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Original Article

Correlation between Birth Weight and Other Anthropometric Parameters

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Abstract

Introduction: There is high incidence of low birth weight (BW) newborns in India. Several of these deliveries are conducted at home where accurate weighing scale may not be available. There is a need to have other anthropometric parameters which can accurately correlate with BW.

Aim: This study was aimed to find anthropometric parameter which can correlate with BW accurately.

Materials and Methods: A total of 254 newborns delivered by normal delivery were examined and anthropometric measurements–mid-arm circumference, mid-thigh circumference, calf circumference (CC), crown heel length, head circumference, chest circumference (ChC), and BW were carried out.

Results: CC had highest sensitivity and comparable specificity with ChC. ChC had highest correlation with BW followed by CC.

Key words: Anthropometric parameter, Calf circumference, Chest circumference, Low birth weight

INTRODUCTION

About 30% of total birth in India are low birth weight (LBW) which is severe hindrance to development.[1,2] It accounts for more than 50% of perinatal deaths and nearly 1/3 of infant deaths. Morbidity associated with LBW babies is also very high.[3] Almost 80% of deliveries in India occur at home and in community setting conducted by trained or untrained birth attendants which lack the basic facilities like accurate weighing scales. This study was planned to find a reliable alternative method to identify LBW babies.

Aim

This study was designed to find methods to detect LBW with various anthropometric parameters and to check their reliability in Indian scenario. It was designed to find best parameter to correlate with birth weight (BW).

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MATERIALS AND METHODS

In this hospital-based study, 254 term normal singleton live newborn babies delivered per vaginum were included in the study. The newborn with congenital anomalies, chromosomal anomalies, and hemolytic diseases were excluded from the study. The following anthropometric measurements were carried out in supine posture within 24 h of birth: BW on lever type weighing scale to the nearest of 50 g, mid-arm circumference (MAC) at the midpoint between acromion and olecranon process, mid-thigh circumference (MTC) just below the most inferior gluteal folds, calf circumference (CC) at the most prominent part of leg in the semi-flexed posture, crown heel length (CHL) with infantometer, head circumference (HC) by passing flexible fiber glass measuring tape around the head over the most prominent part, chest circumference (ChC) at the level of xiphisternum anteriorly, and inferior angles of scapula posteriorly. The data thus obtained were analyzed statistically using correlation matrix, regression equations, sensitivity, and specificity.

Observations

The mean values for various parameters along with standard error were as follows: BW (2846.35 ± 429.41 g), CC (9.99 ± 1.324 g), MTC (13.56 ± 2.175 g), MAC (9.73

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± 1.217 cm), CHL (47.36 ± 3.198 cm), HC (33.21 ± 1.548 cm), and ChC (31.24 ± 16.02 cm). Correlation matrix of all the anthropometric variables was derived. It showed that all the parameters had significant correlation with BW [Table 1]. The highest correlation was the ChC (0.753) followed closely by CC (0.734). The HC also showed a high degree of correlation (0.712) which was comparable to that of chest and CC. The values for MTC, MAC, and CHL were much lower than that of chest, calf, and HC.

The data were further subjected to linear regression keeping BW as dependent variable and R value was derived, as shown in Table 2. Combined R value was 66.5% with all the six variables when regressed with BW. It was also evident from Table 2 that *t*-value was not significant for MAC, MTC, and CHL and so they were deleted from further analysis. Regression analysis was further carried out with CC, HC, and ChC and R was 65.6%. It was evident that even after deletion of three of the parameters, predictive values of model did not change much. Since the study was to find BW surrogates, so various anthropometric parameters were regressed with BW and regression equations were derived. Depending on these equations, regression lines were drawn and from these lines, cutoff values for identifying 2500 g of BW were calculated which were 8.5 cm for CC, 30.0 cm for ChC, and 32.0 cm for HC. Using the above cutoff values, various anthropometric variables were comparatively assessed by determining their sensitivity, specificity, positive, and negative predict values [Table 3] which showed that CC had highest sensitivity and comparable specificity with ChC. CC also had highest negative predictive values and positive predictive value less than that of ChC.

Table 1: Correlation matrix of various parameters

	BW	CC	MAC	MTC	CHL	HC	ChC
BW	1.00						
CC	0.734*	1.00					
MAC	0.599*	0.684	1.00				
MTC	0.637*	0.779	0.703	1.00			
CHL	0.465*	0.458	0.390	0.526	1.00		
HC	0.712*	0.662	0.613	0.742	0.599	1.00	
ChC	0.753*	0.771	0.624	0.705	0.534	0.816	1.00

MAC: Mid-arm circumference; MTC: Mid-thigh circumference; CC: Calf circumference; CHL: Crown heel length; HC: Head circumference; ChC: Chest circumference; BW: Birth weight; *indicates statistically significant at *P*<0.05

Table 2: Linear regression keeping BW as dependent variable

Variable	Coefficient B	S.E.	*t*-ratio
Constant	3230.39	433.87	7.445*
CC	128.93	21.98	6.115*
MAC	23.90	19.50	1.225
MTC	24.39	13.87	1.758
CHL	1.67	6.26	0.267
HC	63.61	20.09	3.166*
ChC	86.21	18.71	4.606*

MAC: Mid-arm circumference; MTC: Mid-thigh circumference; CC: Calf circumference; CHL: Crown heel length; HC: Head circumference; ChC: Chest circumference; BW: Birth weight; R=0.6651. Adjusted R=0.6570. * Significant

Table 3: Sensitivity, specificity, positive predictive value, and negative predictive value of various parameters

Variable	Sensitivity	Specificity	Positive predictive value	Negative predictive value
CC	70.7	92.4	64.4	94.2
ChC	60.0	92.7	70.58	92.7
HC	59.5	91.9	56.8	91.9

CC: Calf circumference; HC: Head circumference; ChC: Chest circumference

RESULTS

For birth weight 2500 g, cut off values for CC was 8.5 cm, for ChC it was 30.0 cm and for HC it was 32.0 cm. Using these cut off values it was found that CC had highest sensitivity and comparable specificity as of ChC.

DISCUSSION

Anthropometry provides a simple and objective method of the assessment of fetal growth at the time of birth. Some recent studies have documented CC as a better predictor of LBW.[4-8] From observations of the present study, it was evident that calf and ChC had high correlation with BW (0.734 cm and 0.753 cm, respectively).[9] Other anthropometric parameters such as MAC and ChC did not show any significant correlation between with BW as also observed by other authors.[5,9,10]

The predictive power R of the model was 66.5%. When all the six anthropometric parameters were combined, 53.8% of predictive values of model were contributed by CC alone. CC combined with either HC or CC had a predictive power of 64.7% and 62.8%, respectively. A comparable value of R is obtained for two combined variables, namely, ChC and CC, CC, and HC and addition of other parameters did not change the predictive power of the model much. The previous studies had shown cutoff value of 10 cm for CC with a sensitivity of 79%.[8,11] In the present study, a cutoff valve of 8.5 cm for CC showed a specificity of 92.7%.

Thus, we conclude that CC is best simple practical and cost effective alternative to BW but needs to be studied extensively to get the mean values at birth as well as the cutoff value based on which color tapes can be made

to be used by health care workers for identifying LBW babies.

CONCLUSIONS

The parameters studied included MAC, MTC, CC, CHL, HC, ChC, and BW correlation matrix and regression equations were derived which showed that ChC had highest correlation with BW (0.753) followed by CC (0.732) and HC (0.712). Regression analysis of data gave a cutoff value of 8.5 cm for CC for 2500 g of BW which showed 92.7% specificity for identifying low birth rate babies.

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