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EVALUATION OF BIRTH WEIGHT IN COMPARISON TO OTHER ANTHROPOMETRIC PARAMETERS TO DETECT LOW BIRTH WEIGHT

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Key Words: BW-birth weight, LBW-low birth weight, CC-chest circumference, MAC-mid-arm circumference, OFC- occipito-frontal circumference, SGA-small for gestational age, IUGR- intrauterine growth retardation.

Background: Birth weight is an important determinant of child survival and development. Low birth weight is a major health problem in developing countries. Identification of low-birth-weight babies in the community and their screening to ascertain required level of care is very important to achieve normal goals in child survival. A large proportion of deliveries take place at home and there is need to develop simple, inexpensive, non-invasive and practical methods to identify LBW newborns soon after birth. The study was aimed to evaluate the relative usefulness and validity of chest, arm and occipito-frontal circumferences and to correlate them with birth weight to identify LBW babies. **Objectives:** To evaluate birth weight in comparison to other anthropometric parameters for detection of low-birth-weight babies. **Methodology:** This was a cross-sectional descriptive study conducted among the low birth weight babies admitted in the Pediatric wards and the low birth weight babies born in the Obstetrics wards of Rajshahi Medical college hospital to evaluate birth weight in comparison to other anthropometric parameters to detect low birth weight by measuring birth weight (BW) at or just after birth, chest circumference (CC), mid-arm circumference (MAC), occipito-frontal circumference (OFC) and to find suitable surrogates for low birth weight by comparing different parameters. **Results:** 350 LBW newborns were studied. Their mean CC, OFC and MAC were 30.05cm, 31.61cm and 9.68cm respectively. Mean

BW was 1975gm. There was significant relationship between birth weight and gestational age (p =<0.001), chest, mid-arm and occipito-frontal circumferences (p =<0.001). There was a positive correlation of birth weight to anthropometric parameters like chest, mid-arm and occipito-frontal circumferences but the highest correlation coefficient was found with mid-arm circumference (BW-MAC: r = 0.90, BW-CC: r = 0.75 and BW-OFC: r = 0.83). Mid – arm and chest circumferences were very good anthropometric surrogates of LBW. But MAC was the best surrogate (r = 0-90) to detect LBW babies. **Conclusion:** Anthropometric values are simple, practicable, quick and reliable indicators for early detection of LBW newborns in a community. MAC in our perspective can effectively be used as a surrogate for LBW.

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INTRODUCTION

Birth weight (BW) is an important, very crucial, sensitive and reliable indicator of neonatal health. It is unanimously recognized that the size of the newborn at birth is an important indicator of fetal and neonatal health in the context of individual as well as population in a community. It is strongly related with fetal, neonatal and post-natal mortality and morbidity. In each year more than 20 million babies born worldwide with low birth weight. It is 15.5% of all births and 95.6% of them born in developing countries. In Bangladesh, 4 million births take place in each year and 36% of that is low birth weight. The World Health Organization (WHO) has defined low birth weight as a newborn baby having weight less than 2500 gm irrespective of gestational age[1] Preterm refers to gestational age <37 weeks[2] IUGR is 'small for gestational age' that is a newborn having a birth weight below the 10th percentile for gestational age[3]. In the developed countries preterm is the most common cause of low birth weight, but in the developing countries small for gestational age (SGA) is the most common[4]. The prevalence of LBW in Bangladesh is amongst the highest in the world. The extent of low birth weight in our country has not been well surveyed or documented, because most (88%) adolescent girls and women deliver at home[5] which makes the large scale data collection of birth weights difficult and because most areas of the country lack of equipment or practice of measuring birth weight at home or at the community-level[6]. Birth weight is a critical determinant of survival, growth and development of the newborn and also a valuable indicator of maternal health, nutrition and quality of antenatal services[7]. Newborns weighing less than 2500 grams have a greater risk of morbidity and mortality[8]. Thus, birth weight measurement is an important screening tool for detecting the newborn at risk with special reference to low birth weight. Low birth weight is the single most important underlying risk factor for neonatal deaths[9]. According to UNICEF, in Bangladesh 320 newborn babies die every day. Over half of all child deaths occur within the first 28 days of life. Low-birth weight is the direct cause of 11% of neonatal deaths. On an average, 58% of newborn babies are not weighed at birth[9]. The reasons are absence of trained personnel or that weighing scales may be non-functional or unavailable at places of delivery[10,11,12]. World Health Organization estimates that almost half of newborn mortality is associated with preterm or low birth weight babies[13]. In some hospital-based studies, it is shown that low birth weight is responsible for 63% of infant mortality as well as 45.2% of perinatal deaths and carries a 37-fold increased risk of death in the first year of life[14,15,16]. Out of four million global annual

