Effect of ethnicity on head form anthropometry of 17-26 year old normal population in Eastern Nepal

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SUMMARY

The human body dimensions are affected by ecological, geographical, populational, sex and age-related factors. Craniometry has wide applications in Forensic Medicine, Plastic Surgery, Orthodontics, Archeology and identification of the origins of ethnical groups. This study was designed to determine the influence of ethnicity on head forms present in adult males and females of Eastern Nepal. This non-interventional comparative cross-sectional study was conducted in a normal healthy pure ethnic population with a sample size of 600 (300 male and 300 female) belonging to a 17-26 age group in the Sunsari and Morang districts of Eastern Nepal. Data were collected among each ethnic group, i.e., Indigenous, Indo-Nepalese and Tibeto-Nepalese, each consisting of 200 individuals (100 male and 100 female) between November 2010 to January 2012. The Maximum Head Length in mm and Maximum Head Breadth in mm were measured, and Cranial Indices were calculated. Anova and independent t-test were used to compare the means among different groups. A 'P' value of 0.05 was considered to be statistically significant. Both males and females of Eastern Nepal were Brachycephalic (81.16±3.16 and 81.85±3.02 respectively). The CI of Tibeto-Nepalese, Indigenous and Indo-Nepalese was 84.75±0.99 (Brachycephalic), 82.17±1.17 (Brachycephalic), and 77.60±0.65 (Mesocepalic) respectively. The CI were 84.70±1.06 (Brachycephalic), 81.42±1.10 (Brachycephalic) and 77.35±0.67 (Mesocephalic) for Tibeto-Nepalese, Indigenous and Indo-Nepalese males. The CI were 84.80±0.91 (Brachycephalic), 82.92±0.63 (Brachycephalic) and 77.85±0.52 (Mesocephalic) for Tibeto-Nepalese, Indigenous and Indo-Nepalese females respectively. The results showed ethnic variations in all parameters, indicating the influence of ethnicity on cranial anthropometry.

Key words: Craniometry – Orthodontics – Ethnic – Anthropometry – Cephalic Index

INTRODUCTION

Craniofacial anthropometry is a technique used in physical anthropometry comprising of precise and systematic measurement of the bones of the human skull (Kolar and Salter, 1996). The human body dimensions are affected by ecological, geographical, populational, sex and age-related factors. Craniometry has wide applications in Forensic Medicine, Plastic Surgery, Orthodontics, Archeology and identification of determining the origins of ethnic groups (John, 2003).

Nepalese society is ethnically diverse and complex in phenotype (physical characteristics) and culture ranging between Indian to Tibetan. Political scientists Joshi and Rose broadly classify the Nepalese population into three major ethnic groups in terms of their origin: Indo-Nepalese (IND), Tibeto-Nepalese (TN) and Indigenous (IN) (Joshi and Rose, 1991).

In view of differences observed in other studies, based on population and ethnic differences, this study was designed to determine the types of shapes of head present in adult males and females of Eastern Nepal. This study will provide a database of cranial measurements that will help

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surgeons in reconstruction surgery.

MATERIALS AND METHODS

This non-interventional comparative cross-sectional study was conducted in the Department of Human Anatomy at B.P. Koirala Institute of Health Sciences following Institutional Research Board's permission. This study was conducted in normal healthy pure ethnic population in a sample size of 600 (300 male and 300 female) belonging to a 17-26 age group in the Sunsari and Morang districts of Eastern Nepal. Data were collected among each ethnic group, i.e., Indigenous, Indo-Nepalese and Tibeto-Nepalese, each consisting of 200 individuals (100 male and 100 female) in collaboration with Department of Community Medicine and School of Public Health and Department of Community Dentistry, BPKIHS between November 2010 to January 2012. Random Sampling technique was done for data collection for the respective ethnic groups during community visits organized by both departments. The informed consent was collected by a questionnaire filled up by participants, which consists of general information along with craniofacial measurements. The participants were initially oriented to the purpose of the study and assured that anonymity would be maintained.

Inclusion criteria
- Healthy Subjects of pure ethnic groups of an age group of 17-26 year
- Residents of the Sunsari and Morang districts of Nepal.

Exclusion criteria
- Any Craniofacial injury or deformity
- Subjects with Chronic/Systemic diseases
- Subjects having family history of intercaste marriage
- Subjects who did not wish to take part in the study

The mean age of all participants was 20.21 years, which included males as 20.81 years and females as 19.61 years.

The participants were asked to sit on a chair in relaxed condition with their heads in anatomical position, and the measurements were taken using a sliding calliper with standard anatomical landmarks.

All the measurements were carried out after careful palpation of the head for anatomical land-

Classification	Range
Dolicocephalic (long and narrow head)	<74.9
Mesocephalic (average head shape)	75.0-79.9
Brachycephalic (broad and short head)	80.0-84.9
Hyperbrachycephalic (very broad and short head)	85.0-89.9

marks, and measurements were taken with an Anthropometer Sliding Caliper (straight and curve) to the nearest 1 mm (Mibodi and Farahani, 2008).

