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Original Research Article

UTILITY OF MID-UPPER ARM CIRCUMFERENCE AS A SCREENING TOOL FOR PREDICTING LOW BIRTH WEIGHT IN NEONATES

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ABSTRACT

Background: Low birth weight (LBW) is associated with high risk of infections, difficulty in breathing, hypothermia and feeding problems. Therefore, LBW should be detected early to allow newborns to receive appropriate care soon after delivery. However, recording of accurate birth weight may not be always possible due to inadequate equipment in resource poor settings especially in rural areas. This study was conducted to determine the efficacy of mid upper arm circumference (MUAC) as a screening tool to identify low birth weight babies where no weighing scales are available. The aim is to study the correlation between mid upper arm circumference and birth weight in neonates in a tertiary care hospital in Lucknow.

Materials and Methods: A cross-sectional observational study was conducted at tertiary care center. A total of 100 newborns were included in this study. MUAC and birth weight were measured. Descriptive statistics including mean, standard deviation and range were calculated for MUAC and birth weight. The correlation between MUAC and birth weight was assessed.

Results: A total of 100 neonates were assessed within 24 hours of life. Correlation analysis demonstrated that birth weight showed a significant positive association with mid–upper arm circumference ($p<0.001$). This indicate that lower birth weight is closely linked with lower mid–upper arm circumference.

Conclusion: Neonates with low MUAC values consistently fall into lower birth weight categories, whereas high MUAC values were strongly associated with higher birth weights. MUAC showed a very strong positive correlation with birth weight.

Keywords: Mid upper arm circumference (MUAC), Low birth weight (LBW), Newborns, Screening tool.

INTRODUCTION

Birth weight is the most sensitive and reliable indicator of the health in a community and an important indicator of infant growth and survival.[1] Neonatal death is more likely among low birth weight (LBW) babies especially in developing countries.[2] Low birth weight is defined as birth weight less than 2500gm irrespective of period of gestation. It is associated with high risk of infections, difficulty in breathing, hypothermia and feeding problems. Therefore, LBW should be detected early to allow newborns to receive appropriate care soon after delivery.[3] The perinatal, neonatal and infant mortality rate is highest in Uttar Pradesh which accounts for 44 deaths per 1000 pregnancies, 35.7 deaths per 1000 live births and 50.4 deaths per 1000 live births respectively.4 In rural areas of India, neonatal mortality rate is 27.5 per 1000 live birth and infant mortality rate is 38.4 per 1000 live birth. The prevalence of LBW babies is higher in rural areas.[4] Hence there is a need for early detection of low-birth-weight babies and early referral to higher centres for their better outcomes and to avoid neonatal deaths. However, recording of accurate birth weight may not be always possible due to inadequate equipment in

resource poor settings especially in rural areas. Mid upper arm circumference has been found to be useful in identifying low birth weight babies as it includes both muscular and fat compartments.[5] The muscular compartment provides an indirect reflection of the protein reserves, while the fat compartment estimates the energy reserves. A low mid upper arm circumference may be an indication of decreased muscle mass, decreased subcutaneous fat tissue or both, which correlates positively with changes in weight.[6]

This anthropometric parameter needs to be highly sensitive so that a good proportion of at-risk neonates will be referred to a higher centre. At the same time, greater specificity is required so that unnecessary referrals do not burden the referral centres. This study was conducted to determine the efficacy of mid-upper arm circumference as a screening tool for identifying low birth weight babies where no weighing scales are available.

MATERIALS AND METHODS

A cross-sectional observational study was conducted at a tertiary care hospital in Lucknow to investigate the correlation between mid-upper arm circumference (MUAC) and birth weight in all neonates born during period of 18 months, from 1st July 2024 to 31st December 2025. Before enrolling the patient, institutional ethical committee approval was taken. Informed consent was obtained from parents.

A minimum sample size of 100 neonates was achieved during the study period. Newborns with gross congenital anomalies involving upper limb and with birth injury of upper arm were excluded.

Data collection was done within 24 hours of birth to ensure accuracy. MUAC was measured at the midpoint between the acromion and olecranon of the left arm, using a non-stretchable tape with a precision of 0.1 cm. The measurement was taken twice, and the average was recorded to enhance reliability. Birth weight was measured using a calibrated digital electronic baby weighing scale immediately after birth, following standard protocols to stabilize the neonate.