neonatal deaths, 98% occur in developing countries, where most newborns die at home (World Health Organization, 1996). About 38% of total under-five mortality occurs during the neonatal period and nearly three quarters of these deaths occur during the first week of life[13]. Only about half of the newborns are weighed at birth and for a smaller proportion of them gestational age is known[17]. Available evidences show that extra essential newborn care for LBW babies can reduce the number of neonatal deaths by 20% - 40%[18]. An advantage of early identification of low birth weight babies especially in resource-poor settings is to enable prompt referral which may determine their survival[18]. For practical purposes some authors recommend 2000 grams as the basis for hospitalizing low birth weight babies[13,19]. To improve the detection of low birth weight (LBW) especially in resource-poor countries, alternative measurements have been studied which include chest circumference (CC)[10,19,20], occipito-frontal circumference (OFC)[21,22] and mid - arm circumference (MAC)[10,23]. CC and MAC have been preferred, because the landmarks can easily be identified and has less chance of measurement errors[10,24]. The combination of OFC and CC has also been found to be a good predictor for estimation of birth weight in view of the simplicity and non-invasiveness of measuring these two body circumferences[25]. It is needed to develop simple, inexpensive and practical methods to identify low birth weight newborns soon after birth particularly in resource-poor settings[26]. Early prediction of the risks to which a child is exposed at birth allows better organization of available resources, thus allowing maximum attention for those needy children[27]. Moreover, in countries like ours it is often not possible to record birth weight. So anthropometric measurements like head circumference, chest circumference and mid arm circumference become important[28] and some of them like chest circumference and mid arm circumference can be used as surrogate markers for birth weight[19]. Many studies were carried out to evaluate the MAC and CC as an alternative indicator of low birth weight. Most suitable and reliable anthropometric surrogate to identify low birth weight newborns and its cut-off point to identify low birth weight newborns is still not well established. But in general, CC or MAC has performed better than other measures and has been recommended for continued investigation. Hence, the present study was designed to evaluate birth weight in comparison to other anthropometric parameters at birth, like MAC, CC and OFC and to find out a suitable surrogate to detect low birth weight babies.

OBJECTIVES

A) General Objective:

To evaluate birth weight in comparison to other anthropometric parameters for detection of low birth weight babies.

B) Specific Objectives:

1. To measure weight within 24 hours of birth.
2. To measure chest circumference (CC)
3. To measure mid arm circumference (MAC)
4. To measure head circumference (OFC).
5. To compare these anthropometric para meters (CC, MAC and OFC) with birth weight.

METHODOLOGY

This was a hospital based cross-sectional descriptive study conducted in the department of Pediatrics and department of Obstetrics and Gynecology of Rajshahi Medical College and Hospital, Rajshahi, Bangladesh from January 2015 to December 2016. Purposive sampling done.

Inclusion Criteria:

1. Newborn babies of 24 hours of age.
2. Newborn babies weighing 1500 – 2499 gm.
3. Newborn babies between 28 - 42 weeks of gestation.

Exclusion Criteria:

1. New born babies of > 24 hours of age.

2. New born babies weighing < 1500 gm and ≥2500 gm.
3. New born babies with serious illness.
4. New born babies with congenital anomalies.
5. Unwillingness of the parent to participate in the study

Data Collection And Analysis: 350 live singleton newborn babies were assessed for MAC, CC, OFC and BW. MAC, CC and OFC were recorded before recording the birth weight to minimize potential bias. The measurements were taken within the first 24 hours of delivery because of postnatal changes in body water composition and balance. A particular sequence of taking measurements was adhered to: OFC first, followed by CC, then MAC and finally weight. Birth weight of the new born was recorded in grams by electronic balance with a difference of ±10gms. The data were analyzed according to the objectives of the study. The descriptive analysis included frequency distribution, mean and standard deviation. Univariate analysis was done to describe the characteristics of the populations. Internal comparison was made by using bivariate analysis. Results were tested with students' 't' test, χ^2 test, one-way ANOVA and 'r' test to identify the LBW babies and find the relationship of birth weight with anthropometric measurements. A two-tailed P value of 0.05 was considered statistically significant.

