



ORIGINAL RESEARCH ARTICLE

STUDY OF CEPHALIC INDEX IN NEWBORNS OF KAVRE REGION

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ABSTRACT

Background: The cephalometry of newborn within first few days is important for assessment of health status, neonatal death, growth and development. The objective of the study is to provide a baseline data for cephalic index and to observe sexual dimorphism.

Methods: The present study was cross sectional type. It consisted of 138(72 males, 66 females) healthy neonates born in Dhulikhel hospital via vaginal delivery. It was conducted from June 2019 to March 2020 after receiving ethical approval. The cephalic index was derived after measuring length and breadth of head. The collected data was entered in excel and analyzed with SPSS (16.0).

Results: The conducted study revealed the overall cephalic index as 86.51 ± 4.95 and head circumference to be 336.05 ± 13.87 mm. The values of head circumference and head length of males were higher than that of females. The head breadth of males was found to be significantly higher than that of females. The most common type of head type was hyperbrachycephalic with prevalence of 37.7% (40.3% males and 34.8% females).

Conclusions: This study concluded that the majority type of head was hyperbrachycephalic. The length, breadth and circumference of head values were higher in males than that of females.

INTRODUCTION

The study of head growth begins with knowledge of normal skull. Cephalometric dimensions are affected by genetics, age, race and gender in addition to geographic, biological, ecological factors.¹⁻⁴ Cephalic index is one of the important parameter for classification of individuals of unknown identity.⁵

The World Health Organization considered cephalometry as an index for the normality of neonates skull and brain.⁴ The anthropometric measurements of newborn within first few days is important for assessment of health status, neonatal death, growth and development.⁶⁻⁸ On the other hand, dimensions of newborn's head can be a good predictor for failure in progress of labor which ends at cesarean section.⁹

Researchers have conducted many studies on the basis of sex and racial groups in different geographical zones.^{1,10-12} The brachycephalic type has become dominant in different communities.^{4,13,14} Taking demographic into account central parts of Europe, Indian population have mesocephalic head.^{3,6,15,16}

Although anthropometric data of neonates have been carried

out in other parts of the world, it is generally lacking in developing countries. The standard value of cephalometric has some limitation regarding with environmental and nutritional factor. The purpose of this study is to provide a baseline data for cephalic index and to observe sexual dimorphism. Cephalometric results may be helpful for pediatricians to detect the deformities of abnormalities of head shape and also for obstetricians by helping in detection of cephalopelvic disproportion.^{3,7,9} These data will also help anthropologist and forensic expert for identification of the racial differences and gender differences.^{5,18}

METHODS

The present study design was cross sectional which was conducted in the Department of Anatomy and data was collected from the Department of Obstetrics and Gynecology Post Natal ward, Kathmandu University Hospital, Dhulikhel during the period of June 2019 – March 2020. The ethical clearance was obtained from Institutional Review Committee of Kathmandu University School of Medical Sciences (IRC-KUSMS Ref. no. 153/19). Convenient sampling technique was used for

data collection.

Sample size was calculated as:

$$n = z^2 \times p(1-p) / e^2$$

$$n = 96$$

Where, n= minimum required sample size

z= 1.96 at 95% confidence interval

p= prevalence, 50%

q= 1-p

e= margin of error, 10%

Considering the non-response rate of 20% final sample size was 116. A total of 138(72 males, 66 females) healthy neonates born in Dhulikhel hospital via vaginal delivery were evaluated within 24 hours of birth. The collected samples were considered for comparative analysis. The parents of all these infants were from Kavre region. Informed consent was taken from parents prior to the measurement of neonate. Verbal consent was taken from parents before taking the photographs. Healthy full term (gestational age more than 36 weeks) neonates with stable health within 24 hours from birth were included in this study. The babies with craniofacial abnormalities such as cleft palate, cleft lip, micrognathia, caput cephalohematoma and hydrocephalous were excluded from this study. Mother with Gestational Diabetes Mellitus, Gestational Hypertension under chronic medication and babies transferred to Intensive Care Unit, Incubator due to any health issues were also excluded.



