

Original Research Article

Neonatal mid upper arm circumference as surrogate of birth weight

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ABSTRACT

Background: Recording an accurate birth weight by primary health worker has been a problem in rural areas, leading to search for an alternative, inexpensive, age independent and noninvasive method to predict newborn birth weight and wellbeing. With this background I aimed to found out whether the neonatal-MUAC is associated with birth weight or not?

Methods: This hospital based prospective observational study was conducted in SNCU and postnatal ward, Kamla Raja Hospital, G.R. Medical College, and Gwalior (M.P). A total of 1303 newborns were included in the study. The Mid upper arm circumference (MUAC) of newborns were taken and Birth weight recorded were filled in a proforma.

Results: Total 1303 neonates were evaluated. The mean MUAC and birth weight in preterm was found to be 1854.80 ± 387.3 and 7.47 ± 0.9 as compared to full term newborn having mean birth weight (2818.95 ± 328.1) and mean MUAC (9.58 ± 0.7). The Pearson coefficient of correlation between neonatal MUAC (N-MUAC) and birth weight was found to be $r = 0.987$ and $p < 0.01$. Birth weight can be predicted from regression equation: Birth weight (gms) = 422.99 (N-MUAC) + (-1272.66) . Cut-off value of neonatal mid upper arm circumference (N-MUAC) was found to be 8.85cm to predict low birth weight newborn.

Conclusions: Birth weight of newborn can be predicted from neonatal mid upper arm circumference (N-MUAC) in areas where the conventional scale are not easily available for measuring the birth weight of newborn.

Keywords: Birth weight, Mid upper arm circumference, Newborns, Special newborn care units

INTRODUCTION

Low birth weight newborns are born too soon, but they are not born to die, their deaths are utterly preventable.”- Dr. Lawn.¹

According to National family health survey (NFHS IV) data infant mortality rate of Madhya Pradesh is 51/1000.²

The low birth weight is defined as the proportion of newborns weighing $< 2,500$ grams. Birth weight of newborns is monitored through both health system surveillance and household surveys. In 2013, nearly 22 million newborns - an estimated 16 percent of all newborns born globally that year had low birth weight.

According to WHO accurate monitoring of low birth weight is challenging because according to NFHS 2015-16 Percentage of live birth whose birth weight was reported in India is only 77.9% and 80.8% in Madhya Pradesh.^{3,4}

According to WHO nearly half of the world newborns are not weighed at birth.

Anthropometry is the single most easily available, universally applicable, does not need expertise, economical, and non-invasive method of assessing body composition. It reflects both the health and nutrition of human body and predicts performance, health, and survival. Therefore, it is used for selecting individuals

and populations for health and nutrition interventions, as well as for monitoring their health and nutrition. Birth weight is the most sensitive and reliable indicator of the health of the community.⁵

Birth weight is an important indicator of infant growth and survival. In developing countries, low birth weight (LBW) is strongly related to infant mortality and morbidity. Neonatal death is more likely among LBW or very low birthweight (VLBW), especially in developing countries. Birth weight has been most widely used as the anthropometric measurement of choice for risk identification in newborns.

However, recording of accurate birth weight by primary health care workers has been a problem in rural areas, leading to a search for an alternative, inexpensive, age-independent and non-invasive method to predict neonatal wellbeing. Some investigations have shown that mid-upper arm circumference (MUAC) can be very useful to estimate the state of nutrition. MUAC covers the muscular and fat compartments. Indirectly, the muscular compartment represents the protein reserves, while the fat compartment estimates the energy reserves.

A low MUAC may, therefore, reflect a reduction in muscle mass, or a reduction in subcutaneous fat tissue, or both, which correlates positively with changes in weight. The MUAC of newborn is routinely measured in the Pediatric Department, Medical School, University of Hasanuddin. A study to evaluate the value of MUAC as a diagnostic tool to identify intrauterine growth retardation (IUGR) in term babies has been carried out previously. However, a study to determine the accuracy of MUAC as a diagnostic tool to identify LBW infant.⁵

Therefore, this study was planned to identify relationship between newborn mid-upper arm circumference (MUAC) and birth weight.

METHODS

This hospital based prospective observational study was conducted in SNCU and postnatal wards Kamla Raja Hospital, G.R. Medical College, and Gwalior (MP). We assess neonates following sequential delivery either with spontaneous vaginal delivery, caesarean section or vacuum extraction. Total of 1303 neonates of various gestational age were evaluated.

It was carried out during 2017-2018. Approval of research protocol obtained from ethical committee of G.R.M.C, Gwalior (Madhya Pradesh) and written consent were obtained from mothers.

