.35±5.28 mm. In female, the head length varies from 169 mm to 190 mm, the mean head length being 178.9±6.14 mm. The difference between

male and female head length was not significant ($p < 0.05$ & difference 8.45 mm). The mean head breadth for Khasi population was 148.13±5.26 mm. In the male the mean head breadth being 149.85±5.82 mm and for female 146.4±3.94. The difference between male and female head breadth was significant ($p > 0.05$ & difference 3.45 mm). In Khasi population 3 (3 males & 0 female) were dolicocephalic; 13 (7 males & 6 females) subjects were mesocephalic; 18 (8 males & 10 females) were brachycephalic and 6 (2 males & 4 females) were hyperbrachycephalic.

Table 4: Statistical data of Manipuri Population

Variable	N	Min	Max	Mean	S.D	S E	P value
Cephalic index (male)	20	80	92.35	85.49	3.23	0.72	0.06393
Cephalic index (female)	20	75.78	89.82	83.50	3.52	0.78	0.06393
Cephalic index (male & female)	40	75.78	92.35	84.49	3.52	0.78	-----
Head length of male (mm)	20	177	192	185.5	3.93	0.87	6.74145E-06
Head length of female (mm)	20	167	190	177.4	5.55	1.24	6.74145E-06
Head length of male & female (mm)	40	167	192	181.4	6.18	1.38	-----
Head breadth of male (mm)	20	151	169	158.5	4.55	1.02	0.91933
Head breadth of female (mm)	20	140	161	148.5	5.12	1.14	0.91933
Head breadth of male & female (mm)	40	140	169	153.5	6.96	1.56	-----

The minimum cephalic index for Manipuri population was found to be 75.78 and maximum cephalic index was found to be 92.35. The mean cephalic index was 84.49. The mean cephalic index for male was 85.49±3.23 and for female was 83.50 ±3.52. The difference between male and female cephalic index was significant ($p > 0.05$ & difference 1.99). The mean head length for Manipuri population was 181.4±6.18 mm. In the male the head length varies from 177 mm to 192 mm, the mean head length being 185.5±3.93 mm. In female, the head length varies from 167 mm to 190 mm, the mean head length being 177.4±5.55 mm. The difference

between male and female head length was not significant ($p < 0.05$ & difference 8.1 mm). The mean head breadth for Manipuri population was 153.5±6.96 mm. In the male the mean head breadth being 158.5±4.55 mm and for female 148.5±5.12. The difference between male and female head breadth was significant ($p > 0.05$ & difference 10 mm). In Manipuri population 5 (0 males & 5 females) are mesocephalic; 19 (9 males & 10) are brachycephalic; 15 (10 males & 5 females) subjects were hyperbrachycephalic and 1 (1 males & 0 females) are ultrabrachycephali

Table 5: Statistical data of Mizo Population

Variable	N	Min	Max	Mean	S D	S E	P value
Cephalic index (male)	20	73.44	89.35	83.47	4.32	0.18	0.07202
Cephalic index (female)	20	76.04	87.28	81.37	2.89	0.65	0.07202
Cephalic index (male & female)	40	73.44	89.35	82.42	3.83	0.85	-----
Head length of male (mm)	20	169	200	188.65	8.07	1.80	0.00239
Head length of female (mm)	20	173	192	182.05	4.25	0.95	0.00239
Head length of male & female (mm)	40	169	200	185.35	7.24	1.62	-----
Head breadth of male (mm)	20	141	167	157.25	6.47	1.45	3.48339E-06
Head breadth of female (mm)	20	140	156	148.05	3.94	0.88	3.48339E-06
Head breadth of male & female (mm)	40	140	167	152.65	7.06	1.58	---

