International Journal of Community Medicine and Public Health
Ngaithianven E. Int J Community Med Public Health. 2023 Jan;10(1):305-310
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20223562

Original Research Article

Study of head and chest growth and their equalization in Churachandpur, Manipur during the first year of life

Evelyn Ngaithianven*

Department of Anthropology, Panjab University, Chandigarh, India

Received: 11 November 2022
Accepted: 15 December 2022

***Correspondence:**
Dr. Evelyn Ngaithianven,
E-mail: veven.evelyn@gmail.com

ABSTRACT

Background: The study of head and chest circumferences and the subsequent age at equalization, when studying infant growth, played a vital role in a community as it helps in identifying those who are susceptible to nutritional issues. Keeping in view the importance, a journey was embarked upon with the object of finding out the growth of head and chest circumferences as well as their age of equalization among the tribal infants in Churachandpur, Manipur.
Methods: Using longitudinal setting, infants taken into account were full term born and measurements were recorded within 24 hours of birth from maternity clinics and hospitals in Churachandpur. The growth pattern of head and chest circumferences were measured independently from birth till the child attained 1 year of age at monthly interval following standard techniques given by Weiner and Lourie by using a narrow, flexible, non-stretch steel tape calibrated in centimetres.
Results: Observation of earlier equalization of head and chest circumferences is recorded among the tribal group studied. After the observation of equalization, chest circumference remains larger than head circumference in both sexes throughout the first year of life, which signifies a good growth among the infant group studied.
Conclusions: It can be recommended from the present study the use of head and chest circumference for identifying vulnerable infant/children from their nutritional standpoint in any kind of settings as it is easily accessible and cost effective. The present study shows a positive secular trend when compared with other available literatures.

Keywords: Head circumference, Chest circumference, Equalization

INTRODUCTION

The study of human growth has been an interest to a lot of professionals, researchers, medical practitioners since a long time. Human growth is a continuous process which assumes different characteristics in each stage of life cycle and is influenced by endogenous factors comprising of biological, genetic and ethnic determinants and by exogenous factors such as nutritional, cultural, environmental and social conditions.[1] Emphasizing on infant/child growth is an important predictor for the overall health and well-being of a person and at aggregate level, for the public health of a population. In any growth studies conducted among infants, one cannot overlook the importance on age of equalization of head and chest circumferences as they bear a definite relationship with each other. The relationship of the circumferences of the head to the chest changes accordingly with age, which is directly influenced by the nutritional status of each child. The actual difference in size between head and chest circumference is taken as a rough guide to the degree of growth failure.[2] Owing to this, a periodic or routine measurement is required in order to detect any kind of growth failure.

It is observed that the growth rate of head circumference is steadier during the initial stage when compared with chest circumference, which grows more rapidly among the well-nourished infants. This results in equalization of the head and chest circumference at certain age/months during the

initial years of life depending on the diet and over all well-being of the child. In well-nourished children, the circumference of the chest equalized much earlier with the head and it becomes larger than that of head during the first year of life. On the other hand, in severe protein calorie malnutrition, due to being malnourished, head remains larger and equalization may not even take place till 3 to 4 years of age. As a result, the expected equalization of the head and chest circumference is delayed and chest circumference remains less than head circumference, which is useful in guiding the degree of growth failure from malnutrition.[3] The importance of taking these parameters in field as well as in any community setting apart from finding the age of equalization is that, it can easily detect any deformities which can be in the form of hydrocephalus, macrocephaly or microcephaly. Similarly, since normal growth requires adequate nutrition, chest circumference alone can also be use in assessing malnutrition in challenging settings.

Delayed equalization of head and chest circumference is thought to indicate malnutrition, which is an important indicator in assessing physical growth. According to Martorell et al 1975, the percentage of children at different ages who have larger head circumference to chest needs to be calculated as well as reported.[3] Thus, keeping in view the importance of age of equalization of these two variables in the study of infant growth, a study was conducted among the Paite tribal infants of Churachandpur, Manipur. Since there has been no studies conducted among the study population in the present context, it will help in throwing light on their nutritional standpoint.

