PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2019.739.742

Research Article
Head Circumference at Birth as a Surrogate Measurement for Identifying Low Birth Weight Newborns

Kusharisupeni, Wahyu K.Y. Putra, Diah M. Utari and Isna A. Fajarini

Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, West Java, Indonesia

Abstract

Background and Objective: The number of neonatal morbidity and mortality cases caused by low birth weight (LBW) can be reduced by providing appropriate care immediately after birth. However, in some rural areas, it is hard to detect LBW without the proper tools or equipment. The aim of this study was to find a simple, reliable and suitable surrogate measurement to detect LBW. **Materials and Methods:** This study was conducted at a maternal clinic in East Jakarta in 2014. All newborns, born during the study period, were included in the study. Birth weight, head circumference (HC) and chest circumference (CC) were measured according to standardized techniques by trained midwives. Receiver Operating Characteristic (ROC) curve analyses were carried out to calculate Area Under Curve (AUC). **Results:** Out of 100 newborns, 57% were male and 43% were female. The average birth weight was 3223±412.21 g, the average HC was 32.69±1.24 cm and average CC was 32.36±145. HC was identified as the optimal surrogate measurement to identify LBW (AUC: 0.74, 95% CI 0.55-0.92), with a cut-off value of 32.12 cm. **Conclusion:** We found that HC is a better surrogate measurement to detect LBW than CC. Further studies are required to validate the results in rural community settings.

Key words: Anthropometric measurement, chest circumference, head circumference, low birth weight, measurements predictor, neonates, surrogate measurement

Received: September 06, 2018 Accepted: February 02, 2019 Published: July 15, 2019

Citation: Kusharisupeni, Wahyu K. Y. Putra, Diah M Utari and Isna A. Fajarini, 2019. Head circumference at birth as a surrogate measurement for identifying low birth weight newborns. Pak. J. Nutr., 18: 739-742.

Corresponding Author: Kusharisupeni, Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, West Java, Indonesia

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Low birth weight (<2500 g) affects growth and development and is associated with slowed cognitive development, impaired growth (stunting) and increased morbidity and mortality. Low birth weight (LBW) rates are very high in Indonesia (stunting: 37.2%, mortality rate: 259/10,000 live births)[1,2]. According to Basic Health Research in Indonesia, the prevalence of LBW was 11.1% on 2010 and 10.2% on 2013, with the lowest prevalence in North Sumatera (7.2%) and the highest prevalence in Papua (16%) and South East Sulawesi (16.9%)[3].

Providing health personnel to assist with labor can reduce morbidity and mortality caused by LBW; however, there is limited availability of labor-assisted health personnel, especially in the remote provinces of North Maluku (17.79%) and Papua (39.18%)[4]. On national level, merely 88.68% of labours are assisted by health personnel, the rest are done by non health personnel (traditional birth attendant)[4]. Additionally, any regions also do not have access to a reliable infant scale, making it difficult to detect LBW. One method to solve this problem is to replace the infant scale with a surrogate measurement such as head circumference or chest circumference[5]. With precise measurement, one could determine the exact weight of the newborn. Thus, appropriate care could be given to LBW newborns.

Many studies have attempted to find a simple, reliable and suitable anthropometric surrogate to identify LBW in newborns, yet there is no consensus on the most reliable anthropometric surrogate and a fix cut-off value[6,7]. Two possible surrogate measurements to detect LBW include head circumference (HC) and chest circumference (CC), as they are part of standard measurements performed on newborns and may be optimal surrogate measurements to detect LBW[5,6,8]; however, data on the validity of these measurements are still limited, especially in Indonesia. Therefore, the aim of this study was to identify a simple, reliable and suitable anthropometric surrogate measurement to detect LBW and to determine its cut-off value.

MATERIALS AND METHODS

The study was conducted at the Anny Rahardjo Maternal Clinic, East Jakarta in 2014 using a cohort prospective design. Inform consent was obtained from mothers. The inclusion criteria for infants were as follows: (1) Born at the same clinic, (2) Born full term, (3) Singleton, (4) Visited the clinic for immunizations and other consultations regularly every month, (5) Exclusively breast fed and (6) Availability of birth, weight, head circumference and chest circumference monthly measurements up to nine months of age records. Ethnic was not considered due to the similarity in ethnicity among the newborns. 100 infants met these criteria.

Birth weight and weight up to nine months of age were measured each month, as well head circumference and chest circumference. Standardized procedures were applied to measure body weight and other measurements; each measurement was performed twice by two midwives (four times in total), the results were recorded to the nearest 0.1 kg and then the average was calculated[9]. Body weight was measured using the Seca baby scale calibrated with a 10 kg burden, while head and chest circumference were measured using flexible measuring tape. HC was measured between glabella anteriorly and along the most prominent point posteriorly, whereas CC was measured at the level of nipple in the end phase of expiration. Two midwives who worked at the maternal clinic and have been trained prior to data collection took measurements.