Figure 1: Photograph showing measuring head length



Figure 2: Photograph showing measuring head breadth

The head length was measured as the distance from glabella to inion (Figure 1) and breadth was measured as the distance between two parietal prominences (Figure 2) with the spreading caliper rounded Galaxy (G108) in millimeter. All the measurements have been taken following the techniques of Martin and Saller.¹⁹ Cephalic Index was measured as the ratio of head breadth to head length multiplied by 100.¹⁹ The head circumference was measured around the maximum fronto-occipital circumference by tapes meter without elasticity (Figure 3).



Figure 3: Photograph showing measuring head circumference

Classification of type of head as given by Martin and Saller is given below.¹⁹

Type of head	Cephalic index
Dolicocephalic (long head)	<75.9
Mesocephalic (round head)	76-80.9
Brachycephalic (broad head)	81-85.9
Hyperbrachycephalic (very broad head)	86-90.9
Ultrabrachycephalic	>91

Data was collected and entered in Microsoft excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 16.0 for descriptive statistical analysis.

RESULTS

The study was done among 138(72 males, 66 females) healthy neonates born in Dhulikhel hospital. The conducted study revealed the overall mean value of cephalic index as 86.51±4.95 and head circumference to be 336.05±13.87 mm (Table 1).

Table 1: Descriptive statistics of head in millimeter (n= 138)

	Minimum (mm)	Maximum (mm)	Mean±SD
Head circumference	305.00	370.00	336.05±13.87
Head length	95.00	125.00	107.31±5.91
Head breadth	78.00	105.00	92.69±4.98
Cephalic index	73.87	97.94	86.51±4.95

Table 2: Descriptive statistics of head in millimeter (n= 138)

	Males (n= 72)			Females (n= 66)		
	Minimum	Maximum	Mean±SD	Minimum	Maximum	Mean±SD
Head circumference	310.00	370.00	336.87±14.52	305.00	370.00	335.15±13.18
Head length	95.00	125.00	108.27±6.07	96.00	118.00	106.27±5.59
Head breadth	78.00	105.00	93.77±4.33	78.00	105.00	91.51±5.39
Cephalic index	75.81	97.22	86.77±4.78	73.87	97.94	86.23±5.15

As seen in Table 2 the value of head circumference and head length of males were higher than that of females. The study also showed that the head breadth of males was found to be higher than that of females.

As illustrated in Table 3 the present study observed that the most common type of head type was hyperbrachycephalic with prevalence of 37.7% (40.3% males and 34.8% females) which was followed by brachycephalic with a prevalence of 25.4 % (25.0 % males and 25.8 % females), ultrabrachycephalic with a prevalence of 21.0 % (20.8 % males and 21.2 % females), mesocephalic with a prevalence of 14.5 % (12.5 % males and 16.7 % females) and dolicocephalic with a prevalence of 1.4 % (1.4 % males and 1.5 % females).

Table 3: Head shape pattern in relation with sex

Head type	Total n= 138 (%)	Males n= 72 (%)	Females n= 66 (%)
Dolicocephalic	2 (1.4)	1 (1.4)	1 (1.5)
Mesocephalic	20 (14.5)	9 (12.5)	11 (16.7)
Brachycephalic	35 (25.4)	18 (25.0)	17 (25.8)
Hyperbrachycephalic	52 (37.7)	29 (40.3)	23 (34.8)
Ultrabrachycephalic	29 (21.0)	15 (20.8)	14 (21.2)
Total	138 (100)	72 (100)	66 (100)

DISCUSSION

Craniofacial assessments of newborns are important measures for physical examination in children and useful in evaluating the health and development of children.¹⁰ The cephalic index helps to identify cranial capacity which reveal the volume of the brain and also helps to predict mental ability.¹⁷ Therefore, we need to establish norms and standards based on ethnic, genetic, diet, sexual differences and environmental factors.

