

ORIGINAL ARTICLE

Detection of LBW Newborn by Measuring Chest Circumference

Mohammed Jamal Uddin¹, Md. Mahbubul Hoque², Sahifa Nazia³, Abu Sayeed Chowdhury⁴, Morsheda Khanam⁵

Abstract

Background: Birth weight is the most sensitive and reliable indicator of child survival and the health of the community. Anthropometric measurements have been proposed as surrogate for birth-weight. These include the chest, head and mid upper arm circumferences of the newborn. In most studies done so far chest circumference has the highest sensitivity followed by head circumference, mid upper arm circumference (MUAC) and foot length to identify LBW newborn. Chest and Head circumference is used to identify LBW newborn in developing country.

Objectives: Detection of LBW newborn by measuring chest circumference.

Methods: Two hundred term and preterm newborns were taken. All measurements were taken within 0-48 hours of delivery. Babies were weighed naked by electronic weighing scale (Tronix pediatrics weighing scale- 4800) to the nearest 20 gm. Chest circumference were measured at the level of nipple at the end phase of expiration with the help of a flexible non-stretchable tape to the nearest of 0.1 cm. The best cut-off point of chest circumference for detecting low-birth-weight <30.5 cm at low risk (who are low birth weight) and lower cut-off points of <29.5 cm at higher risk (who are very low birth weight) were taken as working definition.

Results: This study showed the prevalence of low birth-weight was 65% and the mean birth weight was 2478±700 gm. This study also showed that 39.5% percent were term babies. Chest circumference has significant correlation with birth weight ($r=0.765$). It is also observed that newborns with chest circumference <30.5 cm the chance of low birth weight is 96.2% and when chest circumference will be >30.5 cm 92.6% of them will not be low birth weight.

Conclusion: This study showed that in absence of a weighing scale, simple measurement like chest circumference may be the best indicator to identify newborns with low birth weight (<2500 gm). Chest circumference has significant correlation with birth weight and it is an indicator to identify LBW neonates.

Key words: LBW, chest circumference.

1. Assistant Professor, Department of Pediatrics, Gonoshasthaya Samaj Vittik medical College Hospital, Savar, Dhaka.
2. Professor of Pediatrics, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.
3. Medical Officer, Dr. M.R. Khan Shishu Hospital & ICH, Mirpur, Dhaka.
4. Junior Consultant Pediatrics, Mugda General Hospital, Dhaka.
5. Assistant Professor of Pediatrics, Dr. M.R. Khan Shishu Hospital & ICH, Mirpur, Dhaka.

Correspondence to: Dr. Mohammed Jamal Uddin, Assistant Professor, Department of Pediatrics, Gonoshasthaya Samaj Vittik medical College Hospital, Savar, Dhaka. Cell: 01674003948, Email: jamalsomc@yahoo.com

Received: 11 November 2018; **Accepted:** 03 January 2019

Introduction

Low birth weight (Birth weight < 2500 g) is one of the leading cause of neonatal death. Early identification of Low birth weight (LBW) neonate is essential for any comprehensive initiative to improve their chance of survival.¹

Low birth weight babies are vulnerable for developing various complications during their early infant life. Appropriate and timely care of a newborn is important especially if the baby is born with low birth weight but this is difficult in developing countries due to unavailability of weighing scale at home or health complex. There is need to develop a simple, inexpensive and practical method to identify low birth weight newborns soon after birth.² A number of alternative anthropometric measurements have been proposed as surrogate for birth-weight, these include the head, chest and mid upper arm circumference.^{3,4} In most studies done so far chest circumference has the highest sensitivity followed by head circumference, mid upper arm circumference (MUAC) and foot length to identify LBW.⁵ Chest and head circumference were used to identify LBW newborns, and the cut-off points with the best sensitivity and specificity identified were 30 cm and 31cm for chest and head circumference respectively.⁶ In Bangladesh there is scarcity of data for detecting LBW newborns by measuring chest circumference. So objective of this study was to identify LBW newborns by measuring chest circumference.

Materials and Methods

This cross-sectional study was carried out at Dhaka Shishu (Children) Hospital and Bangladesh Institute of Child Health (BICH), Dhaka, from July 2011 to December 2011. 200 newborn babies were taken. All newborn babies age 0-48 hours and live singleton infants born between 28 to 42 weeks of gestation were included in this study. Newborn babies with congenital chest deformity and gestational age <28 weeks were excluded in this study. Babies gestational age were determined by using Modified Ballard Scoring System. Each baby was thoroughly examined to see any congenital chest deformity. Chest circumference were measured at

the level of nipple at the end phase of expiration with the help of a flexible non- stretchable tape to the nearest of 0.1 cm. Babies were weighed naked by electronic weighing scale (Tronix pediatrics weighing scale- 4800) to the nearest 20 gm. The best cut-off point of chest circumference for detecting low-birth-weight <30.5 cm at low risk (who are low birth weight) and lower cut-off points of <29.5 cm at higher risk (Who are very low birth weight) were taken as working definition.

