ORIGINAL ARTICLE | ASIAN JOURNAL OF MEDICAL SCIENCES

Measurement of head circumference, head length, head width, intercanthal distance, ear length, and distribution of low-set ear in a healthy newborn population of West Bengal

Anasuya Ghosh[1], Subhramoy Chaudhury[2]

[1]Associate Professor, Department of Anatomy, AIIMS, Kalyani, [2]Associate Professor, Department of Anatomy, SMC, Bolpur, West Bengal, India

Submission: 02-05-2022 Revision: 28-08-2023 Publication: 01-10-2023

ABSTRACT

Background: Anthropometry is a process of systemic measurement of the human body and its different parts. A reference dataset of craniofacial measurements of a particular geographic area and particular age group is useful for reconstructive surgery of the face, orthodontic research, criminal and racial identification, assessment of the nutritional status of children and diagnosing dysmorphogenesis conditions. **Aims and Objectives:** The present study was conducted to obtain the measurements of craniofacial parameters, including head length, head width, head circumference, intercanthal distance, ear length, and ear position in normal- and low-birth-weight (BW) healthy newborn babies to prepare a dataset of these parameters. Another objective was to find out if there were statistically significant differences in the above parameters between male and female newborn population in normal- and low-BW (LBW) newborn groups. **Materials and Methods:** This study was conducted at the nursery, department of Pediatrics, RG Kar Medical College and Hospital, West Bengal (Eastern India), on 1571 healthy newborn babies (1-2 days old). **Results:** We obtained the range and mean value of all the parameters in newborn. No statistically significant sexual dimorphism was observed. The most common head shape was mesocephalic (45%). Low-set ear was found in 0.043–0.057% of cases, and no statistically significant difference was observed between normal and LBW newborn population regarding the distribution of low-set ear. Most of the craniofacial parameters had statistically significantly higher values in normal BW babies than in the low-birth-weight group. **Conclusion:** These data sets can be used by clinicians, and researchers as a reference for the newborn population of West Bengal.

Key words: Anthropometry; Craniofacial; Newborn; Low-birth weight; Auricle

Access this article online
Website:
http://nepjol.info/index.php/AJMS
DOI: 10.3126/ajms.v14i10.54589
E-ISSN: 2091-0576
P-ISSN: 2467-9100

INTRODUCTION

Anthropometry is the systemic collection and correlation of measurements of the human body and its different parts. Anthropometry can be used in the diagnosis and treatment of syndromes of dysmorphogenesis, plastic and reconstructive surgeries of the face, orthodontic research, identification of race, identifying racial variation, criminal identification, to assess the nutritional status of children, in ergonomics, etc.[1,2] The measurement of head circumference (HC) is an important screening procedure for detecting nutritional status, proper growth and anomalies of head growth. Auricular anomalies and intercanthal dimensions are important in the diagnosis and treatment of several congenital disorders, systemic syndromes, and genetic conditions.[3,4] "Low-set ear" indicates the depressed positioning of the pinna in two or more standard deviations below the population average, and this condition is also associated with some congenital syndromes.[5]

The published data about the standard craniofacial measurements and distribution of low-set ears in the

Address for Correspondence:
Dr. Anasuya Ghosh, Associate Professor, Department of Anatomy, All India Institute of Medical Sciences, Kalyani, West Bengal, India.
Mobile: +91-6291329015. **E-mail:** anasuyag70@gmail.com

newborn population of West Bengal is rare in literature. The main objectives of this study were the following to obtain baseline data of craniofacial parameters including head length (HL), head width (HW), HC, intercanthal distance (ID), ear length (EL); to acquire the knowledge about the distribution of various head shapes and low-set ear in the healthy newborn population of West Bengal; and to establish the sexual dimorphism if any.

Aims and objectives

The primary aim and objective of this study was to collect a baseline data about various craniofacial parameters in healthy newborn population of West Bengal, which is lacking in literature, for the clinicians of relevant disciplines.

MATERIALS AND METHODS

We conducted an observational, cross-sectional, hospital-based study at a Government Hospital of West Bengal with approval from the university ethics committee over 1½years (2009–2010). The inclusion criteria for the study population were as follows: healthy full-term newborn (37–40 weeks of gestation) without any birth asphyxia, distress or any obvious congenital anomaly, no maternal history of diabetes mellitus, hypertension, cardiac and renal diseases and having both parents born at West Bengal. According to the inclusion criteria, a total of 1860 babies were selected for this study. After obtaining informed ascent from the parents, anthropometric measurements could be performed on 1571 healthy newborns within 24–48 h of their birth. The measurements were taken with proper aseptic precautions at the Nursery of the Government Hospital in the presence of a resident pediatrician. The birth weight (BW) and identification details of the babies were collected from the babies' birth records. The HC was measured using a nonstretchable measuring tape and the rest of the parameters with spreading calipers, and digital calipers considering the error, if any. The study was performed between 2 and 4 pm on all the weekdays during the study period when the cases were asleep, and measurements were done by a single researcher to reduce interobserver bias. Every measurement was recorded twice by the same examiner, and the average of the two was taken (Figure 1).

