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MAIN ARTICLE

Craniofacial anthropometry in newborns of Sikkimese origin

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Abstract

Background: Head and face dimensions vary according to race and geographical zone. Hereditary factors also greatly affect the size and shape of the head. There are important medical applications of craniofacial data specific to different racial and ethnic groups.

Methods: Various cranial and facial anthropometric parameters were assessed in singleton, healthy, full-term newborns of Sikkimese origin in a tertiary care hospital in Sikkim, India. The data were then analysed to determine statistically significant differences between sexes.

Results: Forty-five newborns were included in the study. Both male and female newborns were observed to be hyperbrachycephalic and hyperleptoprosopic. The only significant difference between the sexes was in commissural length, which was observed to be greater in male newborns.

Conclusion: Craniofacial parameters in Sikkimese newborns vary in comparison with those of other newborns from around the world. Larger studies are needed in order to reveal sex-related variations. Similar studies on various racial groups in North-East India are needed to establish standards for populations with East Asian features.

Key words: Anthropometry; Cephalometry; Facial Anthropometry; Neonates

Introduction

An individual is recognised visually by his or her craniofacial features. These features might reveal an individual's racial and ethnic identity.[1] Assessment of craniofacial anthropometric parameters helps to establish standards for a given racial or ethnic group, and thereby assists in congenital anomaly diagnosis and syndrome identification. Such data are also useful in forensic medicine, dentistry, reconstructive surgery and so on.[1,2] Craniofacial parameters in newborns are important health indicators in this age group.[3] Anthropometric parameters are affected by factors related to genetics, environment, geography, sex and age.[4]

Newborn craniofacial anthropometry data from India, particularly North-East India, are sparse. North-East Indians have East Asian features, and hence different populations in North-East India need to be compared not only with each other but also with those from other parts of East Asia to determine the differences. Sikkim, a state in North-East India, represents a zone of intermingling between people of Tibetan descent and Nepalese origin, and migrants from other parts of India. Hence, it is expected that the data from Sikkim will be unique, with both similarities to and variations from craniofacial data collected in other North-East Indian states and the neighbouring regions in South Asia. Craniofacial anthropometry data on North-East Indian newborns do not currently exist. The authors of the present study attempted to lay down standards for craniofacial anthropometry in Sikkimese newborns and provide a reference for future studies.

Materials and methods

This cross-sectional epidemiological study was conducted in the postnatal ward of the Central Referral Hospital, Gangtok, India, from 1 July 2009 to 31 December 2009. The study included singleton, healthy babies born at full-term (according to dates and gestational assessment), irrespective of birth weight, mode of delivery, community and sex. All pre-term babies, those requiring intensive care, and those with obvious deformities or injuries were excluded from the study. Babies with intrauterine or postnatal complications were also excluded from the study.

Institutional ethics committee clearance was obtained prior to commencement of the study. Informed written consent was obtained from the parents prior to craniofacial measurement of the newborns.

The measurements were obtained to the nearest 1 mm with spreading callipers when the babies were

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sleeping or in a restful state, 24–48 hours after delivery. The tips of the callipers were covered with disposable plastic ware. All measurements were obtained by a single observer.

The following dimensions were measured: (1) head length (greatest anteroposterior diameter) – distance between the glabella and the inion; (2) head breadth – maximum transverse diameter between the two euryon points; (3) face length – distance between the nasion and the gnathion; (4) face breadth – distance between the zygomatic bones; (5) intercanthal distance – distance between the medial canthi; (6) lateral canthal distance – distance between the lateral angles of the two palpebral fissures; (7) ear length – distance between the superior and inferior aspects of the ear; (8) commissural distance – distance between the corners of the mouth; and (9) philtrum length – distance between the columella base and the midline depression of the vermilion border.

The cephalic (cranial) index (i.e. head width × 100 / head length) and prosopic (facial) index (i.e. face length × 100 / face width) percentages were determined based on the standard anatomical description. Head and face shapes were classified according to these indices, as reported by William *et al.* (Tables I and II).[5]

Data were collected on a pre-designed proforma. The observations for male and female newborns were compared and the differences were analysed for statistical significance using the Statistical Package for Social Sciences software, version 17.0 (SPSS; Chicago, Illinois, USA).

