J. Dhaka National Med. Coll. Hos. 2011; 17 (01): 29-32

Original article:

Correlation of birth weight with other anthropometric variables in detection of low birth weight (LBW) babies.

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Abstract:

Objective: To asses the correlation of birth weight with other anthropometric variables and their appropriateness in prediction and detection of low birth weight babies.

Methodology: It was a hospital-based cross-sectional observational study, conducted over 100 newborn babies within 24 hours of their birth. Birth weight and other anthropometric variables were recorded and analyzed with statistical package for social science (SPSS-17) and Student's t-test, Chi-squared (λ^2), ANOVA and Pearson correlation tests were done to test the hypothesis and level of significance was set as $p < 0.05$.

Result: All the anthropometric variables were well correlated with birth-weight, irrespective of gestational age ($p<0.01$). The highest correlation was found with chest circumference ($r = 0.962$), while the lowest correlation was observed with calf circumference (r 0.923).

Conclusion: All anthropometric variables except calf circumference can be considered as appropriate indicators for identifying neonates require special attention and intervention for low birth weight (LBW) where weighing machine or facilities for ultrasonography is not readily available.

Key words: LBW, birth weight, anthropometric variable.

Introduction:

Bangladesh is currently one of the very few countries in the world, which is on target for achieving the Millennium Development Goal (MDG) 4 relating to child mortality[1]. Perinatal and neonatal mortality are increasingly important public health issues in many developing countries, as post neonatal mortality rates fall[2]. Neonatal survival depends on both gestational maturity and birth weight and is not significantly better in babies who are LBW for gestational age[3]. The intrauterine milieu affects the health of an individual not only during fetal life but also throughout the postnatal stages of life[4]. In addition to its impact on infant mortality, LBW has been associated with higher probabilities of infection, malnutrition and handicapped conditions during childhood (including cerebral palsy), mental deficiencies and problems related to behavior and learning during childhood[5]. In Bangladesh, the prevalence of low birth-weight is unacceptably high (varies between 23% and 60%) which is more than twice the 15% threshold that indicates a public-health problem[6-8]. Low birth-weight (LBW) has serious implications for the growth, development, health, and survival of children and adults[9]. So it is crucial to identify neonates with low birth weight and ensure their adequate service for survival and development. However in developing countries like Bangladesh and India 70-80% of births take place at home and peripheral hospitals, taking accurate birth weight is a problem due to unavailability of weighing scale and trained personnel[10]. Several studies also have given the conclusion that the newborn's nutritional status is more

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important than birth weight alone for identifying perinatal risks[11-12]. Moreover the customary approach of comparing outcomes in 'small for gestation' with 'appropriate for gestation' infants, when the latter group comprises all from the 10th through the 99th centile, has never been satisfactorily justified[13], which necessitate the determination of additional or alternative indices to improve this evaluation.

The current study was carried out with an aim to determine the most appropriate anthropometric parameter in the newborn to assess birth weight so that newborn with LBW can be identified and managed.

Material & Methods:

The cross sectional observational study was conducted in the department of pediatrics and Obstetrics of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh over a period of six months. One hundred live births were attended within 24 hours of birth and birth weight, mid-arm circumference, chest circumference, abdominal girth, thigh circumference, calf circumference, foot length, occipitofrontal circumference and supine length were recorded. Equipments used were a pediatric weighing machine, a flexible and non-stretchable measuring tape and a vertical measuring scale. All the data were edited and analysed with statistical package for social science-17 (SPSS-17) and Student's t-test, Chi-squared (λ^2), ANOVA and Pearson correlation tests were done to test the level of significance.

Result:

All the anthropometric measurements were significantly higher in babies with normal birth weight compared to those in low birth weight babies ($p < 0.001$) (Table I). Table II shows association between birth-weight and gestational age. Of the 39 preterm babies 100% were low birth weight (LBW) while among the 58 term babies 77.5% were normal birth weight and 22.5% were low birth weight indicating that term babies tend to be of normal birth weight ($P< 0.00\ 1$). All the anthropometric variables exhibited a significantly linear correlation with gestational age ($p <0.001$) (Table III).