The babies were divided into four groups: normal BW (NBW) male, NBW female, low BW (LBW) male, and LBW female. The following parameters were measured and noted.[1,6-14]

1. HL – glabella to furthest occipital point
2. HW – greatest breadth at the right angle to the median plane along the lateral aspect of the parietal bone
3. HC – diameter of the head above the supraorbital ridges and ears covering the occipital prominence
4. ID – the distance between the inner corners of eye fissures where the eyelids meet
5. EL – Superior to the inferior aspect of the ear
6. Ear position – "low-set ear" has been defined as ears placed below the imaginary central horizontal line drawn by joining both the medial canthi of eyes and extended to the side of the face
7. Cephalic index (CI) – (maximum width of skull/maximum length of the skull) * 100
8. BW – "LBW" has been defined as weight <2.5 kg (up to 2499 g) regardless of gestational age, weight being taken preferably within 1st h of life.

The obtained data were analyzed using Microsoft Excel and EpiCalc 2000 version 1.02 software.

RESULTS

The measurements of 1571 newborn babies were analyzed in the study; 890 babies were of NBW, whereas the rest were of LBW (Table 1).

The means and standard deviation of all the parameters were calculated and compared between NBW male and female babies (Table 2) and between low-birth-weight male and female babies (Table 3). No statistically significant sexual dimorphism was noted in any group.

The parameters were also compared between normal versus low-birth-weight male babies (Table 4) and between normal and LBW female babies. The HL, HW, HC, EL, and ID were statistically significantly higher in NBW males than LBW males. In the case of females, the HL, HW, ID and

Figure 1: Measurement of head length and head circumference

Table 1: Demographic data of the study population

Newborn group	Number	Percentage	Mean birth weight (kg)
NBW male	530	33.74	2.75
NBW female	360	22.92	2.9
LBW male	281	17.89	2.15
LBW female	400	25.46	2.16

Table 2: Comparison of parameters between NBW (normal birth weight) male and female babies

Parameters	Male (n=530)		Female (n=360)		P-value
	Mean	SD	Mean	SD	
Head length	11.5	0.387	11.549	0.438	0.58
Head width	8.82	0.331	8.86	0.451	0.63
Head circumference	34.254	0.881	33.56	5.319	0.35
Intercanthal distance	1.963	0.152	1.903	0.169	0.08
Ear length	3.417	0.288	3.377	0.245	0.497

Table 3: Comparison of parameters between LBW (low birth weight) male and female babies

Parameters	Male (n=281)		Female (n=400)		P-value
	Mean	SD	Mean	SD	0.58
Head length	11.004	0.463	10.943	0.412	0.63
Head width	8.277	0.179	8.449	0.336	0.35
Head circumference	32.588	1.376	32.859	0.965	0.08
Intercanthal distance	1.838	0.179	1.803	0.148	0.497
Ear length	3.269	0.235	3.238	0.275	0.72

Table 4: Comparison of parameters between NBW and LBW male babies

Parameters	NBW male (n=530)		LBW male (n=281)		P-value
	Mean	SD	Mean	SD	
Head length	11.5	0.387	11.004	0.463	0.000*
Head width	8.82	0.331	8.277	0.179	0.000*
Head circumference	34.254	0.881	32.588	1.376	0.000*
Intercanthal distance	1.963	0.152	1.838	0.179	0.002*
Ear length	3.417	0.288	3.269	0.235	0.02*

(*) means statistically significant

Table 5: Comparison of parameters between NBW and LBW female babies

Parameters	NBW Female (n=360)		LBW Female (n=400)		P-value
	Mean	SD	Mean	SD	
Head length	11.549	0.438	10.943	0.412	0.000*
Head width	8.86	0.451	8.449	0.336	0.000*
Head circumference	33.56	5.319	32.859	0.965	0.41
Intercanthal distance	1.903	0.169	1.803	0.148	0.007*
Ear length	3.377	0.245	3.238	0.275	0.023*