Statistical Analysis: All analyses were performed using SPSS version 29.0. Descriptive statistics, including mean, standard deviation and range were calculated for MUAC and birth weight. The correlation between MUAC and birth weight was assessed using spearman's rho correlation coefficient. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 100 neonates were assessed. Among them, 52 (52.0%) were male, while 48 (48.0%) were female.

Birth anthropometric measurement of studied neonates

The mean birth weight was 2701.77±491.30 grams, ranging from 1752.0 to 3711.0 grams. The mean mid–upper arm circumference measured 9.58±1.09 cm, with a minimum of 7.2 cm and a maximum of 11.4 cm, reflecting the overall anthropometric profile of the studied neonates.

Correlation of birth weight and neonatal mid upper arm circumference

All neonates with mid upper arm circumference between 7.1–8 cm had birth weights in the 1500–1999 g group. The majority of those with MUAC 8.1–9 cm belonged to the 2000–2499 g group (78.8%), with a small proportion in the 2500–2999 g group. Neonates with MUAC 9.1–10 cm were predominantly in the 2500–2999 g group (54.8%), followed by 25.0% in the 3000–3499 g group and 20.0% in the ≥3500 g group. Those with MUAC >10 cm were mainly distributed in higher birth weight categories, with 38.7% in the 2500–2999 g group, 75.0% in the 3000–3499 g group, and 80.0% in the ≥3500 g group, indicating that larger MUAC values were strongly associated with higher birth weights.

Determination of optimal MUAC cut off for detection of low birth weight

ROC curve analysis demonstrated that mid–upper arm circumference (MUAC) was a highly effective predictor of low birth weight, with an area under the curve (AUC) of 0.977 (95% CI: 0.953–1.000, p<0.001). The optimal cutoff value identified was <8.75 cm, which yielded a sensitivity of 100.0%, specificity of 67.5%. These findings indicate that MUAC is a reliable screening tool for detecting low birth weight neonates.

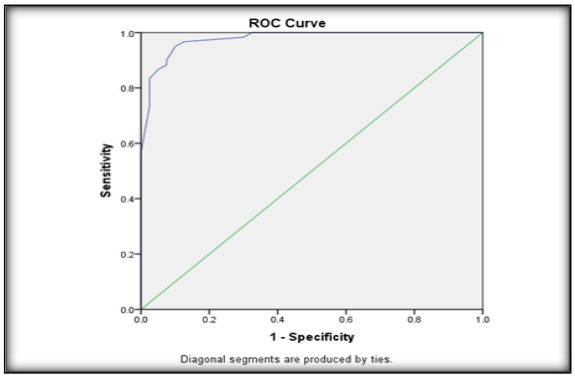

Table 1: Association of Birth Weight and Mid Upper Arm Circumference of studied neonates

MUAC Group (cm)	Birth Weight Group (gm)					P value
	1500-1999 (n=7)	2000-2499 (n=33)	2500-2999 (n=31)	3000-3499 (n=24)	≥3500 (n=5)	
7.1-8	7 (100.0%)	2 (6.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	<0.001
8.1-9	0 (0.0%)	26 (78.8%)	2 (6.5%)	0 (0.0%)	0 (0.0%)	
9.1-10	0 (0.0%)	5 (15.2%)	17 (54.8%)	6 (25.0%)	1 (20.0%)	
>10	0 (0.0%)	0 (0.0%)	12 (38.7%)	18(75.0%)	4 (80.0%)	

DISCUSSION

In this study out of 100 neonates, 52 (52.0%) were male and 48 (48.0%) were female. Our study noted that the mean birth weight was 2701.77±491.30 grams, ranging from 1752.0 to 3711.0 grams. In a previous study, Mandal A reported that the mean birth weight was 2895 grams, similar findings were also noted by Joshi HS et al.[7,8] While Salman U et al also reported that the mean birth weight was 2.316 ± 0.563 kgs.[9]