Pearson's correlation coefficient was used to measure the strength of the association between HC and CC with LBW. A Receiving Operating Curve (ROC) was used to determine the sensitivity and specificity, as well as the cut-off value, of the methods. ROC is the best analysis to predict dichotomous outcomes. Further analysis was performed to determine which surrogate measurement was more appropriate to detect LBW.

RESULTS

Descriptive characteristics: Across the nine months of the study, 100 deliveries took place; all newborns met the inclusion criteria. The proportion of male and female newborns was similar (male: 57%, female: 43%). The mean birth weight was 3,223±412.21 g, HC was 32.69±1.23 cm and CC was 32.36±1.45 cm (Table 1).

Correlation coefficients: Based on the results of a Pearson Correlation test, HC and CC were correlated with birth weight with r values of 0.4 and 0.6, respectively. The correlation between CC and birth weight was stronger compared to the correlation between HC and birth weight.

ROC curve analysis: ROC analysis was used to quantify the performance of a classifier (CC and HC at birth with LBW). HC had a higher AUC (0.74), indicating higher accuracy of the test, while CC (0.58) had a lower AUC (Fig. 1).

Table 1: Characteristics at birth

Measurements	Mean	SD	Range
Birth weight (g)	3.223	412.21	2,200-4,400
Head circumference (cm)	32.690	1.24	30-36
Chest circumference (cm)	32.360	1.45	29-36

Table 2: Area under the curve, sensitivity and specificity of head and chest circumference

Measurements	AUC (95% CI)	Critical limit (cm)	Sensitivity (%)	Specificity (%)
Head circumference at birth	0.74 (0.55-0.92)	32.12	67	67
Chest circumference at birth	0.58 (0.17-0.98)	32.12	67	53

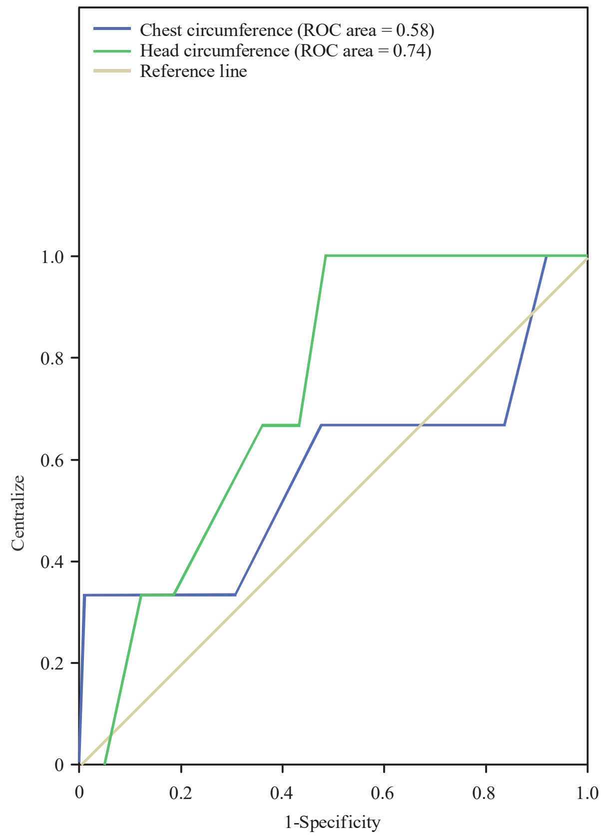

Fig. 1: ROC curve of chest and head circumference for optimal birth weight surrogate

AUC, critical, limit, sensitivity and specificity: Head and chest measurement sensitivity and specificity were calculated and an operational cut-off value was determined by taking the value with the highest average of sensitivity and specificity. HC and CC had the same sensitivity (67%); however, HC had better specificity compared to CC (HC: 67%, CC: 53%). Due to the higher AUC of HC (0.74 (0.55-0.92)), a cut-off value was taken from HC (32.12 cm). Therefore, a HC less than 32.12 was categorized as LBW (Table 2).

DISCUSSION

Our study found that the average birth weight was 3,223 g (±412.2 g), which is relatively high compared to the average birth weight in Ghana (2,900±700 g) and India (2,398±560 g)[8,10]. The discrepancy in findings is likely due to differences in inclusion criteria, as our study only includes full-term and singleton newborns. The HC average in the present study is similar to results of a previous study by Sreeramareddy *et al.*[5] (32.72±1.7 cm) in India; however, the values of this study were slightly different compared with the results of studies by Pankaj and Kanchan[11] (33.59±1.18 cm) and Hadush *et al.*[12] (34.6±1.5 cm). The average CC in the current study was similar to results of a previous study conducted by Sreeramareddy *et al.*[5] (32.8±1.9 cm)but was slightly higher compared to results of a study by Suneetha and Kavitha[10] (30.68±2.26 cm) and Pankaj and Kanchan[11] (31.11±1.92 cm).