(*) means statistically significant

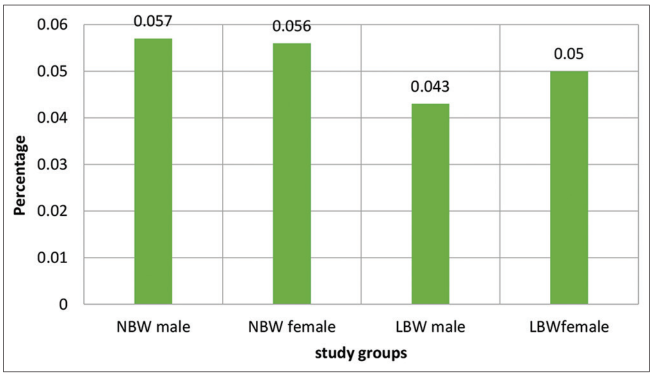

Figure 2: Distribution of low-set ear

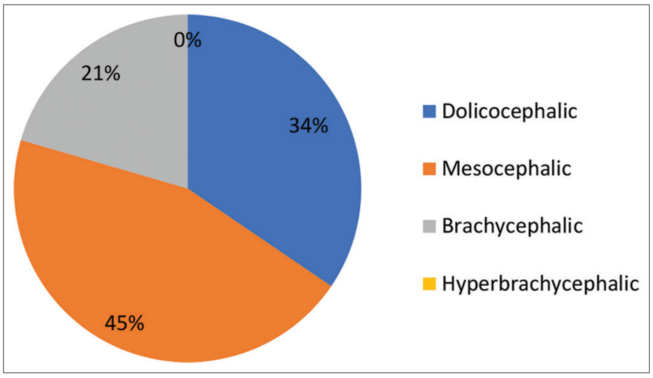

Figure 3: Distribution of head shapes

EL were statistically significantly higher in NBW females than the LBW females (Table 5).

The distribution of low-set ears has been tabulated (Figure 2). It varied from 0.043% to 0.057% in the study population. There was no statistically significant difference in the distribution of low-set ears in NBW babies versus LBW babies. The distribution of various head shapes in the population of West Bengal has been tabulated (Figure 3). The most common variety was mesocephalic in both genders, followed by dolichocephalic.

DISCUSSION

The present study provided a range of datasets for HL, HW, HC, ID, EL, CI and distribution of low-set ears in NBW and LBW male and female newborn population at West Bengal, Eastern India. This study could not establish any statistically significant sexual dimorphism; however, most of the parameters showed statistically significant higher values in NBW newborn than LBW newborn population.

The present study revealed average HL of NBW males newborn in West Bengal is 11.5± 0.387cm, which is comparable to the average HL of Turkman and Fars males newborn in Iran, where the values are 11.44±0.529 cm and 11.453 cm, respectively.[7] The average measurement in sikkimese males and females was 10.03±0.74 and 10.05±0.52 cm, respectively, which is relatively lower than the present study.[15]

The average HW and HC of normal male newborn in the present study were 8.82±0.331 cm and 34.254±0.881 cm, whereas those values were 8.804±0.632 cm and 34.998±1.485 cm, respectively, in the Turkman male newborn of Iran. Hence, the values of craniofacial parameters of Iran and West Bengal are quite similar.[7] The average HW and HC of male and female newborn were 34.53±1.52 and 34.28±1.30 and 9.17±0.79 and 8.89±0.57 cm, respectively, in the Sikkimese newborn quite close to newborn of West Bengal.[15]

In a study at Ludhiana, the HC of male and female newborn was 33.23±1.57 cm and 33.19±0.78 cm, respectively, which are slightly less to those of newborn of West Bengal.[1] In a study at Maiduguri Metropolis, the average HL, HW, and HC of male and female newborn showed slightly higher values than those of West Bengal.[16] In the same study, the CI of the male and female newborn of the Kannuri tribe were 70.03 and 77.15, respectively, whereas in West Bengal, these values were 76.17 and 76.78, respectively.[16]

The study conducted in Iran showed that dominant and rare types of head shapes were mesocephalic (36.5%) and hyperbrachycephalic (8.9%), respectively.[7] In the present study, the predominant head shape was mesocephalic (45%) too; however, the second-most common was dolichocephalic (34.5%). In a study at Gujarat, the mesocephalic was the predominant head shape.[17]

The study at Ludhiana showed the average ICD and EL in normal male newborn was 2.005±1.43 and 3.755±2.24 cm, respectively, whereas the values of the above parameters in the present study were 1.963± 0.152 cm and 3.417±0.288 cm, respectively.[1] The values of both studies are quite comparable.