In pre-term babies all the selected anthropometric variables, except calf circumference, had significant linear correlation with the birth-weight ($p < 0.01$). In term babies all the anthropometric variables exhibited significantly linear correlations with the birth weight of babies ($p < 0.01$). In post-term babies no significant correlation was observed between the variables of interest (except supine length and weight, $p < 0.05$). However, all the anthropometric variables were found to be well correlated with birth-weight of babies, irrespective gestational age ($p<0.01$). The highest correlation coefficient was found between chest circumference and birth-weight of babies ($r = 0.962$), while the lowest correlation coefficient was observed between calf circumference and birth weight of babies (r 0.923) (Table IV).

Table I. Comparison of anthropometric variables between LBW and normal weight babies

#Anthropometric measurements(cm)	Birth weight (gm)		p-va1ue*
	Normal (n =48)	LBW (n=52)	
Supine length	51.15 ± 1.30	42.01 ± 4.06	<0.001
Occipitofrontal circumference	35.35 ± 0.85	28.63 ± 3.65	<0.001
Mid-arm circumference	11.79 ± 0.74	7.62 ± 1.31	<0.001
Chest circumference	32.94 ± 1.71	25.71 ± 3.35	<0.001
Abdominal girth	30.86 ± 1.34	20.38 ± 6.00	<0.001
Thigh circumference	16.65 ± 1.09	12.06 ± 2.36	<0.001
Calf circumference	11.79 ± 0.88	8.04 ± 1.50	<0.001
Foot length	8.78 ± 0.34	6.95 ± 0.78	<0.001

Data were analyzed with help of **Student's t-test** and were presented as **mean ± SD.**

- **Level of significance was 0.05.**

Table II. Comparison gestational age between LBW and normal weight babies

Gestational age (Weeks)	Number	Birth weight		P value
		Normal	Low birth weight	
Preterm	39	00	39 (100%)*	
Term	58	45(77.5%)	13(22.5%)	0.001
Post term	03	3(100%)	00	

Data were analysed with help of Chi-squared (λ^2) and were presented as n (%)

*Level of significance was 0.05.

Table III. Association between anthropometric measurements and gestational age.

#Anthropometric measurements (cm/gm)	Gestational age			(r)*	p-value**
	Pre-term (n=39)	Term (=58)	Post- term (=58)		
Supine length	40.5 ± 2.9	49.8 ± 2.9	53.0 ± 1.2	0.861	<0.001
OFC	27.3 ± 3.1	34.5 ± 1.7	36.1 ± 0.3	0.895	<0.001
MAC	7.1 ±0.6	11.0±1.5	12.8 ±0.5	0.830	<0.001
Chest circumference	24.3 ± 2.4	31.9 ± 2.4	35.9 ± 0.4	0.879	<0.001
Abdominal girth	18.1 ±4.9	29.7 ±2.6	33.2±0.6	0.894	<0.001
Thigh circumference	11.2±1.7	15.9±1.5	19.6±0.9	0.855	<0.001
Calf circumference	7.5±1.0	11.1 ±1.3	13.6±0.5	0.821	<0.001
Foot length	6.6 ± 0.5	8.4 ± 0.6	9.5 ± 0.2	0.853	<0.001
Birth weight	1615±412	2803±411	3136±902	0.859	<0.001

Data were analysed with help of ANOVA

statistics and were presented as mean ± SD.

* Pearson correlation coefficient was used and was denoted by r.

**Level of significance was 0.05.

Table IV. Correlation of birth weight with other anthropometric variables

Correlated variables		Correlation coefficients (r)			
(X)	(Y)	Pre-term (n = 39)	Term (n = 58)	Post-term (n = 3)	Overall (N 100)
Supine length	Weight	0.852**	0.922**	0.999*	0.961**
OFC	Weight	0.927**	0.914**	0.986^{NS}	0.950**
MAC	Weight	0.662**	0.919**	0.960^{NS}	0.950**
Chest circumference	Weight	0.852**	0.863**	0.951^{NS}	0.962**
Abdominal girth	Weight	0.880**	0.927**	0.965^{NS}	0.949**
Thigh circumference	Weight	0.754**	0.91 6**	0.859^{NS}	0.953**
Calf circumference	Weight	0.304^{NS}	0.968**	0.876^{NS}	0.923**
Foot length	Weight	0.683**	0.935**	0.769^{NS}	0.951**

*Correlation is significant at 0.05 levels.