Our study demonstrated that the mean mid–upper arm circumference measured 9.58±1.09 cm, with a minimum of 7.2 cm and a maximum of 11.4 cm. Mid arm circumference (MAC) in Mandal A[7] study was ranged from 8 – 13 cm with a mean of 10.5 ± 1.1 cm. Salman U et al[9] reported that the mean MUAC was 8.90 ± 1.08 cm. Vaik AF et al reported that the mean mid-arm circumference of the study population was 9.6±1.0 cm (range 7 -12.4 cm). Farooq et al[11] reported that the mean MAC was 10.41± 1.02cm.[10]

In our study all neonates with Mid Upper Arm Circumference between 7.1–8 cm had birth weights in the 1500–1999 g group. The majority of those with MUAC 8.1–9 cm belonged to the 2000–2499 g group (78.8%), with a small proportion in the 2500–2999 g group. Neonates with MUAC 9.1–10 cm were predominantly in the 2500–2999 g group (54.8%), followed by 25.0% in the 3000–3499 g group and 20.0% in the ≥3500 g group. We found that neonates with MUAC >10 cm were mainly distributed in higher birth weight categories, with 38.7% in the 2500–2999 g group, 75.0% in the 3000–3499 g group, and 80.0% in the ≥3500 g group, indicating that larger MUAC values were strongly associated with higher birth weights.

Agrawal et al found that 48.6% of neonates with mid upper arm circumference between 8.1-9 cm belonged to 2000-2499,31.5% belonged to 2500-2999 g and neonates with MUAC of 9.1-10 cm belonged to 2500-2999 (62.5%).[6] Similar to our findings Agrawal et al also found that mid upper arm circumference between 10-11.0 cm belonged to 3000-3499 (49.2%), ≥3500 g (88%).[6]

Correlation analysis demonstrated the birth weight showed a very strong correlation with mid–upper arm circumference (rho =0.904, p<0.001). Farooq et al reported that there was strong positive correlation between MAC and birthweight (rho=0.89, p<0.001).[11] In our study ROC curve analysis demonstrated that mid–upper arm circumference (MUAC) was a highly effective predictor of low birth weight, with an area under the curve (AUC) of 0.977 (95% CI: 0.953–1.000, p<0.001). Agrawal et al demonstrated that ROC curve analysis of newborn MUAC and birth weight show that area under curve (AUC) for newborn is 0.974 which also signify statistically significant association.[6]

In this study the optimal cutoff value of MUAC for LBW was identified as <8.75 cm, which yielded a sensitivity of 100.0% and specificity of 67.5%. These findings indicate that MUAC is a reliable screening tool for detecting low birth weight neonates. Agrawal A et al reported that the newborn MUAC cut-off value found to be 8.85cm (OR 9.176 95%CI (7.273-11.527) to predict the low birth weight of newborn.[6] Salman U et al reported that a cut-off point of <9.3 cm of MUAC showed 81.1% sensitivity and 78.3% specificity.[9] Das JC et al showed MUAC cut off value of 9 cm for low birth weight.[12] Sawale et al reported cut-offs of MUAC ≤8.45 cm, ≤7.5 cm for predicting birth weight below 2000gm and 1500gm with sensitivity of 91.22%, 92.81% respectively.[13]

A key strength of this study lies in its demonstration of mid–upper arm circumference (MUAC) as a simple, cost-effective, and highly reliable predictor of birth weight, supported by robust statistical correlation and ROC curve analysis showing excellent sensitivity. This makes MUAC a practical screening tool for early identification of low-birth-weight neonates, especially in resource-limited settings where baby weighing machine may not be readily available.

However, a limitation of the study is that it was conducted in a single tertiary care hospital with a relatively small sample size of 100 neonates, which may restrict the generalizability of the findings to wider populations with diverse ethnic, nutritional, and socioeconomic backgrounds. Future multicentric studies with larger cohorts would help validate and strengthen the applicability of MUAC as a universal screening tool.

CONCLUSION

This study confirms that mid–upper arm circumference (MUAC) is a highly reliable anthropometric marker for predicting birth weight in neonates. The findings highlight MUAC as a simple, cost-effective, and practical measure for early identification of low-birth-weight neonates, particularly in resource-limited settings, thereby supporting its utility in neonatal care and public health surveillance.

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