The minimum cephalic index for Mizo population was found to be 73.44 and maximum cephalic index was found to be 89.35. The mean cephalic index was 82.42. The mean cephalic index for male was 83.47 ± 4.32 and for female was 81.37 ± 2.89 . The difference between male and female cephalic index was significant ($p > 0.05$ & difference 2.1). The mean head length for Mizo population was 185.35 ± 7.25 mm. In the male the head length varies from 169 mm to 200 mm, the mean head length being 188.65 ± 8.07 mm. In female, the head length varies from 173 mm to 192 mm, the mean head length being 182.05 ± 4.25 mm. The difference between

male and female head length was significant ($p > 0.05$ & difference 6.6 mm). The mean head breadth for Mizo population was 152.65 ± 7.06 mm. In the male the mean head breadth being 157.25 ± 6.47 mm and for female 148.05 ± 3.94 . The difference between male and female head breadth was not significant ($p < 0.05$ & difference 9.2 mm). In Mizo population 1 (1 male & 0 females) subjects are dolicocephalic; 12 (5 males & 7 females) were mesocephalic; 19 (7 males & 12 females) were brachycephalic and 8 (7 males & 1 female) were hyperbrachycephalic

Table 6: Statistical data of Naga Population

Variable	N	Min	Max	Mean	S.D	S.E	P value
Cephalic index (male)	20	80.2	89.3	84.22	2.62	0.58	0.13154
Cephalic index (female)	20	78.07	88.88	82.86	3.06	0.68	0.13154
Cephalic index (male & female)	40	78.07	88.88	83.54	2.93	0.65	---
Head length of male (mm)	20	172	197	185.4	5.89	1.32	0.00018
Head length of female (mm)	20	170	191	178.4	5.05	1.13	0.00018
Head length of male & female (mm)	40	170	197	181.9	6.51	1.45	---
Head breadth of male (mm)	20	147	169	156.05	4.55	1.02	2.8695E-07
Head breadth of female (mm)	20	140	159	147.4	4.55	1.02	2.8695E-07
Head breadth of male & female (mm)	40	140	169	151.73	6.28	1.40	---

The minimum cephalic index for Naga population was found to be 78.07 and maximum cephalic index was found to be 89.3. The mean cephalic index was 83.54. The mean cephalic index for male was 84.22 ± 2.62 and for female was 82.86 ± 3.06 . The difference between male and female cephalic index was significant ($p > 0.05$ & difference 1.36). The mean head length for Naga population was 181.9 ± 6.51 mm. In the male the head length varies from 172 mm to 197 mm, the mean head length being 185.4 ± 5.89 mm. In female, the head length varies from 170 mm to 191 mm, the mean head length

being 178.4 ± 5.05 mm. The difference between male and female head length was significant ($p > 0.05$ & difference 7). The mean head breadth for Naga population was 151.73 ± 6.28 mm. In the male the mean head breadth being 156.05 ± 4.55 mm and for female 147.4 ± 4.55 . The difference between male and female head breadth was not significant ($p < 0.05$ & difference 8.65 mm). In Naga population 2 (0 males & 2 females) subjects were mesocephalic; 25 (12 males & 13 females) were brachycephalic and 13 (8 males & 5 females) were hyperbrachycephalic

Table 7: Statistical data of Tripuri Population

Variable	N	Min	Max	Mean	S.D	S.E	P value
Cephalic index (male)	20	77.84	88.1	82.50	3.25	0.73	0.08852
Cephalic index (female)	20	78.77	90.96	84.25	3.22	0.72	0.08852
Cephalic index (male & female)	40	77.84	90.96	83.38	3.35	0.75	---
Head length of male (mm)	20	176	200	186.7	6.22	1.39	8.50533E-08
Head length of female (mm)	20	166	187	175.3	4.89	1.09	8.50533E-08
Head length of male & female (mm)	40	166	200	181	7.98	1.78	---
Head breadth of male (mm)	20	146	164	153.95	5.84	1.30	0.00033
Head breadth of female (mm)	20	140	156	147.6	4.50	1.008	0.00033
Head breadth of male & female (mm)	40	140	164	150.77	6.10	1.36	---