Head length: The mean head length was 107.31±5.91 mm in the present study. Various studies have been conducted worldwide among Nigerian¹⁰, Italian¹⁴, Turkish⁸, Iranian^{4,12,20} population which showed the greater mean values of head length than the present study. A study conducted among different tribes of South Africa among Bantu and Cape colored observed the mean head length to be higher than the our study.¹¹ Gopalipur et al. conducted study among Turkman and Fars races of Iran which revealed the greater mean values than our study.^{3,6}

In the present study, the mean head length of males and females were 108.27±6.07 mm and 106.27±5.59 mm respectively. The mean value in males was slightly higher than that of females.

In a study on Sikkimese newborns of North India, mean value of head length of males and females were 10.03 ±0.74 cm and 10.05 ±0.52 cm respectively.²¹ This finding is comparable to that of the current study. Few other studies conducted among Turkish,⁸ Nigerian¹⁰ and Indian^{13,15} newborns observed that the males had higher mean values but the overall mean values were greater than the present study. Garba et al. conducted a study among Nigerian newborns between two tribes Kanuri and Bura which had also similar finding like present study where the mean value of males were more.⁷

Head breadth: Many studies^{4,8,12,14,20} have reported the head breadth which is in accordance with the present study having mean value as 92.69±4.98 mm. A study done by Muhammad et al. in Nigerian newborns, revealed the mean value of head breadth to be higher than the conducted study.¹⁰ Gopalipur et al. had conducted different studies with certain interval of time among Turkman and Fars races reported lesser value than ours.^{3,6} Similarly, Jordaan et al. observed the head breadth among Bantu and Cape colored groups whose result is almost similar to our findings.¹¹

The mean value for head breadth in males (93.77±4.33 mm) was slightly higher than that of females (91.51±5.39 mm). In contrast, studies done on Indian,¹⁵ Nigerian¹⁰ and Turkish⁸ populations showed the mean values were higher than our study. Similar result was also found by authors who revealed the mean values of head breadth is higher among males in different region of India.^{13,21} But a study done on Kanuri tribes of people in Nigeria claimed that the females head breadth values are more than that of males.⁷

Head circumference: Few studies reported the mean value of head circumference which is not supported by the results of the current study.^{4,8,14,22} Gopalipur et al. observed the mean value of head circumference among Turkman (346.42±14.06) and Fars (346.39±17.82) group. These findings differ from the present study regarding head circumference.³ Another study on Kurdish newborn in Italy, reported increase in head circumference length directly related to parity of mother and gestation of the newborn.²³

A study done in UK among European, Chinese, South Asian descent newborns revealed Chinese and South Asian newborns had smaller head circumference than European newborns.²⁴ A study claimed that nulliparous mothers of large fetal head circumference are at risk of primary cesarean section and assisted vaginal delivery relative to the mothers who had average fetal head circumference.²⁵ Another study done on Spanish

population also observed that alcohol consumption diminishes the head circumference of newborns.²⁶ In the present study, the mean head circumference in males (336.87±14.52 mm) is slightly higher than that of females (335.15±13.18 mm). Many studies reported the mean values to be higher than conducted study but observed the similar trend revealed females had lower values than males.^{21,22,27} In newborns, the mean head circumference was noticed to have females values higher than that of males which is not consistent with the current study.⁸ The author mentioned that Kanuri and Bura groups of newborns had similar pattern who reported males mean head circumference values were higher than females.⁷

Cephalic Index: The overall minimum value for cephalic index found in this study was 73.87% and the maximum value was 97.94%. The mean value of cephalic index found to be 86.51±4.95. In contrast, study done among newborns of Iranian,^{4,12,20} Nigerian,¹⁰ Italian¹⁴ and Indian¹⁵ reported to have lower values. Similarly, a study done by Pankaj et al. mentioned lesser values of mean cephalic index in Himachal Pradesh (80.97±4.18), lower hills (80.34±4.43), inner Himalaya (82.12±4.12) than the current study.¹³