METHODS

The present study was conducted among the tribal infants (Paite) of Churachandpur town, Manipur using longitudinal method of studies. Churachandpur lies on the south-western part of Manipur and shares an international border with Myanmar on the south. The literacy rate (2011 census) in the town is 94.7% for male and 87.38% for female. According to census of India 2011, the tribal population in the town was 76.64% and majority of the population practice Christianity (93.01%). The Paites, who formed the most dominant tribal group in the town, are Tibeto-Burmese in speech and Mongoloid in physical type. They belong to the Northern Chin sub group of Kuki-Chin-Mizo.[4] They are still found living in their traditional houses made of wooden/mud floor, bamboo mixed with mud walls and a tin or thatched roof. They have the practice of maintaining a kitchen garden filled with variety of seasonal fruits, roots and vegetables as well as rearing animals such as pig, cow, goat, mithun, and hen.

The study was approved by the Department of Anthropology, Panjab University, Chandigarh, India. Ethical issues associated with the study were taken into account. Before commencing the fieldwork, information was first gathered/survey regarding the specific months in which maximum numbers of babies are born in a year from Gynaecologists in the study area. Accordingly, the duration for collecting the sample was planned tentatively. The likelihood of continued stay of the parents/mothers in the town for over a period of one year was taken into account due to the nature of study. Detail information regarding the nature of work was explained to the mothers in plain and simple language in their own mother tongue before obtaining their consent. A prior consent was obtained from mothers who are in their third trimesters so that the new born babies can be measured soon after birth. The consent form was prepared in English and Paite languages, and provided to the mothers for review. After a formal consent, data collection was initiated. As data was initially collected in hospital/clinic setting, consent was obtained from hospitals and clinic administration as well. Special care was observed during measurement of infants with respect to hygiene and careful handling of infant under the supervision of hospital/clinic staff and the mother themselves. Mothers included in the study comprised those who attained full term pregnancy. Only full term born babies were included in the study.

The newborn were measured within 24 hours of birth. Thereafter, each infant was measured at monthly intervals up to the age of 12 months, with strict adherence to ±3 days at each age, by paying house visits. Hence, from birth to the age of one year each infant was measured 13 times for anthropometric variables considered in the present study. The basic data comprised of 219 infants (114 boys and 105 girls). However, it was not possible to maintain the same sample size throughout the study period due to the nature of study. Three precious babies were lost during the initial stage of fieldwork, where two of them died due to cardiovascular disease and the third due to severe diarrheal. Others could not be followed up due to the following reasons namely relocating to their ancestral village, shifting to other state due to employment, not able to trace some families who are staying on rent basis. By the 12^{th} months of age; the data consists of 162 infants (75 girls, 87 boys).

For measuring the head and chest circumferences, standard techniques given by Weiner and Lourie (1981) were followed by using a narrow, flexible, non-stretch steel tape calibrated in centimetres.[3] Head circumference was measured by placing the steel tape firmly around the frontal bones just superior to the eye brows, above the glabella, passing around the head at the same level on each side crossing over the maximum prominence of the occiput at the back. Measurement was recorded up to the nearest 0.1 cm. While taking the measurement infant's hands were restrained by the mother/attendant. Similarly, maximum circumference of the chest was noted at the nipple line with the steel tape during mid-inspiration and the measurement was recorded up to the nearest millimetre.

To evaluate the development of morphological traits in two sexes, sexual dimorphism index by Wolanski for each body was also calculated using the formula below.[6]

$$\text{Sexual dimorphism index} = \frac{2(X_m - X_f)}{X_m + X_f} \times 100$$

Where Xm signify the mean male measurement and Xf the corresponding female measurement.

The data were analyzed in consultation with a statistical programmer, using computer Microsoft excel for windows and statistical package for the social sciences (SPSS) 16. The results thus obtained are presented in tabular form followed with suitable interpretations.

RESULTS

The rate of growth of head circumference for both boys and girls from birth till 1 year of age are shown in Table 1 as well as Figures 1 and 2. In girls the mean head circumference at birth is 34.71 cm, while in boys it is 35.36 cm. In both sexes the maximum gain in the mean head circumference is observed from birth to 1 month followed by 1-2 months, however, the least gain in girls is found from 5-6 months and in boys from 6-7 months. From birth to 12 months of age, mean head circumference increases by 35.58 in girls and 36.90 in boys. The intra sample variability in both sexes is highest at birth and lowest at 12 months. It is further observed that the mean head circumference for boys is higher than girls throughout the study period.