Parameters measured
- Maximum Head Length in mm
- Maximum Head Breadth in mm

Data obtained from each subject were recorded in a special form and data, and were transferred to a computer in MS Excel software. The data collected was tabulated and analysed using Statistical Package Social Sciences (SPSS)-15.0 version software. One-way Anova was used to compare the means among three different ethnic groups whereas independent t-test was used to compare the means between the sexes of different ethnic groups. The 'p' value (0.05) was considered to see the significance differences.

Operational definitions
1. Maximum Head Length (MHL): It is the distance between glabella (g) to opisthocranium (op).
   a. Opisthocranium (op) - Most prominent point on dorsal surface of head in midsagittal plane.
   b. Glabella (g) - Median eminence between two ciliary arches.
2. Maximum Head Breadth (MHB): It is the maximum breadth taken right angle to midsagittal plane using a spreading caliper.
3. Cephalic Index (CI): It is the ratio of maximum head breadth to maximum head length multiplied by 100.

$$CI = \frac{\text{Head Breadth}}{\text{Head Length}} \times 100$$

Depending upon indices the types of head shapes were classified as given below (Panero, 1979). Head Shape Range of Cephalic Index (CI) (%)

RESULTS

Table 1 showed comparison of Mean, SD and 'p' value between males and females concerning anthropometric parameters. This table showed highly statistically significant difference in MHL, MHB and CI. Both males and females of Eastern Nepal were Brachycephalic (81.16±3.16 and 81.85±3.02 respectively).

Table 2 showed that there was high statistically significant difference seen in all the parameters in all ethnic groups (p<0.001). MHL and MHB were highest in Indo-Nepalese population. The CI of Tibeto-Nepalese , Indigenous and Indo-Nepalese was 84.75±0.99 (Brachycephalic), 82.17±1.17 (Brachycephalic), and 77.60±0.65 (Mesocepalic)

Table 1. Mean, standard deviation and 'p' value of parameters compared between males and females in the entire sample

Parameters	MALE (Mean±SD)	FEMALE (Mean±SD)	p-value
MHL(mm)	182.01±9.92	175.61±7..17	<0.001***
MHB(mm)	147.46±4.57	143.55±2.16	<0.001***
CI	81.16±3.16	81.85±3.02	0.006***

p<0.05**= Statistically significant difference; p<0.001***= high statistically significant difference; p>0.05 NS= no statistically significant difference.

respectively.

Table 3 showed the comparison of Mean, SD and 'p' value of males only among under study ethnic groups. This table showed that there was highly statistically difference in all parameters among all three ethnic groups. The CI were 84.70±1.06 (Brachycephalic), 81.42±1.10 (Brachycephalic) and 77.35±0.67 (Mesocephalic) for Tibeto-Nepalese, Indigenous and Indo-Nepalese males.

Table 4 showed comparison of Mean,SD and 'p' value of females only in all ethnic groups. This table showed that there was highly statistically difference in all parameters (p value <0.001) among all three ethnic groups except MHB (p=0.51). The CI were 84.80±0.91 (Brachycephalic), 82.92±0.63 (Brachycephalic) and 77.85±0.52 (Mesocephalic) for Tibeto-Nepalese, Indigenous and Indo-Nepalese females respectively.

DISCUSSION

Studies suggest that ethnicity as well as sex can be determined accurately with head measurements, which varies between major ethnic groups and even smaller population. The previous study found significant genetic variance component for Maximum head length and breadth in both sexes (Susane et al., 1983). The study conducted in Gujrat state of India found the Mean head length of males as 18.26 cm and females 16.5 cm (Shah and Jadhav, 2004). Anthropological studies conducted based on population changes have revealed that people from Africa, India, Australia, Central part of Europe and North America are dolicocephalic; head shapes of people in the Pacific Ocean are brachycephalic, while in the Middle East, Russia and Central part of Europe the head shapes are mesocephalic and most people living along the borders of the Atlantic Ocean are of the mesocephalic type (Chamella et al., 1997; Golalipour et al., 2003).

MHL and MHB in mm in males (182.01±9.93, 147.46±4.57 respectively) were found to be greater than the females (175.61±7.16, 143.55±2.16 respectively). The mean CI of both males and females of all ethnic groups were 81.16 and 81.85 respectively. The cephalic indices obtained in this study were lower than those of other studies such as study conducted in India (Rajlakshmi et al., 2001) and Iran (Golalipour, 2006) which was 88.4±1.1 and 84.8±6.9 and respectively, while it was higher than studied conducted in South Africa (Jordaan, 1976) which was 80.29±0.89. Since Eastern Nepal lies in the temperate zone, the classification of the subjects as brachycephalic has been in agreement with the study carried out in India, which concluded that head form is brachyce-

Table 2. Mean, standard deviation and 'p' value of parameters among all ethnic groups taking into account both sexual series together.