Results

Total 200 babies according to inclusion criteria were taken. Table I showed maximum 67% were in age group of 0-24 hours and 33% were in age group of 24-48 hours. The average age was 22.51 hours. Male were predominant (54.0%). Regarding gestational age, 11.5% were 28-32 weeks, 49.0% were 33-37 weeks and 39.5% were >37 weeks. Figure 1 showed VLBW babies were 5% , LBW were 60% and rest 35% were >2500 gm and the mean birth weight was 2278±700 gm. Table II showed that 35% baby's chest circumference were <29.5cm and their mean birth weight was 1486gm, 31% baby's chest circumference were <30.5cm and their mean birth weight was 2160gm and 34% had chest circumference >30.5cm and their mean birth weight was 2908gm. This table also indicated that babies with chest circumference <29.5cm were very low birth, those with chest circumference <30.5cm were low birth weight and those with chest circumference >30.5 cm were normal birth weight. Table 3A showed that birth weight were more when chest circumference was > 30.5cm than <30.5cm which was 2967gm vs 1912 gm respectively. From this table it can be seen that chest circumference has a significant relation with birth weight ($p<0.05$). Table IIIB showed that chest circumference were more when birth weight was >2500 gm than <2500 gm which was 31.10 cm vs 27.61 cm respectively. From this table it can also be seen that birth weight has significant relation with chest circumference ($p<0.05$). Table IV showed that newborns with chest circumference <30.5 cm the chance of low birth weight were 96.2% and when chest circumference >30.5 cm 92.6% of them will not be low birth weight.

Table I

Socio-demographic characteristics of the study subjects (n=200)

Socio-demographic characteristics	Frequency	Percentage
Age in hours		
0-24 hrs	134	67.0
24-48 hrs	66	33.0
Mean±SD (hrs)	22.51±12.39	
Sex		
Male	108	54.0
Female	92	46.0
Gestational age (week)		
28-32 week	23	11.5
33-37 week	98	49.0
>37 weeks	79	39.5
Mean±SD (week)	35.72±3.81	

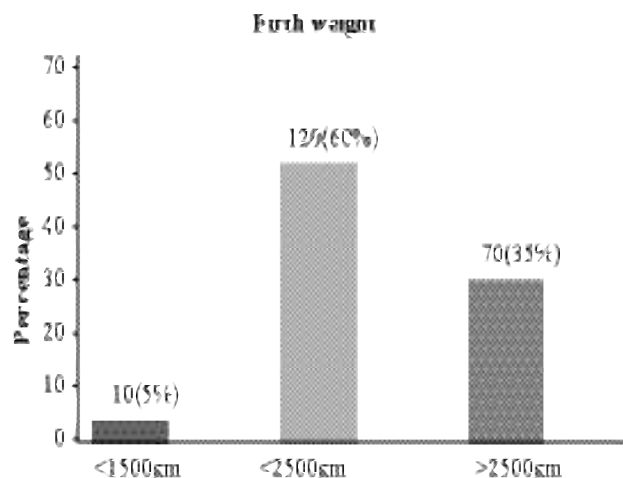


Fig 1 Bar diagram showing birth weight of the subjects (n=200)

Table II

Chest circumference & mean birth weight

Chest circumference (cm)	Frequency	Percentage	Chest circumference (cm)	Birth weight (gm)
			Mean±SD	(mean±SD)
<29.5	70	35.0	29.50±2.72	1486±47
<30.5	62	31.0		2160±35
>30.5	68	34.0		2908±26
Total	200	100.0		

Table III

Comparison of chest circumference & birth weight

A. Chest circumference

Chest circumference	Birth weight				Mean±SD	p value
	<2500 gm		>2500 gm			
	N	%	N	%		
<30.5 cm	125	96.2	07	10.0	1912±543	0.001
>30.5 cm	05	3.8	63	90.0	2967±373	
Total	130		70			

B. Birth weight

Birth weight	Chest circumference				Mean±SD	p value
	<30.5 cm		>30.5 cm			
	N	%	N	%		
<2500 gm	125	94.7	05	7.7	27.61±2.48	0.001
>2500 gm	07	5.3	63	92.6	31.10±1.23	

p value reached from student 't' test.

