Original Article

Diagnostic Accuracy of Mid Upper Arm Circumference (MUAC) for Screening Low Birth Weight Babies

Screening of Low Birth Weight Babies

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ABSTRACT

Objective: To determine the diagnostic accuracy of Mid Upper Arm Circumference (MUAC) for screening low birth weight babies.

Study Design: Cross-sectional study.

Place and Duration of study: This study was conducted at the Pediatric Unit II and Gynecology Unit II at Civil Hospital Karachi, Pakistan, from January to June 2012.

Materials and Methods: A hospital base study was carried out on full term, singleton 112 live born babies. Birth weight was taken through digital weighing scale as gold standard against anthropometric measurement of MUAC in centimeters. Correlation between MUAC and low birth weight was calculated with 95 % confidence interval. Sensitivity, specificity, positive and negative predictive values were calculated.

Results: Out of 112 newborn babies studied, 44 (39 %) were male and 68 (61%) were female. The mean birth weight was 2.316 ± 0.563 kgs and 51 (45.5%) newborns were low birth weight (LBW). The mean MUAC was 8.90 ± 1.08. In low birth weight mean MUAC was 8.41 ± 0.87; 95% CI (8.21; 8.61) and in normal birth weight mean MUAC was 9.90 ± 0.70; 95% CI (9.66; 10.13).Pearson correlation between low birth weight and MUAC was found statistically significant (r= 0.858;P-value <0.001). A cut-off point of <9.3 cm of MUAC showed 81.1% sensitivity and 78.3% specificity.

Conclusion: Mid upper arm circumference was statistically significant anthropometric surrogate of birth weight at cut-off point < 9.3 cm in the study population. Further studies are needed to validate the finding of this study in community setting. MUAC is simple, practicable, quick and reliable indicator for predicting LBW newborns in the community and can be easily measured by paramedical workers in developing nations.

Key Words: Low birth weight, Anthropometric measurements, MUAC, newborn

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INTRODUCTION

Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams (5.5 pounds). This is based on epidemiological observations that infants weighing less than 2,500 g are approximately 20 times more likely to die than heavier babies[1]. It also has an impact on long term growth and development and has association with chronic diseases.[2-4]

Globally four million neonatal deaths occur out of which 98% occur in developing countries. About 38% of under-five mortality occurs during the 1st 28 days of life with 75% occurring during the 1st week of life.[5] The prevalence of global low birth weight is 14% [6-12] but contributes to 60-80% of all neonatal deaths.[6-8]

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Early identification and referral of low birth weight is thus important to improve the outcome of such babies. In developing countries like Pakistan most of the deliveries are conducted at home. Low birth weight babies are not identified at birth as most of them are not weighed. A simple and easy method to identify low birth weight babies may circumvent the problem. A number of studies have shown a strong association between anthropometric measurements and birth weight.

This study was thus undertaken to determine the diagnostic accuracy of MUAC for screening of low birth weight babies.

MATERIALS AND METHODS

This hospital based case cross-sectional study was conducted at Pediatric Unit-II and Gynecology Unit-II of Civil Hospital Karachi, Pakistan from January to June 2012. Civil Hospital Karachi is one of the largest tertiary care

teaching hospitals catering to urban peri-urban areas of Sindh, Pakistan.

The newborns, singleton of either sex, full-term with gestational age of ≥ 37 weeks (confirmed on antenatal ultrasound) presenting within 24 hours of life in Pediatric and Gynecology units of Civil Hospital Karachi (C.H.K) during study period were included in the study.

Sample size was calculated to be 112 with a confidence interval of 95% and margin of error equal to 10%.

The newborns with congenital anomalies/ dysmorphic features, multiple births, hydrocephalus and gestational age of less than 37 completed weeks (pre-term babies) were excluded.

Anthropometric measurements of all neonates that fulfilled the inclusion criteria were taken after obtaining informed consent from the parents. Birth weight was taken in supine position within 24 hours after birth by a digital scale to the nearest 10 grams. To ensure reliability and to avoid confounders all the babies were weighed naked in a single same digital weighing scale which was checked by known standard weight before weighing babies; Mid upper arm circumference was taken at midpoint between the tip of acromion process of scapula and olecranon process of ulna of left arm. MUACs were measured to the nearest 0.1 cm using a non-extendable measuring tape with a width of 1.0 cm.