Parameters	Tibeto-Nepalese (TN) (Mean±SD)	Indigenous (IN) (Mean±SD)	Indo-Nepalese (IND) (Mean±SD)	p-value
MHL(mm)	172.02±5.78	174.94±2.69	189.49±6.29	<0.001***
MHB(mm)	145.76±4.68	143.73±1.81	147.02±4.37	<0.001***
CI	84.75±0.99	82.17±1.17	77.60±0.65	<0.001***

p<0.05**= Statistically significant difference; p<0.001***= high statistically significant.

Table 3. Mean, standard deviation and 'p' value of parameters among males of all ethnic groups.

Parameters	Tibeto-Nepalese(TN) (Mean±SD)	Indigenous (IN) (Mean±SD)	Indo-Nepalese (IND) (Mean±SD)	p-value
MHL(mm)	175.21±5.80	176.36±1.99	194.464.94	<0.001***
MHB(mm)	148.38±4.72	143.58±1.68	150.41±3.60	<0.001***
CI	84.70±1.06	81.42±1.10	77.35±0.67	<0.001***

p<0.05**= statistically significant difference; p<0.001***= high statistically significant difference; p>0.05 NS= no statistically significant difference.

Table 4. Mean, standard deviation and p value of parameters among females of all ethnic groups.

Parameters	Tibeto-Nepalese (TN) (Mean±SD)	Indigenous (IN) (Mean±SD)	Indo-Nepalese (IND) (Mean±SD)	p-value
MHL(mm)	168.82±3.51	173.51±2.54	184.51±2.29	<0.001***
MHB(mm)	143.14±2.80	143.87±1.93	143.63±1.48	0.51 NS
CI	84.80±0.91	82.92±0.63	77.85±0.52	<0.001***

p<0.05**= statistically significant difference; p<0.001***= high statistically significant difference; p>0.05 NS= no statistically significant difference.

phalic in temperate zones and is longer (dolicocephalic) in tropical zones (Bharati et al., 2001). However, the results of a previous work on one-day-old normal neonates in Maiduguri (Garba et al., 2008) and a similar study carried out in India (Tuli et al., 1995) revealed that the dominant head type was dolicocephalic. The study conducted in Easten Africa revealed that black Africans tend to have more dolicocephalic head than their white peers within the first 2 years of life (Okanlawon et al., 1990).

In the study conducted in Iran in normal newborns, the CI was found to be 77.00±5.21 and 77.97±5.35 in Turkman and Fars Races respectively (Golalipour et al., 2003). The study results were in agreement with head shapes compared with similar studies in North Iran (Golalalipour, 2006) and Chile (Del Sol, 2005), where the dominant types of head shapes were found to be Mesocephalic in both.

On the other hand, when compared among all 3 ethnic groups under study, there was highly significant difference (p<0.001) in MHL, MHB and CI. MHL and MHB were highest in Indo-Nepalese population. The CI of Tibeto-Nepalese, Indigenous and Indo-Nepalese were 84.75±0.99 (Brachycephalic), 82.17±1.17 (Brachycephalic), and 77.60±0.65 (Mesocepalic) respectively. Again, there was highly significant difference (p<0.001) in MHL, MHB and CI when compared among males and females of all 3 ethnic groups separately, but in the case of females MHB showed no significant difference (p=1.000). MHL was found to be shortest in case of Tibeto-Nepalese males 175.21±5.80, MHB highest for Indo-Nepalese males (150.41±3.60). The CI were 84.70±1.06 (Brachycephalic), 81.42±1.10 (Brachycephalic) and 77.35±0.67 (Mesocephalic) for Tibeto-Nepalese, Indigenous and Indo-Nepalese males respectively. MHL were found to be shortest in case of Tibeto-Nepalese females with 168.82±3.51. The CI were 84.80±0.91 (Brachycephalic), 82.92±0.63 (Brachycephalic) and 77.85±0.52 (Mesocephalic) for Tibeto- Nepalese, Indigenous and Indo-Nepalese females respectively.

The results showed that there was highly statistically significant difference in MHL, MHB and CI (p<0.001) when compared between both sexes among all participants. It can thus be concluded that males and females of Eastern Nepal were Brachycephalic (81.16±3.16 and 81.85±3.02 respectively).

Further, data obtained from this study, would be used as local standards for diagnostic and anthropometric evaluation useful for Surgeons, Anthropologists, Forensic experts, Criminal investigators and Nutritionists. More in-depth extensive studies involving other population groups belonging to both sexes in various age groups in other regions of Nepal would be helpful in evaluation of craniofa-cial anthropometric dimensions while evaluating the effect of ethnicity, culture and environment. Further, long-term, extensive-population based studies can be also planned for identifying and establishing the genetic and environmental influences on various anthropometric parameters.

Conclusion: The results showed ethnic variations in all parameters indicating the influence of ethnicity on cranial anthropometry. This type of craniofacial anthropometric study was new and innovative in the context of Nepal, and the results obtained from the study would be helpful to extend the knowledge of the Craniofacial Anthropometry of different ethnic groups residing in various parts of Nepal. Therefore, there should be need for further studies to know the scientific reasons behind variations in measurements among different ethnic groups in this country.

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