The minimum cephalic index for Tripuri population was found to be 77.84 and maximum cephalic index was found to be 90.96. The mean cephalic index was 83.38. The mean cephalic index for male was 82.50 ± 3.25 and for female was 84.25 ± 3.22 . The difference between male and female cephalic index was significant ($p > 0.05$ & difference 1.75). The mean head length for Tripuri population was 181 ± 7.98 mm. In the male the head length varies from 176 mm to 200 mm, the mean head length being 186.7 ± 6.22 mm. In female, the head length varies from 166 mm to 187 mm, the mean head length being 175.3 ± 4.89 mm. The difference between

male and female head length was not significant ($p < 0.05$ & difference 11.4 mm) The mean head breadth for Tripuri population was 150.77 ± 6.10 mm. In the male the mean head breadth being 153.95 ± 5.84 mm and for female 147.6 ± 4.50 . The difference between male and female head breadth was significant ($p > 0.05$ & difference 6.35 mm). In Tripuri population 5 (4 males & 1 female) subjects were mesocephalic; 22 (10 males & 12 females) were brachycephalic; 12 (6 males & 6 females) and 1 (0 males & 1 female) are ultrabrachycephalic.

Table 8: Comparison of cephalic index of seven different tribal population

Variable	Arunachali	Garro	Khasi	Manipuri	Mizo	Naga	Tripuri
Cephalic index (male)	82.20	84.79	80.04	85.49	83.47	84.22	82.50
Cephalic index (female)	80.40	86	81.90	83.5	81.37	82.86	84.25
Mean value of Cephalic index (male & female)	81.80	85.39	80.97	84.49	82.42	83.54	83.38

In comparison of cephalic index of seven different tribal population of male Manipuri population had the highest cephalic index i.e 85.49 and Khasi population had the lowest i.e 80.04, in female Garo population had the highest cephalic index i.e 86 and Arunachali population had the lowest i.e 80.40 and in comparison of the mean value of both male and female Garo population had the highest i. e 85.39 and Khasi population had the lowest i. e 80.97

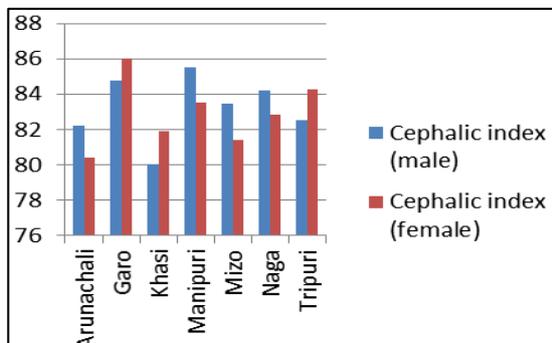


Fig 3: comparison of cephalic index of male and female of seven different tribal population chart

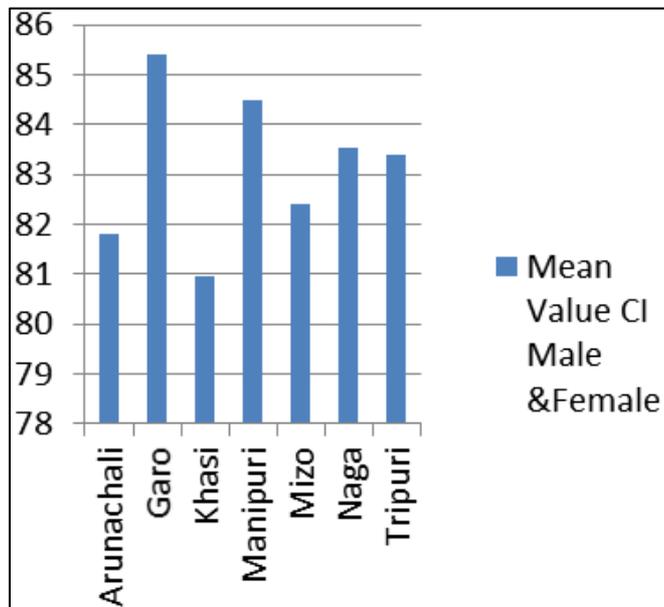


Fig 4: comparison of mean value of cephalic index of male and female of seven different tribal population chart

Table 9: Variation in features of seven different tribal population.