** Correlation is significant at the 0.01 level. NS = Not Significant.

Discussion:

Low birth weight (LBW) is among the strongest determinants of infant mortality and morbidity, and the chances for intact survival of LBW infants is much lower in developing countries due to inadequate or limited medical care including proper antenatal care [14]. The current study was conducted to identify the suitable parameters to predict low birth weight babies and those who are at risks of adverse antenatal, perinatal and postnatal outcome.

In Bangladesh, the prevalence of low birth-weight is unacceptably high (varies between 23% and 60%) [6-8], in the current study 38% of the babies were with low birth weight (1500-2500 gms) and 14% with every low birth weight (900-1500 gms).

Considering that birth weight is not fully satisfying indices for prediction of perinatal risk and long term out come, an alternative or additive parameter has been searched for a long time. A series of anthropometric variables (Mid-arm circumference, chest circumference, abdominal girth, thigh circumference, calf circumference, foot length, occipitofrontal circumference and supine length) had been identified as suitable by different authors with variable sensitivity and specificity[13-24].

In the current study, all the anthropometric measurements were significantly higher in babies with normal birth weight compared to those in low birth weight babies ($p < 0.001$), similar association was also found between birth-weight and gestational age (P< 0.00 1), Anthropometric variables exhibited a significantly linear correlation with gestational age indicating that higher the gestational age the greater are the anthrpometric measurements ($p < 0.001$) all the anthropometric variables were found to be well correlated with birth-weight of babies, irrespective gestational age ($p<0.01$). The highest correlation coefficient was found between chest circumference and birth-weight of babies ($r = 0.962$), while the lowest correlation coefficient was observed between calf circumference and birth weight of babies (r 0.923).

Dhar et al[20] (2002) have found a similar result and chest circumference (CC) was the best detector of birth-weight, where as Kadam et al[18] found relatively highest correlation between birth weight & thigh circumference (T.C.) & next with chest circumference (CC). A study conducted over Bangladeshi population, by Zakir et al, (Huque and Hussain, 1991) [25] showed that a chest circumference of 30.14 cm, a thigh circumference of 14.56 cm and a mid-arm circumference of 8.90 cm corresponded well with a birth weight of 2,500 gm. On this basis sensitivity, specificity and predictive values of the chest circumference was better than the other two measurements. However, the mid-arm circumference was observed to be more reliable than the other two measurements for detecting birth weight less than 2,000 gm.

In the current study, in pre-term babies all the selected anthropometric variables, except calf circumference, were found to bear significantly linear correlation with the birth-weight of babies ($p < 0.01$) and in full-term babies all the anthropometric variables exhibited significantly linear correlations with the birth weight of babies ($p < 0.01$). In post-term babies no significant correlation was observed between the variables of interest (except supine length and weight, $p < 0.05$) probably due to very small numbers of post-term babies. Yau & Chang[25] in similar type of study over Chinese newborn babies found that, except for the head circumference/ length ratio, all other indices showed a significant correlation

with gestational age and a weaker correlation coefficient of the mid-arm circumference/head circumference ratio was found comparing with the pre-term group. HC and TC appears to be better indicators for picking up LBW babies and MAC and CFC appears to be better in picking up very LBW babies[27].

So, a series of anthropometric measurements (Mid-arm circumference, chest circumference, abdominal girth, thigh circumference, foot length,

occipitofrontal circumference and supine length) have been found to be suitable and additional alternative indices for predicting birth weight and adverse perinatal out come.

Conclusion:

Mid-arm circumference (MAC), chest circumference (CC), abdominal girth (AG), thigh circumference (TC), foot length (FL), occipitofrontal circumference (OC) and supine length (SL) all are correctly correlated with birth weight and can be considered as appropriate indicators for identifying neonates require special attention and intervention for low birth weight (LBW) where weighing machine or facilities for ultrasonography is not readily available.

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