Table IV
Validity of chest circumference to identify LBW newborns

Chest circumference	Birth weight	
	<2500 gm	>2500 gm
<30.5 cm	125	07
>30.5 cm	05	63
Sensitivity	96.2%	
Specificity	90.0%	
Accuracy	94.0%	
Positive predictive value	94.7%	
Negative predictive value	92.6%	

Discussion

The importance of low birth weight (LBW) as a public health problem and its impact on infant and child morbidity and mortality is well recognized. More than 60% of low birth weight babies are born preterm, and in recent years, there has been a rise in the number of premature infants in the population.⁷ World Health Organization (WHO) estimated that LBW contributes to 60-80% of all neonatal deaths (death within 28 days after birth) worldwide.⁸

In Bangladesh, most deliveries take place at home and are mostly attended by relatives or traditional birth attendants. These people are not aware of the importance of weight-recording at birth. Even the trained traditional birth attendants (dais) have no weighing scale in their delivery-kits. Also in most health complexes, babies are not weighed routinely due to paucity of a suitable weighing scale at the centre. To overcome this problem, a number of alternative anthropometric measurements have been proposed as surrogate for birth-weight.⁹

In this study is an attempt to know the feasibility of using chest circumference for identification of low birth weight babies. We studied 200 term and preterm newborns with birth weight.

This study showed the mean birth-weight was 2278±700 gm and the prevalence of low birth-weight was 65%. Mean birth weight in this study was relatively lower than the previous studies from India and Bangladesh. A WHO multicenter study reported that the average birth weight was 2630, 2780 and 3840 for newborns in India, Nepal and Sri Lanka respectively.¹⁰⁻¹³

The proportion of LBW was (65%) in this study which was in contrast to similar studies reported earlier where the proportion of LBW was 46%.¹²⁻¹⁴ However, a majority of these studies were preterm newborns also. Reliable population-based data on proportion of LBW in Bangladesh is not available. The Nepal Demographic and health survey reported that up to 40% of the newborns in rural areas are LBW.¹⁵

In this study the mean chest circumference was 27.61 cm and 31.10 cm for birth weight of <2.5 kg and >2.5 kg respectively which was similar to earlier studies.^{16,17} The significant correlation of chest circumference with birth weight in this study ($r=0.765$). This findings consisted with Sajjadian et al.¹⁸ where they found positive correlation of birth weight with chest circumference ($r=0.74$). The optimal cut-off points for chest circumference to identify LBW newborns were ≥ 31.2 cm.

In a study by Kapoor et al¹⁷, 54 low birth weight newborns were studied and a mean chest circumference of 29.5 cm correlated well with birth weight. But, when tested in field conditions the difference of 3 cm in chest circumference was noticed which reflected the difficulty in measuring chest circumference in field situations. In a similar study by Huque et al¹⁶ 217 full term newborns with low birth weight were studied, mean chest circumference was 30.14 cm for predicting birth weight of <2.5 kg and 28.34 cm for babies <2 kg. The correlation coefficient was 0.867.

Virdi et al.¹⁵ in a study enrolling 256 term newborns, chest circumference of 30.0cm with a correlation of 0.734 was less sensitive in identifying low birth weight babies. In a study by Bhat et al¹⁹ involving 119 term newborn babies, chest circumference of 32.23cm was used to identify babies with birth weight <2.5kg and it didn't correlate well with birth weight ($r=0.40$). Sharma et al²⁰ in their hospital based study reported that chest circumference of 29.5cm for identifying <2500g birth weight babies.

Correlation of chest circumference with birth weight was better in this study compared to Virdi et al¹⁷ and Bhat et al.¹⁸ but less compared to Huque et al¹⁶. The causes for difference in measurement and correlation with chest circumference are difficult for workers to measure in field situations, needs more handling of baby and need to be lifted from the bed and complete undressing of the infant is not permitted by the parents or relative owing to social customs, beliefs and taboos.¹⁷

The correlations between birth weight and chest circumference are high ranging from 0.60 to 0.95 and suggested that chest circumference is the Optimal anthropometric measure for establishing cut-off for the identification of LBW infants.^{21,22}

A WHO collaborative study has recommended that chest circumference of 29 centimeters and 30 centimeters may identify “highly at risk” and “at risk” newborns respectively.²¹

Thus, it is evident that from analysis of data of this study that chest circumference is the best suitable and simple surrogate parameter that could be used in the domiciliary outreach where it is not possible to record weight of newborn at birth.