RESULTS

A total of 350 LBW babies were included in this study. Age of the babies were <24 hours, 183 (52.3%) were male and 167 (47.7%) were female and mean birth weight was 1975 gram. Their mean CC, OFC and MAC were 30.05cm, 31.61cm and 9.68cm respectively. There was a positive correlation of birth weight with anthropometric parameters like MAC, CC and OFC but with highest correlation coefficient was found with MAC (r: 0.90).

Table-1: Correlation between BW and CC.

BW and CC	Lower	r	Upper	p
	0.70	0.75	0.79	<.001

Table no. 2: Correlation between BW and OFC.

BW and OFC	Lower	r	Upper	p
	0.80	0.83	0.86	<.001

Table no. 3: Correlation between BW and MAC.

BW and MAC	Lower	r	Upper	p
	0.88	0.90	0.92	<.001

Table no. 4: Correlation of birth weight with CC, OFC and MAC of the LBW babies.

Correlation co-efficient	BW - CC	BW - OFC	BW - MAC
r	0.75	0.83	0.90
p	<.001	<.001	<.001

Table no. 5: Pearson Correlation Matrix among CC, OFC, MAC and BW.

Variable		1 (CC)	2 (OFC)	3 (MAC)	4 (BW)
1	CC	-			
2	OFC	0.92	-		

3	MAC	0.76	0.84	-	
4	BW	0.75	0.83	0.90	-

Table no. 6: Linear Regression with CC group, MAC group, and OFC group predicting BW.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1704.843	36.060		47.278	<.001
	Distribution of LBW babies by chest circumference group	238.204	30.353	.388	7.848	<.001
2	(Constant)	1426.593	26.089		54.683	<.001
	Distribution of LBW babies by chest circumference group	74.039	20.674	.121	3.581	<.001
	Distribution of LBW babies by mid-arm circumference group	323.508	14.337	.759	22.564	<.001
3	(Constant)	1402.194	26.333		53.249	<.001
	Distribution of LBW babies by chest circumference group	61.883	20.506	.101	3.018	.003
	Distribution of LBW babies by mid-arm circumference group	273.782	19.005	.643	14.406	<.001
	Distribution of LBW babies by occipito-frontal circumference group	73.264	18.848	.173	3.887	<.001

DISCUSSION

Low birth weight is a very important phenomenon in the developing countries. In a country like ours only a few expectant mothers get the services of maternity and child health programs. Even in the cities, only a few people use to go to hospitals and clinics for pregnancy check-ups and delivery. They are deprived from ultrasonic fetal growth assessments. Although government has established community clinics in the rural areas with maternal and child health components, not all of them have even a weighing machine. This fact reveals that only a small fraction of the population of the country has a chance to get their babies weighed after birth as most of them are born at home by the hand of untrained or semi-trained birth attendant, relatives or neighbors[29]. Anthropometric parameters used in assessing LBW babies, birth weight is regarded as gold standard. Since identification of LBW babies in rural community is of highest priority to provide effective minimal perinatal care to decrease mortality, there is a constant search for a simple and inexpensive method for screening such newborns. Therefore, this study was done at a tertiary care centre in Rajshahi Medical College Hospital to find out anthropometric parameter which correlates best with birth weight so that it could