A similar growth trend was observed as in head circumference. The longitudinal growth patterns of chest circumference are shown in Table 2 as well as Figures 3 and 4. The mean for girls' chest circumference at birth is 33.96 cm and in boys it is 34.47 cm. Maximum gain in mean chest circumference occurs during the first 6 months (girls–29.50%, boys–30.60%) than the latter 6 months (girls–11.16%, boys–10.50%). The highest values of intra sample variability are found at birth and 1month and the least values at 12th months in both sexes. It is also observed that the mean chest circumference for boys is higher than girls throughout the study period as observed in head circumference.

Table 1: Head circumference from birth to 12 months.

Age (in months)	Girls			Boys		
	N	Mean	±SD	N	Mean	±SD
Birth	105	34.71	1.41	114	35.36	1.49
1	88	36.83	1.26	99	37.85	1.28
2	83	38.46	1.29	93	39.53	1.19
3	80	39.67	1.29	92	40.89	1.14
4	79	40.55	1.17	91	41.68	1.15
5	78	41.48	1.43	88	42.45	1.18
6	77	42.06	1.14	88	43.22	1.29
7	76	42.78	1.16	88	43.93	1.30
8	75	43.53	1.17	87	44.63	1.29
9	75	44.18	1.26	88	45.42	1.24
10	74	45.02	1.14	88	46.34	1.19
11	74	45.98	1.13	88	47.39	1.08
12	74	47.06	1.06	88	48.41	1.00

Table 2: Chest circumference from birth to 12 months.

Age (in months)	Girls			Boys		
	N	Mean	±SD	N	Mean	±SD
Birth	105	33.96	2.05	114	34.47	2.11
1	88	36.54	2.21	99	37.57	2.27
2	83	38.99	1.65	93	40.24	1.98
3	80	40.86	1.56	92	41.93	1.80
4	79	41.98	1.59	91	43.01	1.70
5	78	42.90	1.61	88	43.95	1.68
6	77	43.98	1.64	88	45.02	1.74
7	76	44.26	1.79	88	45.33	1.82
8	75	44.68	1.75	87	45.71	1.92
9	75	45.01	1.86	88	46.17	1.88
10	74	46.00	1.64	88	46.98	1.80
11	74	47.40	1.52	88	48.28	1.54
12	74	49.20	1.31	88	50.09	1.26

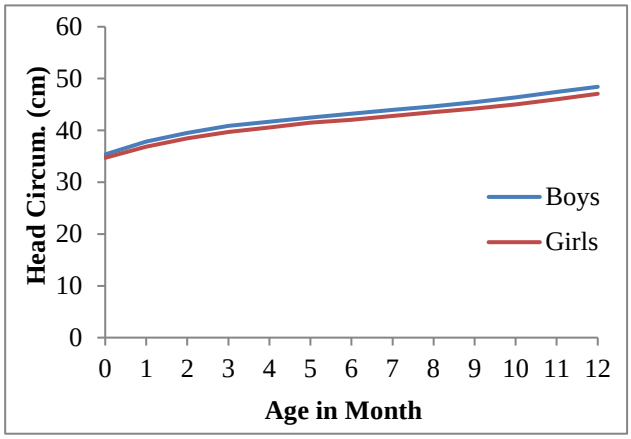

Figure 1: Distance curve for head circumference from birth to 12 months.

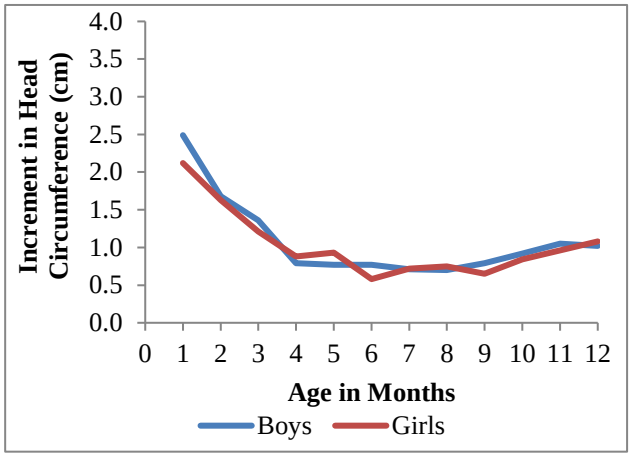

Figure 2: Velocity curve for head circumference from birth to 12 months.