Conclusion

This study showed that chest circumference has significant correlation with birth weight. When chest circumference <30.5 cm there is more chance of low birth weight (<2500gm) and chest circumference >30.5 cm there is less possibility of low birth weight.

References

- Hadush MY, Berhe AH and Medhanyie AA. Foot length, chest and head circumference measurements in detection of Low birth weight neonates in Mekelle, Ethiopia: a hospital based cross sectional study. *BMC Pediatrics* 2017;**17**:111
- Rajesh N, Kiran P. Identification of an anthropometric surrogate to low birth weight in newborns: a hospital based cross sectional study. *Int J Community Med Public Health* 2018;**5**:2066-71.
- Berihun MZ, Meseret Z, Nuru M. Incidence and correlates of low birth weight at a referral hospital in Northwest Ethiopia. *Pan Afr Med J* 2012;**12**:4.
- Negassi T. Prevalence and factors associated with low birth weight in Axum and lealay maichew districts, North Ethiopia a comparative cross sectional study. *Int J Nutr Food Sci* 2014;**3**:560-66.
- Nabiwemba L, Orach Garimoi C, Kolsteren P. Determining an anthropometric surrogate measure for identifying low birth weight babies in Uganda: a hospital-based cross sectional study. *BMC Pediatr* 2013;**13**:54.
- Raymond EG, Tafari N, Troendle JF, Clemens J. Development of a practical screening tool to identify preterm, low birthweight neonates in Ethiopia. *Lancet* 1994;**344**:524-27.
- Makki AM. Risk factors for low birth weight in Sana' City, Yemen. *Ann Saudi Med* 2002;**22**:333-35.
- Arunda MO, Agardh A and Asamoah BO. Survival of low birthweight neonates in Uganda: analysis of progress between 1995 and 2011. *BMC Pregnancy and Childbirth* 2018;**18**:189.
- Mullany LC, Darmstadt GL, Khatri SK, Leclercq SC, Tielsch JM. Relationship between the surrogate anthropometric measures, foot length and chest circumference and birth weight among newborns of Sarlahi, Nepal. *Eur J Clin Nutr* 2007;**61**:40-46.
- World Health Organization. Multi-centre study on low birth weight and infant mortality in India, Nepal and Sri Lanka. Southeast Asia Regional Office, World Health Organization: New Delhi; 1994.
- Bishnupada D, Golam M, Shamsun, Nazrul N. Birth-weight and other anthropometric parameters of newborns in Bangladesh. *J health Popul Nut* 2002;**20**:36-41.
- Ezeaka VC, Egri-Okwaji MT, Renner JK, Grange AO: Anthropometric measurements in the detection of low birth weight infants in Lagos. *Niger Postgrad Med J* 2003;**10**:168-72.
- Ahmed FU, Karim E, Bhuiyan SN. Mid-arm circumference at birth as predictor of low birth weight and neonatal mortality. *J Biosoc Sci* 2000;**32**:487-93.
- Samal GC, Swain AK. Calf circumference as an alternative to birth weight to predict low birth weight babies. *Indian Pediatrics* 2001;**38**:275-77.
- Viridi VS, Jain BK, Harmesh Singh. Calf circumference for identification of low birth weight babies. *Indian Pediatrics* 2001;**38**:934-35.
- Huque F, Hussain ZAM. Detection of low birth-weight newborn babies by anthropometric measurements in Bangladesh. *Indian Journal of Pediatrics* 1991;**58**:223-31.
- Kapoor SK, Kumar G, Pandav CS, Anand K. Performance of surrogate markers of low-birth-weight at community level in rural India. *Journal of Epidemiology and Community Health* 2001;**55**:366-67.
- Sajjadian N, Shajari H, Rahimi F, Jahadi R, Barakat MG. Anthropometric measurements at birth as predictor of low birth weight. *Health* 2001;**3**:752-56.
- Bhat IA, Dhar GM, Shah GN, Neelofar K, Shezada A: Efficiency of various anthropometric measurements in determining low birth weight babies. *Indian Journal of Maternal and child Health* 1995;**6**:40-42.
- Sharma JN, Saxena S, Sharma V. Thigh circumference at birth as the best predictor of low birth weight babies. *Indian Pediatrics* 1989;**26**:18-20.
- Use of a simple anthropometric measurement to predict birth weight. WHO collaborative study of birth weight surrogates. *Bull World Health Organ* 1993;**71**:157-63.
- Ramaiya C, Msamanga G, Massawe S, Mpanju W, Nywalle E. Newborn's arm circumference as screening tool of low birth weight in temekepestric, peres salaam, Tanzania. *Tropical and Geographical Medicine* 1994;**46**:318-21.