The present study failed to show any statistically significant difference between the male and female newborn; however, previous studies[1,18] found statistically significantly higher values for EL in male newborn compared female newborn. The study by Fok et al., showed ear position was normal in nearly all newborn and this data supported our study findings.[18] In the present study, the maximum EL in female newborn was 40 mm, whereas a previous study in Germany reported the maximum EL in female newborn was 52 mm.[19] In a study at Puducherry, statistically significant higher values were noted in male EL. In another previous study on the Persian population most of the cranial parameters had statistically significant higher values in adult male; however, the present study could not find any such.[20,21]

The present study was conducted on 1–2 days old newborn population of Eastern India, which has been rarely done before as per published literature. This study included both normal and LBW healthy newborn of a considerable number which made the study unique. Future studies should be conducted on a multicentric approach on a larger population size, and on various age groups. The use of 3D photographs, stereophotograph, and computed tomography data of subjects and using special software for analyzing various parameters of the face might be able to produce a more dependable data set for clinicians.[22-27]

Limitations of the study

Some of the limitations of the study were following- it was limited to a single hospital, only a few cranio-facial parameters were measured, and all the measurements were manual. More detailed and exact values of all possible craniofacial parameters should be collected using advanced technologies in future studies.

CONCLUSION

The present study showed that the statistically significant sexual dimorphism could not be established in craniofacial parameters among newborn populations of West Bengal, Eastern India; however, the NBW newborn had statistically significant higher values of all the parameters than healthy LBW newborn. Distribution of low-set ear was 0.043–0.057% across the whole newborn population including babies of both genders and all BWs. Distribution of low-set ear did not vary statistically significantly across the normal and LBW newborn group. These results could be readily used as a reference data set by the clinicians and researchers for newborn pediatric population at this geographical area.

ACKNOWLEDGMENT

We would like to sincerely acknowledge Dr Tapan Sinha Mahapatra, Associate Professor, Department of Pediatrics, RG Kar Medical College and Hospital for allowing us to conduct this study and helping to make necessary arrangements at the nursery of the Department of Pediatrics, RG Kar Medical college. We would like to thank all the staffs and the residents of the Department of Pediatrics who helped us to conduct this study. Finally, I want to show my sincere gratitude to all the parents who gave their consent to participate in this study and the newborn babies, without whom the study would not have been possible.

REFERENCES

1. Agnihotri G and Singh D. Craniofacial anthropometry in Newborns and Infants. Iran J Pediatr. 2007;17(4):332-338.
2. Bailer JC 3rd, Meyer EA and Pool R. Anthropometric Measurements. Assessment of the NIOSH Head-and-face Anthropometric Survey of US Respirator Users. Washington,

DC: The National Academic Press; 2007. p. 29.

https://doi.org/10.17226/11815

3. Lian WB, Cheng MS, Tiong IH and Yeo CL. Auricular anthropometry of newborns at the Singapore General Hospital. Ann Acad Med Singap. 2008;37(5):383-389.

https://doi.org/10.47102/annals-acadmedsg.v37n5p383

4. Charles OA, Hakeem FB, Nervey DW and Mildred BA. Normal outer and inner canthal measurements of the Ijaws of Southern Nigeria. Eur J Sci Res. 2008;22(2):163-167.

5. Sivan Y, Merlob P and Reisner SH. Assessment of ear length and low set ears in newborn infants. J Med Genet. 1983;20(3):213-215.

https://doi.org/10.1136/jmg.20.3.213

6. Charan J and Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121-126.

https://doi.org/10.4103/0253-7176.116232

7. Reddy KS. The Essentials of Forensic Medicines and Toxicology. 34th ed. India: Jaypee Brothers Medical Publishers; 2017. p. 53.

8. Golalipour MJ, Haidari K, Jahanshahi M and Farahani RM. The shapes of head and face in normal male newborns in south-east of Caspian Sea (Iran-Gorgan). J Anat Soc India. 2003;52(1):28-31.

9. Farkas LG and Munro IR. Anthropometric Facial Proportions in Medicine. 1st ed. Illinois: Charles C Thomas Pub Ltd.; 1986. p. 250-252.

10. Kelly KM, Littlefield TR, Pomatto JK, Ripley CE, Beals SP and Joganic EF. Importance of early recognition and treatment of deformational plagiocephaly with orthotic cranioplasty. Cleft Palate Craniofac J. 1999;36(2):127-130.

https://doi.org/10.1597/1545-1569_1999_036_0127_ioerat_2.3.co_2

11. Kolar JC and Salter EM. Practical Measurement of Head and Face for Clinical, Surgical and Research Use. Craniofacial Anthropometry. Springfield: Charles C Thomas; 1997. p. 334.