be used as a surrogate in the community level to identify low birth weight babies so that they are given specialized care and referred to higher centers. The study population was distributed almost equally amongst both the sexes. There was no statistically significant effect of sex of the baby to birth weight or any of the anthropometric parameters. Therefore, the values were generalized for both the sexes. All anthropometric parameters like MAC, CC and OFC measured in this study had significant relationship with birth weight. All showed significant correlation with birth weight. The correlation coefficient 'r' for CC, OFC and MAC was 0.75, 0.83 and 0.90 respectively ($p < .001$). It could be assumed that as MAC showed highest correlation coefficient ($r = 0.90$, $p < .001$) and it was better than other two parameters detecting LBW babies. By One-way ANOVA it was evident that CC, OFC and MAC had significant association with BW. But MAC showed the strongly significant association with BW than the other two. The means of anthropometric measurements of the present study were in close proximity with studies by Huque F and Hussain Z [24], Mehta et al. (1998)[30]. In this study, all parameters were significantly ($p<0.001$) correlated to each other. With regard to birth weight, CC, OFC and MAC showed correlation coefficient (r) as .75, .83 and .90. This finding were in conformity with Bhargava, SK. et al. (1985)[19], Jagadish, C. Das. (2012)[31], Naik DB. Kulkarni AP. Aswar NR. (2003)20, Sajjadian, N. et al. (2011)[32] S.L. Sood, G.S. Saiprasad and C.G. Wilson (2002)[33] and Arisoy, A.E. and Gulnihan sarman (1995)[34]. As anthropometric measures increased the mean birth weight also increased. This was similar to studies done by Dhar, B. et al. (2002)[35]. In the present study BW and MAC showed the highest correlation($r=0.90$) as compared to other anthropometric parameters. Sharma, JN. et al. (1986)[36], Kaur and Bansal (2002)[37] had found the same type of highest correlation of birth weight with MAC. So the present study shows a stronger association between MAC and BW. The results of the present study showed that MAC could be used for identifying LBW babies at the community level, where weighing scales are not easily available. Since LBW is highly predictive of neonatal mortality and MAC can identify infants with LBW with a fair degree of accuracy and it would be logical to assume that this substitute measurement would be useful in predicting neonatal outcome. Moreover, in the community, where taboos exist regarding weighing of newborns, this measurement can be used without any obstruction from the community to identify LBW newborns. The findings of the present study revealed that, MAC is the best to identify low birth weight babies. Multiple regression equation also showed that MAC alone explained the variation of birth-weight by 90% and the additional use of CC and OFC did not significantly improve the prediction of birth-weight. Moreover, MAC is more practicable than that CC as there may be chest deformity. In most cases, measurement of OFC at birth could not be accurate due to molding of head, particularly in cases of prolonged and obstructed labor. The use of mid-arm rather than chest circumference as a surrogate for birth weight is recommended for three reasons; firstly, it is simple to measure and feasible than chest circumference; secondly, there is less chance of hypothermia in comparison to CC where more area needs to be exposed and thirdly, the findings suggest that measurement of both MAC and CC is of little additional value in predicting LBW babies. Trained birth attendants and health and family planning workers residing at the community level can easily be provided with a measuring tape. Since it is a simple tool to measure babies and also to detect LBW babies, grassroots-level health and family planning workers and trained birth attendants can play a significant role in identifying LBW babies and in giving proper advice to mothers and other caretakers. Even at the Upazila Health Complexes and District Hospitals, physicians can also identify 'at-risk' babies by measuring circumferences like MAC

and CC. But MAC appeared to be the best surrogate for detecting LBW.

CONCLUSION

MAC and CC were very good anthropometric surrogates for detection of LBW babies. But MAC was the best surrogate. MAC in our perspective can effectively be used as surrogates for LBW. LBW babies whose anthropometric parameters show strong correlation with BW should be considered as high risk for early postnatal diseases requiring immediate medical intervention, thereby, increasing their chances for survival and optimal development. This could serve as a selective measure for either early neonatal discharge or continuing medical surveillance and would possibly result in a reduction of the present unacceptably high third world neonatal mortality and morbidity rates.

RECOMMENDATION

1. Anthropometric values are simple, practicable, quick and reliable indicators for quick detection of LBW newborns in the community and can be easily measured by paramedics and field workers in a developing nation like ours.
2. Tapes with different colored risk zones could be devised and tested for reliability so that they can be used in community level by traditional birth attendants and multipurpose health workers.
3. It is preferable that this color coded tape can be included in the clean delivery kit issued for the traditional birth attendants so that LBW babies can be identified and referred to higher centers at the earliest.
4. Further studies are needed in this field to cross-validate these results.

LIMITATIONS OF THE STUDY

1. The study was conducted in a single tertiary level hospital. Findings of the study could not be generalized.
2. It was a non-randomized study hence the strength has been compromised.

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