Neonatal mid upper arm circumference (MUAC) assessment was performed for each of the newborn between 24 and 48 hours after birth. Correlation between Newborn MUAC and gestational age is analyzed by Pearson coefficient of correlation and regression analysis.

To avoid interobserver bias anthropometric measurement and assessment of gestational age carried out by single investigator only. Measurements were done 3times and mean was used in analysis

Inclusion criteria

Intramural newborns admitted in SNCU and postnatal ward, Kamla Raja Hospital G.R. Medical College, and Gwalior (M.P.).

Exclusion criteria

- Newborns with congenital malformation of left upper arm.
- Birth injury of left upper arm.

Materials used are MUAC tape and study proforma.

Statistics analysis

Analysis was done with SPSS version20 software. Chi-square or Fischer exact as applicable and mean was compared using one-way ANOVA. All at 95% confidence level with p less than 0.05 considered to be significant.

RESULTS

A total of 1303 newborns were studied. Authors have found only 28-42 weeks gestational age newborns. It was observed that extremely low birth weight (ELBW) newborn (<1000gm) found to be having the lowest range of MUAC 5.5-6(100%) followed by very low birth weight (VLBW) (1001-1499gm) having the MUAC range of 6.1-7(58.5%), low birth weight(LBW) newborns found to be having MUAC range of 8.1-9(48.6%), normal birth weight(NBW) (>2500gm) found to be having MUAC in range of 9.1-10(62.5%). Highest range of MUAC of newborn 10.1-11(88%) and >11(8%) found to be present in newborns having birth weight \geq 3500gm (Table 1).

Mid upper arm circumference of the newborn ranges from 5.5 cm to 11.5 cm. A majority (i.e. 49%) of newborns were within the range of 8.1 cm to 10.0 cm. In the pooled sample 40.9 percent of newborns have the measurement 8.0cm or below. Mid upper arm circumference (MUAC) of newborns were found above 10 cm in the 10%.The mean MUAC and birth weight in preterm is found to be 1854.80 ± 387.3 and 7.47 ± 0.9 as compared to full term newborn having mean birth weight(2818.95 ± 328.1) and mean MUAC (9.58 ± 0.7).

The Pearson correlation coefficient(r) was found to be $r = 0.987$ and $p < 0.01$ suggesting good strength of relationship between newborn mid upper arm circumference and birth weight (Figure 1). A linear regression analysis was done, and regression equation was derived to predict the birth weight of newborn: Birth

weight = Newborn BW (gms) = 422.99 (newborn MUAC) + (-1272.66) R²=0.879 (Figure 2).

Table 1: Relationship between newborn MUAC and birthweight.

Birth weight (Gms)	Newborn MUAC						
	5.5 to 6.0 No. (%)	6.1 to 7.0 No. (%)	7.1 to 8.0 No. (%)	8.1 to 9.0 No. (%)	9.1 to 10.0 No. (%)	10.1 to 11.0 No. (%)	>11.0 No. (%)
≤ 1000 (n=5)	5(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
1001-1499 (n=118)	46(39.0)	69(58.5)	3(2.5)	0(0)	0(0)	0(0)	0(0)
1500-1999 (n=246)	8(3.3)	135(54.9)	99(40.2)	4(1.6)	0(0)	0(0)	0(0)
2000-2499 (n=354)	0(0)	16(4.5)	143(40.4)	172(48.6)	23(6.5)	0(0)	0(0)
2500-2999 (n=368)	0(0)	0(0)	9(2.4)	116(31.5)	230(62.5)	13(3.5)	0(0)
3000-3499 (n=187)	0(0)	0(0)	0(0)	12(6.4)	81(43.3)	92(49.2)	2(1.1)
≥ 3500 (n=25)	0(0)	0(0)	0(0)	0(0)	1(4)	22(88)	2(8)

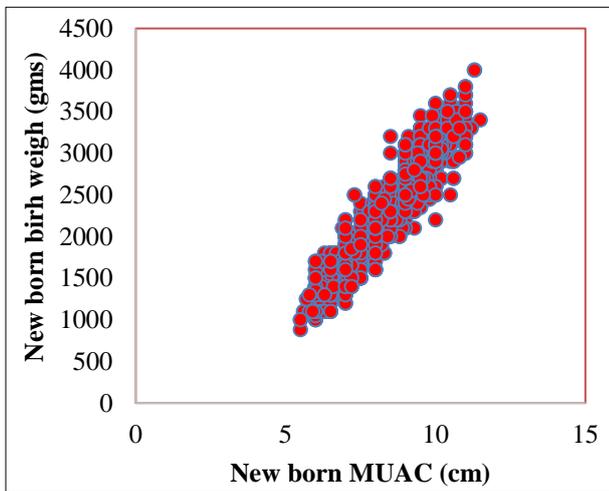


Figure 1: Correlation between neonatal MUAC and birth weight.

