International Journal of Contemporary Pediatrics
Sheikh AR et al. Int J Contemp Pediatr. 2017 Nov;4(6):2065-2069
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20174732

Original Research Article

Evaluation of Calf circumference as a procedure to screen low birth weight babies: a hospital based cross sectional study

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Received: 30 July 2017
Accepted: 04 September 2017

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ABSTRACT

Background: In spite of the interventions being taken, low birth weight still persists as a public health problem in low and middle-income countries. World Health Organization defines low birth weight as birth weight less than 2500 gm. There is a constant search to find newer methods to detect low birth weight babies so that early methods can be instituted. This study was conducted to evaluate calf circumference as procedure to screen low birth weight babies in tertiary care hospital in Nagpur.
Methods: A cross sectional study was conducted in tertiary care hospital of Nagpur, Maharashtra for a period of 4 months. The study subjects were babies delivered at the hospital. Birth weight was recorded using a digital weighing scale within 24 hours of the delivery. Length, calf circumference, head and chest circumference were measured according to standard guidelines.
Results: Majority of mothers were in the age group of 20 to 24 years of age group, were educated up to primary school and belonged to Hindu religion. The mean calf circumference of low birth weight babies was 9.64±1.13 cm and was 10.96±1.01 cm in normal weight babies. The mean values of calf circumference were significantly lower in low birth weight babies ($p < 0.001$). The sensitivity and specificity for the best cut off of calf circumference was found to be 89.97% and 42.86% respectively.
Conclusions: Measuring calf circumference was found to be a good test with higher sensitivity but lower specificity. Hence, calf circumference can be used as an alternative method to screen babies born in remote areas, where the facility of weighing the baby at birth is not available.

Keywords: Calf circumference, Low birth weight, Newborn

INTRODUCTION

In spite of the interventions being taken, low birth weight still persists as a public health problem in low and middle-income countries.[1]

In spite of the interventions being taken, low birth weight still persists as a public health problem in low and middle-income countries.[1] World Health Organization defines low birth weight as birth weight less than 2500 gm. Low birth weight is one of the leading causes of death among the under 5 children across the world.[2] To combat this problem, global nutrition targets were set by World Health Organization. One of the global nutrition targets is reduction in low birth weight by 30% around the world by 2025.[1]

Birth weight has been universally used as a measure of low birth weight because its correlation with gestation and ease of recording in hospital setting.[3] Around 66% of

children in India are not weighed at birth.[4] Many measures are being taken to increase the institutional delivery in India; but, some studies still report home deliveries occurring in rural and urban poor families.[5-8] According to UNICEF estimates, the institutional delivery rates are 90.9%. The remaining 9.1% are deliveries at home.[9]

So, taking accurate weight is a problem due to unavailability of weighing scale and trained personnel. There is a constant search to find newer methods to detect low birth weight babies so that early methods can be instituted. Several studies have mentioned the surrogates to measurement of birth weight as in remote and rural areas mostly proper weighing machine is not available.[10-20] So, this study was conducted to evaluate calf circumference as procedure to screen low birth weight babies in tertiary care hospital in Nagpur.

METHODS

A cross sectional study was conducted in tertiary care hospital of Nagpur, Maharashtra for a period of 4 months. The study subjects were babies delivered at the hospital. All babies delivered during this period were included in the study. Babies with congenital anomalies and serious illness were excluded from the study. Permission from institutional ethics committee was sought before initiation of the present study.

A study conducted by Taksande A et al found that the specificity for calf circumference to be 75.6%.[13] Using this specificity, 95% confidence interval and 11% allowable error the minimum sample size was found to be 179.[21] We included 200 babies for convenience of calculations. Post-natal mothers were interviewed after obtaining informed consent using pre-designed questionnaire. The data instrument included age, educational status, and religion, type of delivery and gender of the baby. Educational status was classified using the Indian standard for classification of educational status and classification of religion was based on Census of India.[22-23] Birth weight was recorded using a digital weighing scale within 24 hours of the delivery. Length, calf circumference, head and chest circumference were measured according to standard guidelines.[24] Birth weight was classified using the World Health Organization guidelines into low birth weight and normal birth weight.[2]

Statistical analysis:

Data was collected and compiled using EPI Info version 7.2. Qualitative variables were expressed in percentages. Continuous variables were expressed in mean and standard deviation. The difference between two means was computed using unpaired t test. Box and Whisker plots were used to depict the calf circumference in both low birth weight and normal weight babies. Statistical Software for Social Sciences was used to calculate the Pearson's correlation coefficient between calf circumference and birth weight. Receiver operating characteristic curves were constructed. Further sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated for the best cut off point of calf circumference.