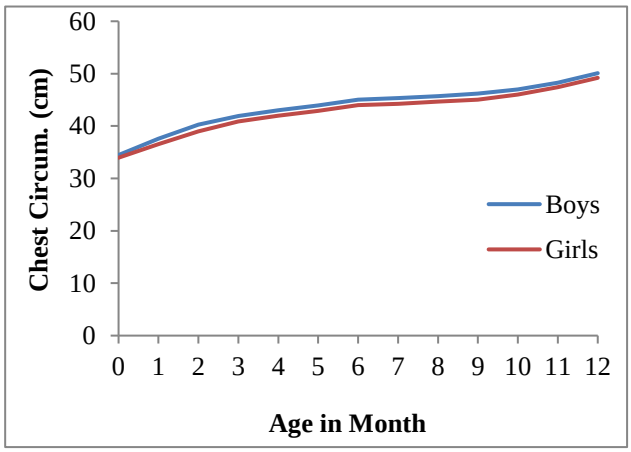

Figure 3: Distance curve for chest circumference from birth to 12 months.

Further, in order to find out whether any significant differences exist between boys and girls, student's t-test was applied. Table 3 depicted the p values, which are found to be statistically significant sex ($p<0.01$) throughout the study period except at birth for chest circumference.

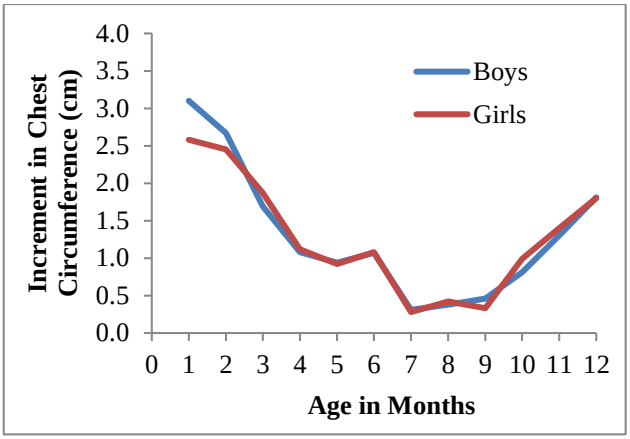

Figure 4: Velocity curve for chest circumference from birth to 12 months.

Table 3: Sex difference (t-values).

Age (in months)	Head circumference (in cm)	Chest circumference (in cm)
Birth	3.29**	1.82
1	5.46**	3.15**
2	5.68**	4.49**
3	6.57**	4.13**
4	6.32**	4.05**
5	4.76**	4.10**
6	6.05**	3.91**
7	5.86**	3.74**
8	5.65**	3.54**
9	6.29**	3.91**
10	7.15**	3.58**
11	8.06**	3.63**
12	8.34**	4.37**

**P<0.01

Table 4: Sexual dimorphism index.

Age (in months)	Head circumference	Chest circumference
Birth	1.85	1.50
1	2.73	2.80
2	2.74	3.14
3	3.05	2.59
4	2.74	2.42
5	2.56	2.42
6	2.68	2.33
7	2.64	2.37
8	2.51	2.28
9	2.76	2.53
10	2.89	2.11
11	3.01	1.84
12	2.84	1.79

Sexual dimorphism index (SDI) was also calculated using the formula given by Wolanski. It is observed from Table

4 that SDI was lowest at birth for both the variables taken into account. And maximum sexual dimorphism was observed at the 3rd month for head circumference and 2nd month for chest circumference.

DISCUSSION

The importance of physical growth of infants cannot be overlooked as they reflect the nutritional standpoint of each child taken into account and in turn reflects the health image of the community. Growth especially during the first year of life is very fascinating as the child undergoes incomparable rapid changes which make them vulnerable. In the present study, the head circumference at birth was larger than the chest circumference in both boys and girls. However, equalization of head and chest circumference for boys occurs at 1-2 months and for girls it takes place at 2-3 months. It is observed that, from the preceding months till the first year of life in both sexes, chest circumference remains larger than head circumference, which signifies a good growth. Further, in both the variables observed, the boys are comparatively larger than the girls throughout the study period.