Results

Forty-five newborn infants were examined during the study period. Of these, 29 (64.4 per cent) were male and 16 (35.6 per cent) were female. The majority of the newborns were from the Nepalese community. Among the others, Bhutias and Lepchas were predominant (Table III).

Most measurements were larger in male newborns than female newborns, with the exception of head length, face length and philtrum length, which were larger in female newborns. However, only commissural distance was significantly larger in male than female newborns. There were no significant differences between the sexes for the other craniofacial parameters (Table IV). The mean cephalic index percentages for male and female newborns were 90.87 and 88.67 respectively. The mean prosopic index percentages for male and female newborns were 100.02 and 97.26 respectively. Thus, all the newborns, irrespective of sex, were hyperbrachycephalic and hyperleptoprosopic.

TABLE I
HEAD SHAPE CLASSIFICATION BASED ON CEPHALIC INDEX[5]

Head shape	Cephalic index range (%)
Dolichocephalic	<74.9
Mesocephalic	75–79.9
Brachycephalic	80–84.9
Hyperbrachycephalic	85–89.9

TABLE II
FACE SHAPE CLASSIFICATION BASED ON PROSOPIC INDEX[5]

Face shape	Prosopic index range (%)
Hypereuryprosopic	<79.9
Euryprosopic	80–84.9
Mesoprosopic	85–89.9
Leptoprosopic	90–94.9
Hyperleptoprosopic	>95

TABLE III
ETHNIC DISTRIBUTION OF NEWBORNS

Ethnicity	Frequency (%)
Nepali	23 (51.1)
Lepcha	4 (8.9)
Bhutia	9 (20.0)
Others	9 (20.0)
Total	45 (100.0)

TABLE IV
CRANIOFACIAL MEASUREMENTS IN MALE AND FEMALE NEWBORNS

Parameter	Mean ± SD (cm)		p
	Males*	Females†	
Head circumference	34.53 ± 1.52	34.28 ± 1.30	0.58
Head length	10.03 ± 0.74	10.05 ± 0.52	0.92
Head width	9.17 ± 0.79	8.89 ± 0.57	0.21
Cephalic index	90.87 ± 6.63	88.67 ± 6.83	0.29
Face length	5.78 ± 0.49	5.59 ± 0.46	0.11
Face width	5.78 ± 0.36	5.69 ± 0.39	0.42
Prosopic index	100.02 ± 8.26	97.26 ± 7.06	0.26
Intercanthal distance	2.31 ± 0.24	2.81 ± 0.25	0.67
Lateral canthal distance	7.36 ± 0.62	7.14 ± 0.46	0.28
Philtrum length	0.74 ± 0.10	0.75 ± 0.09	0.62
Commissural distance	2.74 ± 0.22	2.59 ± 0.19	0.02
Ear length	3.11 ± 0.29	2.99 ± 0.22	0.14

*$n = 29$; †$n = 16$. SD = standard deviation

Discussion

In the current study, commissural length, which was higher in male compared with the female newborns, was the only craniofacial parameter to vary significantly with sex. The newborns were hyperbrachycephalic and hyperleptoprosopic, reflecting a broad skull and a long face.

The cephalic index percentages for male and female newborns in the current study were 90.87 and 88.67 respectively. Thus, the newborns' skulls were hyperbrachycephalic and there was no significant difference between the sexes. In a study on Manipuri newborns,

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the mean cephalic index was 88.4 per cent for full-term newborns, indicating hyperbrachycephalic skulls.[6] This finding is comparable to that of the current study. Nigerian newborns of various tribes were reported to be dolichocephalic or mesocephalic.[4] Brazilian neonates were observed to have a mean cephalic index as high as 98.0 per cent.[7] The adult population of the Gurung community of Nepal has been observed to be brachycephalic.[8] Hereditary and environmental factors affect the shape of the head; the cranial anthropometry of various races is primarily influenced by these two factors.[3]