Several studies have attempted to find a reliable, simple and inexpensive surrogate measurement to detect LBW. In this study, we found that the best surrogate measurement was HC; this result is in line with previous studies conducted in Nepal, Ethiopia and Nigeria[5,13,14]. Although, HC and CC had the same sensitivity (67%), HC was chosen to be the best surrogate measurement due to its higher AUC (0.74) and specificity (67%). While HC may not be accurate due to the moulding of head as a result of prolonged and obstructed labor, newborns designated as LBW would be referred to other health care facilities with better medical equipment for further evaluation. Using ROC curve analysis, we determined the optimal cut-off points by choosing the value with highest average of sensitivity and specificity and identified a value of 32.12 cm for HC, such that values less than 32.12 cm would be considered LBW. This cut-off value is comparable to other studies conducted in developing countries, such as India (31.5 cm) and Nigeria (32.95 cm) but slightly lower compared to Ethiopia (33.25 cm) and Uganda (33.3 cm)[7,13-14]. The difference in cut-off values is likely due to differences in average birth weight.

This study has some limitations. We did not analyze differences in anthropometric measurements between males and females, as we did not find differences between genders. We also did not consider ethnic variables because our respondents were of the same ethnicity. Thus, higher average birth weight may be due to the low prevalence of LBW. It is possible that there were inter and intra-observer bias measurements. This study should be validated in rural communities.

CONCLUSION

The current study concludes that HC is a better surrogate measurement for detecting LBW in Indonesian newborns compared to CC. This study should be validated in rural community settings with a larger number of participants.

SIGNIFICANCE STATEMENT

This study discovered the use of head circumference as an optimum surrogate measurement to detect low birth weight in neonates compared to chest circumference. The result of this study is useful to detect neonates low birth weight in rural settings.

ACKNOWLEDGMENTS

We acknowledge and thank the director of Anny Rahardjo Maternal Clinic for permitting us to carry out this study.

REFERENCES

1. Torche, F. and G. Echevarria, 2011. The effect of birthweight on childhood cognitive development in a middle-income country. Int. J. Epidemiol., 40: 1008-1018.
2. Aryastami, N.K., A. Shankar, N. Kusumawardani, B. Besral, A.B. Jahari and E. Achadi, 2017. Low birth weight was the most dominant predictor associated with stunting among children aged 12-23 months in Indonesia. BMC Nutr., Vol. 3, No. 1. 10.1186/s40795-017-0130-x.
3. HMI., 2013. Basic health research. Health Ministry Indonesia, Jakarta.
4. HMI., 2016. Data and information of Indonesia health profile. Health Ministry of Indonesia, Jakarta.
5. Sreeramareddy, C.T., N. Chuni, R. Patil, D. Singh and B. Shakya, 2008. Anthropometric surrogates to identify low birth weight Nepalese newborns: A hospital-based study. BMC Pediatr., Vol. 8, No. 1. 10.1186/1471-2431-8-16.
6. Otupiri, E., P. Wobil, S.B. Nguah and M.J. Hindin, 2014. Anthropometric measurements: Options for identifying low birth weight newborns in Kumasi, Ghana. PloS One, Vol. 9, No. 9. 10.1371/journal.pone.0106712.
7. Elizabeth, N.L., O.G. Christopher and K. Patrick, 2013. Determining an anthropometric surrogate measure for identifying low birth weight babies in Uganda: A hospital-based cross sectional study. BMC Pediatr., Vol. 13, No. 1. 10.1186/1471-2431-13-54.
8. Kaur, M., Z. Singh, G. Kaur and L.D. Goyal, 2013. Correlation of birth weight with other anthropometric measurements of newborns. Indian J. Basic Applied Med. Res., 2: 870-879.
9. WHO., 2008. Training Course on Child Growth Assessment. World Health Organization, Geneva.
10. Suneetha, B. and V.K. Kavitha, 2016. A study of relationship between birthweight and various anthropometric parameters in neonates. IOSR J. Dental Med. Sci., 15: 50-57.
11. Pankaj, S. and K. Kanchan, 2017. Correlation of birth weight with other anthropometric parameters of newborns in Himachal Pradesh. Int. J. Cur. Res. Rev., 9: 49-54.
12. Hadush, M.Y., A.H. Berhe and A.A. Medhanyie, 2017. Foot length, chest and head circumference measurements in detection of low birth weight neonates in Mekelle, Ethiopia: A hospital based cross sectional study. BMC Pediatr., Vol. 17, No. 1. 10.1186/s12887-017-0866-0
13. Olusanya, B.O., 2010. Surrogate measurements for identifying newborns with low birth weight in a community with predominant non-hospital births. J. Child Health Care, 14: 386-395.
14. Shastry, C.K.R. and B.P.R. Bhat, 2015. Neonatal screening by chest circumference and a study of relationship between birthweight and other anthropometric parameters. Int. J. Biomed. Res., 6: 160-163.