Features	Arunachali	Garo	Khasi	Manipuri	Mizo	Naga	Tripuri	Variation
Cephalic index (male)	82.2	84.79	80.04	85.49	83.47	84.22	82.5	2.906767
Cephalic index (female)	80.4	86	81.9	83.5	81.37	82.86	84.25	3.054992
Cephalic index of male & female (mm)	81.3	85.39	80.97	84.49	82.42	83.54	83.38	2.240171
Head length of male (mm)	185.95	180.25	187.35	185.5	188.65	185.4	186.7	6.06102
Head length of female (mm)	180.2	172.4	178.9	177.4	182.05	178.4	175.3	8.698469
Head length of male & female (mm)	183.07	176.33	183.13	181.4	185.35	181.9	181	6.668017
Head breadth of male(mm)	152.65	152.8	149.85	158.5	157.25	156.05	153.95	7.739082
Head breadth of female (mm)	144.7	148.2	146.4	148.5	148.05	147.4	147.6	1.496224
Head breadth of male & female (mm)	148.67	150.5	148.13	153.5	152.65	151.73	150.77	3.330943

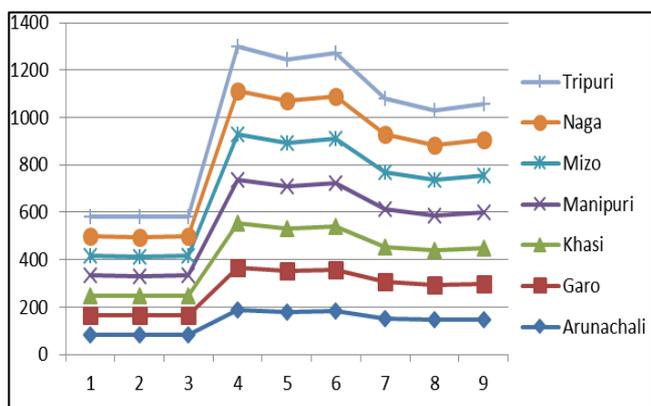


Fig 5: Variation in features of seven different tribal population chart

After analyzed the variation in features of head from seven different tribal population the result was found that the variation of the cephalic index of male was found to be 2.906767, female 3.054992 and male and female was 2.240171. The variation head length of male was found to be 6.06102, female 8.698469 and male and female was 6.668017. The variation of the head breadth of male was found to be 7.739082, female 1.496224 and male and female was 3.330943.

Discussion

Different workers have studied the cephalic index in different populations and have reported different type of cranial characteristics.5stated that the human body dimensions are

affected by ecological, biological, geological, racial, sex, and age factors.9also stated that cephalic index is very useful anthropologically to find out racial differences. The present study provides valuable new data pertaining to the cephalic indices and shapes of the heads in an adult population of Arunachali, Garo, Khasi, Manipuri, Mizo, Naga and Tripuri. Although the sample of individuals examined was small it is representative of the seven different tribal population of North Eastern State. To obtain a more valid estimate of Cephalic index which is true representative of the seven different tribal population a study with a larger sample covering a wider geographic area of the seven different tribal population settlement is necessary.

Conclusion

The results of the present study was found that the mean cephalic index of Garo population had the highest among the population (i.e. 85.39), and lowest in Khasi population (i.e. 80.97), the mean head length of Mizo population had the highest (i.e. 185.35), and lowest in Garo population (i.e. 176.33), the mean head breadth of Manipuri population had the highest (i.e. 153.5) and lowest in Khasi population (i.e. 148.13). Thus it was concluded that the seven different tribal population can be classified as brachycephalic except Garo population but among them the mean value of cephalic index was different for different population. There was a highly significant gender difference in the Cephalic index, but there were less differences of cephalic index among seven different tribal population. The data presented in the present report can be useful for anthropologist, an expert in forensic science,

forensic investigation and this study will serve as the basis of comparison for future studies.

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