The mean value of cephalic index in males (86.77±4.78 mm) in this present study, was almost similar with females (86.23±5.15 mm). In a study on Sikkimese newborns of North India, mean value of cephalic index of males and females were 90.87 and 88.67 respectively.²¹ This finding differ from the present study having greater values than ours. The mean cephalic index values seen in few studies^{7,10,15} are lower than the mean cephalic index values of present study. A study done on different regions of India observed lower mean values it was revealed in which females had higher values than males.¹³

The types of head shape which is described in this study had also been discussed in other studies in Indian,^{1,13,15} Italian,¹⁴ Iranian,^{3,4,6,12} Nigerian^{7,10} and Polish¹⁶ children. A study done by Sinha et al. on Sikkimese origin Indian population was in accordance with our study who reported hyperbrachycephalic type of head as most common type.²¹ In contrast with our study few studies reported hyperbrachycephalic to be least observed.^{3,4,6,10,12,15} Garba et al. who studied in Nigerian population reported absent of hyperbrachycephalic type of head in the males.⁷ A study conducted in Polish population claimed the second most common cranial type is hyperbrachycephalic.¹⁶

Studies done on Nigerian newborns of various tribes reported to be dolichocephalic or mesocephalic or brachycephalic.^{7,10} Studies conducted in many geographical region of Iran concluded the dominant type of head to be mesocephalic type.^{3,6,12} However, Eivazi et al. conducted a study on Iranian neonates reported brachycephalic type of head to be most common.⁴ Sikka et al. observed the overall type of head is mesocephalic but coming to different endogamous group it varied to be mesocephalic and brachycephalic.¹ Similarly, few studies conducted in northern¹³ and southern¹⁵ part of India concluded brachycephalic and mesocephalic respectively dominant type of head. A study done among Italian population

found that the brachycephalic was the dominant type of head which when compare with present study it is second most common type of head.¹⁴ But a study conducted in Polish population reported the dominant cranial type in their study as mesocephalic.¹⁶ Researches conducted on various places among Indian,¹³ Italian,¹⁴ Iranian⁴ and Nigerian¹⁰ population found the most rare type of head to be dolicocephalic type of head which was comparable to the present study.

In relation to sex, the most common head shape found in the present study is hyperbrachycephalic in both males (40.3 %) and females (34.8 %). The dominant hyperbrachycephalic head shape found in this study resembles similar reports in Indian population of Sikkimese origin.²¹ In contrast, studies done on Southern Odisha, India¹⁵ and Sokoto, Nigeria¹⁰ they found hyperbrachycephalic as least common type in males having 1.80% and 6.25% respectively. Whereas, Garba et al. reported absent of hyperbrachycephalic in males.⁷

The reports of dolicocephalic head shape being rarest in females (4.25 %) from Sokoto, Nigeria¹⁰ is consistent with our findings of dolicocephalic head shape least common in males (1.4 %) and females (1.5 %). In contrast, Garba et al. reported dolicocephalic as most common type of head found in males (66.7%) and females (43.3%).⁷

A study done among Southern Odisha population found that the brachycephalic was the second common type of head in females (31.90%) which was comparable to the present study among both sex.¹⁵ But studies conducted among Indian¹ and Nigerian¹⁰ population reported the dominant cranial type in their study as brachycephalic. The observed variations may be associated to race, genetical, geographical and nutritional factors used in the previous studies.

For the first time, this study has provided valuable information on the cranial measurements and pattern of head shapes of newborns of Kavre, Nepal. This information could be of great clinical relevance in the diagnosis and treatment of cranial anomalies. Although the research has reached its aim, there were some unavoidable limitations. Due to unavailability of ample data, the measurements of neonatal head were evaluated with confined analysis in the present study. Thus, the data obtained from this study cannot be generalized for all Nepalese population as baseline data.

CONCLUSION

Present study concluded that the majority of type of head in neonates was hyperbrachycephalic. The length, breadth and circumference of head values were higher in males than that of females. Cephalometric results will be helpful for pediatricians to detect the deformities of abnormalities of head shape and also for obstetricians. These data will also help anthropologist and forensic expert and further researches.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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