The result of the present study population is then compared with some limited literatures available on other infants. Ghai and Sandhu made a study among middle class urban population in Delhi; Banik et al among different socio-economic classes in an urban area of Delhi; Mehta and Merchant among higher and lower socio-economic classes of Bombay city and Agarwal and Agarwal among the affluent Indian children.[7-10] They reported that the head and chest circumference become equal between an average age of 9 and 12 months. However, studies conducted among American infants around the same period as observed among some Indian infants, equalization occur between 6 and 12 months, which are quite advanced.[11,12] Further, among the combined socio-economic group of Punjabi infants equalization takes place at 4-5 months in boys and 5-6 months in girls.[13] Furthermore, a study in rural areas of Ballabhgarh in Haryana and among slum population in Delhi observed that chest circumference overtakes head circumference at an average age of 20-21 months.[14]

CONCLUSION

From the reports above we can conclude that observance of early equalization among the present study when compared with previous studies points towards positive secular trend as well as a well-nourished group of population. Thus, through the findings among the present study infants, it can be recommended that, age of equalization of head and chest circumference, which is cost effective and easily measurable, can be use among field and community health workers which helps in understanding normal growth as well as detecting any form of growth deformities. However, it is difficult to evaluate the standard age of equalization as there are limited literatures available. It will be interesting to explore further on this area in order to have an unambiguous picture as well as a standardised age of equalization.

ACKNOWLEDGEMENTS

Author would like to thank hospital staff and administrators for their support during the initial stage of data collection. They are also grateful to the mother infant pairs who took part in the study. They are also grateful to (Late) Dr. R. K. Pathak for his guidance and continuous support throughout the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Spyrides MHC, Struchiner CJ, Barbosa MTS, Kac G. The effect of breastfeeding practices on infant growth. Rev Bras Saude Mater Infant. 2005;5:145-53.
2. Dean RFA. Effects of malnutrition, especially of slight degree, on the growth of young children. Courrier. 1965;15:73-83.
3. Martorell R, Yarbrough C, Malina RM, Habicht JP, Lechtig A, Klein RE. The head circumference chest circumference ratio in mild-to-moderate protein-calorie malnutrition. J Trop Pediatr Environ Child Health. 1975;21(4):203-7.
4. Grierson GA. Linguistic Survey of India. Delhi: Motilal Banarsidass. 1967.
5. Weiner JS, Lourie JA. Practical Human Biology. London: Academic Press. 1981.
6. Wolanski N. Methods of control of the physical development of children and youth. PZWL, Warszawa. 1965.
7. Ghai OP, Sandhu RK. Study of physical growth of Indian children in Delhi. Indian J Pediatr. 1968;35:91-108.
8. Datta Banik ND, Krishna R, Mane SIS, Raj L, Tasker AD. A longitudinal study of physical growth of children from birth upto five years of age in Delhi. Indian J Med Res. 1970;58:135-42.
9. Mehta K, Merchant SM. Physical growth of children in first year of life in higher and lower socio-economic classes of Bombay city. Indian Pediatr. 1972;9:751-4.
10. Agarwal DK, Agarwal KN. Physical growth in Indian affluent children (birth-6 years). Indian Pediatr. 1994;31(4):377-413.
11. Vaughan VC. Growth and development. In: Vaughan VC, Mckay RJ, Editors. Nelson Textbook of Pediatrics. 10th edition. W.B. Saunders Co. Philadelphia. 1975.
12. Watson EH, Lowery GH. Growth and development of children. 5th edition. Chicago: Year Book Medical Publishers. 1967.

13. Bhalla AK. A longitudinal study of body growth of Punjabi children during the first year of life. Unpublished PhD thesis submitted at Panjab University, Chandigarh. 1983.
14. Sundaram KR, Seth V, Jena TK, Shukla DK. Age at which chest circumference overtakes head circumference in children. Indian J Pediatr. 1995;62(1):89-94.

Cite this article as: Ngaithianven E. Study of head and chest growth and their equalization in Churachandpur, Manipur during the first year of life. Int J Community Med Public Health 2023;10:305-10.