12. Park K. Park's Textbook of Preventive and Social Medicine. 26th ed., Vol. 26. Madhya Pradesh: Banarsidas Bhanot Publishers; 2021. p. 398.

13. Jahanbin A, Rashed R, Yazdani R, Shahri NM and Kianifar H. Evaluation of some facial anthropometric parameters in an Iranian population: Infancy through adolescence. J Craniofac Surg. 2013;24(3):941-945.

https://doi.org/10.1097/SCS.0b013e31828dcf4f

14. Farkas LG, Hreczko TM and Katic MJ, Forrest CR. Proportion indices in the craniofacial region of 284 healthy North American white children between 1 and 5 years of age. J Craniofac Surg. 2003;14(1):13-28.

https://doi.org/10.1097/00001665-200301000-00004

15. Ghosh A, Manjari C and Mahapatra S. The craniofacial anthropometric measurement in a population of normal newborns of Kolkata. Nepal J Med Sci. 2013;2(2):125-129.

https://doi.org/10.3126/njms.v2i2.8955

16. Sinha P, Tamang BK and Chakraborty S. Craniofacial anthropometry in newborns of Sikkimese origin. J Laryngol Otol. 2014;128(6):527-530.

https://doi.org/10.1017/S0022215114001029

17. Garba SH, Numan AI and Mishara IG. Craniofacial classification of normal newborns in Maiduguri metropolis, Nigeria. Int J Morphol. 2008;26(2):407-410.

18. Shah GV and Jadhav HR. The study of cephalic index in students of Gujarat. J Anat Soc India. 2004;53(1):25-26.

19. Fok TF, Hon KL, So PC, Wong E, Lee AK and Chang A. Auricular anthropometry of Hong Kong Chinese babies. Orthod Craniofac Res. 2004;7(1):10-14.

https://doi.org/10.1046/j.1601-6335.2003.00274.x

20. Niemitz C, Nibbing M and Zachar V. Human ears grow throughout the entire lifetime according to complicated and sexually dimorphic patterns--conclusions from a cross-sectional analysis. Anthropol Anz. 2007;65(4):391-413.

21. Shah M, Verma IC, Mahadevan S and Puri RK. Facial anthropometry in newborns in Pondicherry. Indian J Pediatr. 1991;58(2):259-263.

https://doi.org/10.1007/BF02751133

22. Amini F, Mashayekhi Z, Rahimi H and Morad G. Craniofacial morphologic parameters in a Persian population: An anthropometric study. J Craniofac Surg. 2014;25(5):1874-1881.

https://doi.org/10.1097/SCS.0000000000000902

23. Dang RR, Calabrese CE, Burashed HM, Doyle M, Vernacchio L and Resnick CM. Craniofacial anthropometry: Normative data for Caucasian infants. J Craniofac Surg. 2019;30(6):e539-e542.

https://doi.org/10.1097/SCS.0000000000005489

24. Jayaratne YS and Zwahlen RA. Application of digital anthropometry for craniofacial assessment. Craniomaxillofac Trauma Reconstr. 2014;7(2):101-107.

https://doi.org/10.1055/s-0034-1371540

25. Wong JY, Oh AK, Ohta E, Hunt AT, Rogers GF, Mulliken JB, et al. Validity and reliability of craniofacial anthropometric measurement of 3D digital photogrammetric images. Cleft Palate Craniofac J. 2008;45(3):232-239.

https://doi.org/10.1597/06-175

26. Marcus JR, Domeshek LF, Loyd AM, Schoenleber JM, Das RR, Nightingale RW, et al. Use of a three-dimensional, normative database of pediatric craniofacial morphology for modern anthropometric analysis. Plast Reconstr Surg. 2009;124(6):2076-2084.

https://doi.org/10.1097/PRS.0b013e3181bf7e1b

27. Jodeh DS and Rottgers SA. High-fidelity anthropometric facial measurements can be obtained from a single stereophotograph from the vectra H1 3-dimensional camera. Cleft Palate Craniofac J. 2019;56(9):1164-1170.

https://doi.org/10.1177/1055665619839577

Authors' Contributions:
AG- Concept, Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of the study protocol, clinical protocol, data collection, data analysis, manuscript preparation and submission of article; **SC-** Design, data analysis, manuscript preparation, editing, and manuscript revision.

Work attributed to:
RG Kar Medical College, West Bengal - 700 004, India.

Orcid ID:
Anasuya Ghosh - https://orcid.org/0000-0001-9037-1611
Subhramoy Chaudhury - https://orcid.org/0000-0001-8012-3489

Source of Support: Nil, **Conflicts of Interest:** None declared.