The mean prosopic index percentages for male and female newborns in the current study were 100.02 and 97.26 respectively. This indicated a hyperleptoprosopic skull, which implies a longer (rather than broad) face shape. There was no significant variation in terms of the sex of the newborns. A North Indian study reported euryprosopic skulls in newborns at full-term.[9] Nigerian newborns were found to have a hypereuryprosopic face.[3] Other studies indicate highly variable results, albeit in the adult population. Hyperleptoprosopic, mesoprosopic and euryprosopic skulls have all been reported in the general Indian population.[10–13] A detailed analysis of anthropometry data among populations of North-East India, the region to which Sikkim belongs, suggested that most of the tribes from this region have a mesoprosopic face and a few have a euryprosopic face. Only two tribes included in the analysis were reported to have a leptoprosopic face and none had a hyperleptoprosopic face. It must be noted that these studies were not conducted on newborns; hence, comparison is precluded. Despite the authors' best efforts, no similar studies could be found on newborns from this region.

The mean philtrum lengths for male and female newborns in the current study were 0.74 cm and 0.75 cm respectively. The difference between sexes was not significant. Agnihotri and Singh revealed a significant difference between sexes, reporting respective philtrum lengths of 0.89 cm and 0.77 cm in North Indian male and female newborns.[14] Chinese newborns, who have East Asian features like the Sikkimese, have been shown to have a shorter philtrum length than Caucasian newborns.[15] In contrast, Korean infants have been observed to have a philtrum length of around 0.95 cm.[16]

As in our study, a study on Singapore newborns revealed no significant difference between sexes in terms of ear length.[17] However, the Singapore newborns had a larger ear length (3.64 cm) than the newborns in the current study (3.11 cm and 2.99 cm for male and female newborns respectively). The average length of the Singaporean newborn pinna was comparable to that of Japanese newborns, but longer than in Hong Kong Chinese and African newborns, and shorter than in Caucasian newborns. Nigerian newborns have been reported to have a mean ear length of 3.2 cm, which is somewhat longer than that in the current study.[18] Some studies have reported a variation in ear length on account of sex, whereas others have found no relationship between sex and ear length.[17] Anthropometric assessment of the pinna according to ethnicity is essential to establish norms for the diagnosis of various dysmorphogenesis and congenital disorders. Shorter fetal ear length has been associated with aneuploidy and trisomy 21.[19,20]

Commissural length was the only craniofacial parameter in the current study to vary significantly according to sex, with the distance being greater in male than in female newborns (2.74 *vs* 2.59 cm respectively). This finding is not supported by a study of North Indian newborns, which reported lengths of 2.49 cm and 2.45 cm for males and females respectively.[14] Nigerian newborns were found to have a mean commissural length of 3.1 cm, which is longer than the distance reported in the current study and in the North Indian newborn study.[18] Korean newborns were reported to have a mean oral commissural length of 2.68 cm, which is similar to the finding of the current study.[16]

The intercanthal distance and the lateral canthal distance in the current study were not significantly different in male and female newborns. The mean intercanthal distance was similar to that observed by Agnihotri and Singh in North Indian newborns, although this distance was greater in the current study.[14] (Agnihotri and Singh did not report lateral canthal distances.) Nigerian newborns were also found to have smaller intercanthal and lateral canthal distances than those in the current study, with means of 2.1 cm and 6.1 cm respectively.[18] Bulgarian and German newborns also had smaller intercanthal distances than the newborns in the current study.[21]

- **In the neonatal period, the lower portion of the face might show variations on account of sex**
- **Craniofacial anthropometry data on North-East Indian or East Asian populations are sparse**
- **The measurements for other populations, including East Asian and Indian, vary greatly from the Sikkimese population, which has distinct East Asian features**
- **Similar studies are needed to establish reliable standards for medical applications**

To encapsulate, sex does not generally appear to affect craniofacial parameters, although larger studies are needed to establish or disprove this finding. Previous studies indicate that in the neonatal period, the lower portion of the face might show variations on account of sex.[22] Some of the parameters recorded in this study have not previously been reported for North-East Indian or East Asian populations. Hence, it is currently difficult to draw comparisons with similar populations. Craniofacial anthropometric parameters of populations from other parts of the world vary greatly from those of the Sikkimese population, which has distinct East Asian features. Similar studies on races from North-East India, and on other ethnic and racial groups from around the country, are needed to establish reliable standards for medical applications.

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