RESULTS

Table 1 shows the socio demographic characteristics of the study population. Majority of mothers were in the age group of 20 to 24 years of age group, were educated up to primary school and belonged to Hindu religion. A total of 113 children were delivered by Caesarean section and majority were males. Among 200 children, 21% were low birth weight according to World Health Organization classification.

Table 1: Socio demographic characteristics of the study population.

Demographic characteristics	Number (n=200)	Percentage
Age group of mothers*		
<20	8	4
20-24	100	50.00
25-29	85	42.5
30-35	7	3.5
Educational status of mother$		
Illiterate	11	5.5
Primary	78	39
Upper primary	45	22.5
Secondary	30	15
Senior secondary	32	16
Graduate and above	4	2
Religion		
Hindu	96	48
Muslim	55	27.5
Sikh	4	2
Buddhist	37	18.5
Others	8	4
Type of delivery		
Normal delivery	87	43.5
Caesarean section	113	56.5
Gender of the baby		
Male	121	60.5
Female	79	39.5
Birth weight of the baby		
<2.5 kg	42	21
≥2.5 kg	158	79

*In years; $: Based on Indian Standard of Educational Classification

In the present study, the Pearson's correlation coefficient between calf circumference and birth weight was 0.66 ($p < 0.001$). The mean calf circumference of low birth weight babies was 9.64±1.13 cm and was 10.96±1.01 cm in normal weight babies. The mean values of calf

circumference were significantly lower in low birth weight babies (p<0.001).

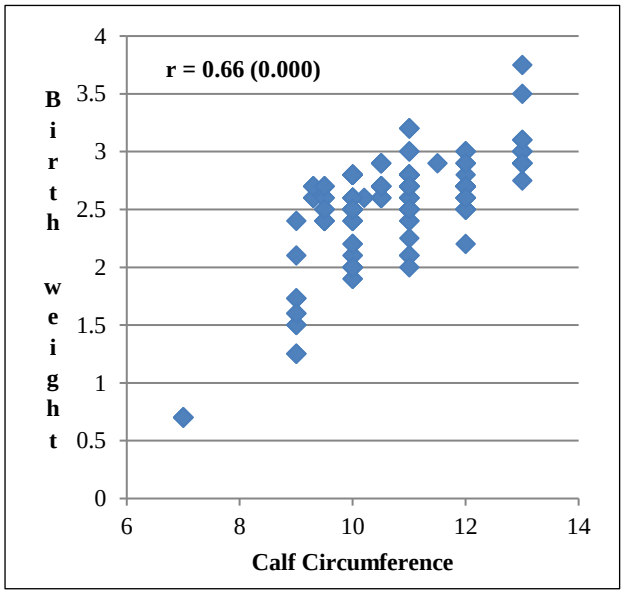

Figure 1: Scatter diagram showing correlation between calf circumference and birth weight of the study subjects.

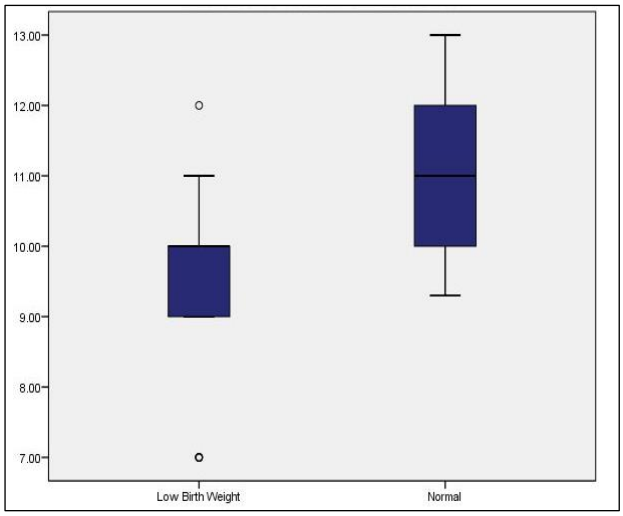

Figure 2: Box and Whisker plots of calf circumference in low birth weight and normal birth weight babies.