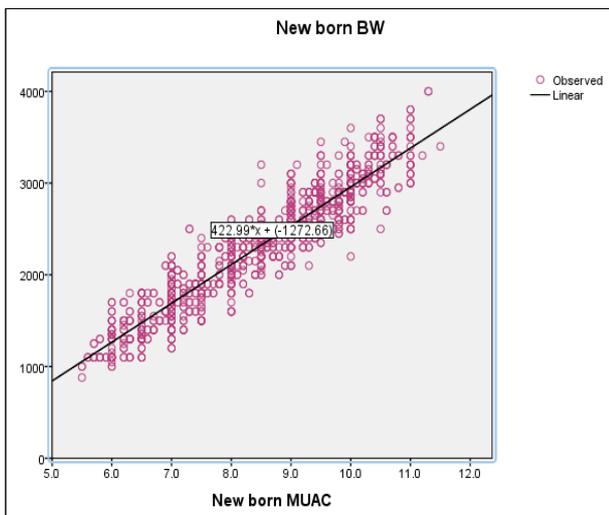


Figure 2: Linear regression curve based on the correlation between MUAC of newborn and birth weight.

To determine the optimal cut off along with Sensitivity and Specificity, ROC curve analysis of newborn MUAC and birth weight has done. Result shown that area under curve (AUC) for newborn MUAC is 0.974 which also signify statistically significant association. Cut off value to predict low birth weight is 8.85 having (sensitivity 94.8% specificity 91.1%) (OR 9.176 95%CI (7.273-11.577)) (Figure 3).

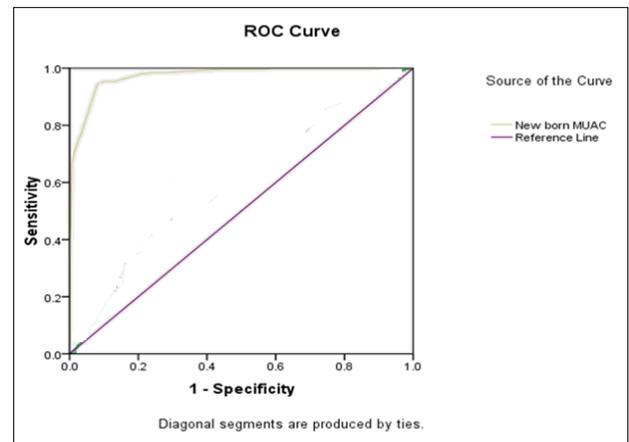


Figure 2: ROC curve.

DISCUSSION

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. Sauerborn et al, reported 9.5cm cut off to predict the low birth weight of a newborn.⁶ Study conducted by Ramaiya et al, in Tanzania was found that the correlation coefficient of 0.88 between birth weight and newborn MUAC and MUAC cut off of 9.5cm to predict low birth weight.⁷ Figueira, Sood found a correlation between newborn MUAC values and birth weights with r = 0.66, r = 0.76 Figueira and Sood excluded preterm newborns, whereas this Study included term and preterm babies.^{8,9}

Newborn MUAC shown a linear correlation with birthweight. The Pearson Coefficient of correlation(r) was found to be 0.903 p value<0.01 in the present study. Similar finding was also observed by Kumar et al, in their study having $r=0.879$ and the p value was significant i.e $p<0.001$.¹⁰

In conclusion, there is a high positive correlation between birth weight and MUAC. Our data allowed us to determine that the following equation can be used to predict birth weight from MUAC: Birth weight = 422.99 (newborn MUAC) + (-1272.66). The optimal cut-off point value of newborn MUAC value for LBW <8.85cm. The limitation of this study was associated with the fact that assessment of MUAC was performed after body weight had been measured.

CONCLUSION

Statistically it has been proved that neonatal MUAC can be used as a surrogate of birth weight. The Cut-off value of newborn MUAC to predict the low birth weight is 8.85cm. The advantage of this simple, locally available and inexpensive method, that it can be used at community level by front line health worker (FLHW). It's indirectly point out the status of maternal malnutrition in the community and in hospitalised mothers. Neonatal MUAC shall be incorporated in neonatal anthropometry.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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