Figure 3 shows the receiver operating characteristic curve for calf circumference. The area under curve was 0.80 (0.73 to 0.87) and the best cut off was 9.75 cm of calf circumference. The sensitivity and specificity for the best cut off off calf circumference was found to be 89.97% and 42.86% respectively.

Table 3: Evaluation of calf circumference.

Best cut off*	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Diagnostic accuracy
9.75cm	89.97%	42.86%	85.54%	52.94%	80%

*Based on ROC curve analysis

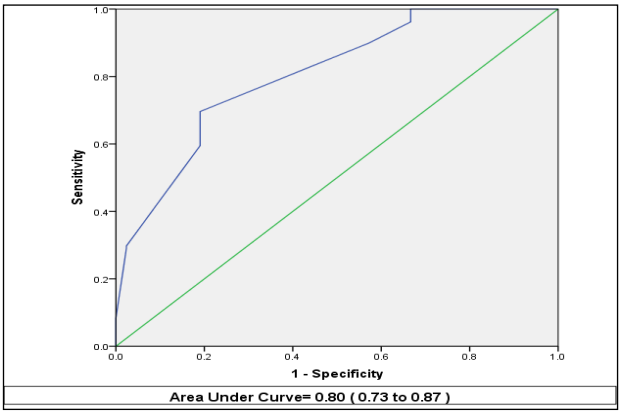

Figure 3: Receiver operating curve for calf circumference.

DISCUSSION

One of the high-risk groups among under 5 children in low birth weight babies. Since, they have significantly higher chances of morbidity and mortality. This cross-sectional study was conducted to evaluate calf circumference as procedure to screen low birth weight babies. In the present study, 21% of the study subjects were low birth weight category. We found a moderately positive correlation between calf circumference and birth weight of the babies. On receiver, operating characteristic curve analysis calf circumference can be used as a good test to differentiate low birth weight babies. A cut off point of 9.75 cm calf circumference yielded 89.97% sensitivity and 42.86% specificity.

A study by Kakrani V et al and Sumeetha B et al found the Pearson's correlation coefficient between calf circumference and birth weight to be 0.72 (p<0.001) and 0.70 (p <0.001) respectively.[12,11] This was in accordance with the present study findings. Higher coefficients were reported by Sunil Kumar P et al, Kulkarni YR et al, Alia RA et al, Kaur M et al, Jyoti SD et al, Das JC et al and Kumar S et al.[10,14-16,18,20] A study by Kulkarni YR et al found the best cut off of calf circumference to be 9.6cm. Similar studies by Taksande A et al reported 9.75 cm,

Sumeetha B et al as 9.7 cm and Kumar SP et al as 9.8 cm as their best cut off to screen the infants.[10,11,13,14] These studies were in accordance with the present study. Higher cut off points were reported by Kumar S et al, Das JC et al, Kusharisupeni et al and Jyoti SD et al.[10,16-18]

Present study had higher sensitivity and lower specificity for cut-off point of calf circumference in screening the infants. Similar results were found by Jyoti SD et al and Kusharisupeni et al.[16,17] But, some studies conducted by Kumar S et al, Das JC et al, Kulkarni YR et al, Taksande A et al and Sunil Kumar P et al found higher specificity for their cut off point.[10,13,14,18] Based on the area under curve, we found that calf circumference can be used as a good test to screen the infants. Similar results were found by study conducted by Kusharisupeni et al.[17]

These values which we have found are from one hospital and one geographical location. So, generalizability to whole of the population will be an issue. In spite of these limitations, calf circumference is an easy and feasible method to screen babies born in remote areas.

CONCLUSION

In the present study, calf circumference correlated moderately with birth weight of the babies. Measuring calf circumference was found to be a good test with higher sensitivity but lower specificity. Hence, calf circumference can be used as an alternative method to screen babies born in remote areas, where the facility of weighing the baby at birth is not available. Larger studies with more representative population using the uniform standardised techniques have to be conducted to obtain precise results.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sheikh AR, Thakre SS, Thakre S, Patil CR, Petkar PB. Evaluation of Calf circumference as a procedure to screen low birth weight babies: a hospital based cross sectional study. Int J Contemp Pediatr. 2017;4:2065-9.