Data was collected with the help of structured questionnaire containing the information about mother (date of admission/time/name/ place of delivery/mode of delivery), information about newborns (gestational age/general health/gender/ hours of life/birth weight/MUAC)

Data was analyzed by using SPSS version 15.0 software. The mean with standard deviation was calculated for quantitative variables like birth weight, MUAC and gestational age, for the qualitative variables, like gender and mode of delivery, frequency and percentages were calculated. Sensitivity, specificity, positive predictive value and negative predictive value were calculated for MUAC against the actual birth weight of baby taken as gold standard. For outcome variables of the study we developed the cutoff points for measurement on our findings.

RESULTS

A total of 112 new born babies were enrolled in this study.

The mean mid-upper-arm circumference (MUAC) was 8.90 ± 1.08. Among those, 68 (60.7%) were female and 44 (39.3%) were male. A total of 75(67.0%) newborns were Low Birth Weight and 37 (33.0%) newborns were normal Birth Weight (Table-I). A total of 59 (52.7%) newborns had a MUAC Less than 9 cm and 53 (52.7%) newborns had a MUAC greater than or equal to 9.

In univariant analysis, mean MUAC in female was (8.93± 1.04; 95% CI: 8.68; 9.18) and mean MUAC in male was (8.86 ± 1.15; 95% CI: 8.51; 9.21), were found not statistically significant (t-test=0.327; P- value = 0.744).

In low birth weight mean MUAC was (8.41± 0.07; 95% CI: 9.66; 10.13) and normal birth weight mean MUAC was (9.90± 0.87; 95%CI: 12.43 - 12.97), which were found statistically significant (t-test=17.91; P- value = <0.001) (Table-2). The Pearson correlation test showed the positive significant relation (r = 0. 0.858; p- value < 0.001) between MUAC and birth weight (Table 3). In addition, cut off point of MUAC was performed to determine the most accurate cut-off value in order to distinguish LBW from normal birth weight newborns by using sensitivity and specificity test, MUAC <9.3cm correlated with LBW with a sensitivity of 81.19% and specificity of 78.7% (Table 4).

Table No,1: Percentage distribution of Birth Weight (grams)

Birth Weight (grams)	No.	%age
≤ 2500	75	67.0
> 2500	37	33.0

Table No.2: Comparison of MUAC values of newborns based on birth weight

Characteristics	birth weight ≥ 2.5 kg	birth weight < 2.5 kg
Mean	9.90	8.41
Std. Deviation	0.70	0.87
Minimum	9.20	7.30
Maximum	11.10	10.20
Range	1.90	2.90
95% Confidence Interval	(9.66 ; 10.13)	(8.21 ; 8.61)
t-test statistic = 17.91; P- value = <0.001		

Table No.3: Correlation analysis between MUAC and Birth weights

Correlations	MUAC	Birth weight
MUAC	1	0.858*
Birth weight	0.858*	1
Significant P value <0.001		

Table No.4: Sensitivity, Specificity, Positive Predictive and Negative Predictive Values at different MUAC cut off point

MUAC (cm)	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
< 9.3	81.1	78.7	65.2	89.4
< 9.4	62.2	78.7	59.0	80.8
< 9.8	43.2	89.3	66.7	76.1

DISCUSSION

The main aim of this study was to identify and validate the best suitable substitute parameter, proxy to birth weight, which when used by the health personnel in domiciliary outreach will detect the maximum number of at risk neonates for providing them with timely and needed intervention strategy. In our study there was no significant difference in birth weight and anthropometric measurements between male and female newborns. Therefore we analyzed the combined data for both sexes.

The mean birth weight in our study was relatively higher than previous studies from India and Bangladesh[9]. A WHO multicenter study reported that the average birth weight was 2630, 2780 and 3840 grams for newborns in India, Nepal and Sri Lanka respectively. [10] Similar higher mean birth weights of 3195 and 3029 grams have also been reported from other studies conducted in Iran and Nepal.[11-12] Possible reason for higher weight may be because full term (completion of 37 weeks of gestation), singleton live births were included and pre mature were excluded in our study. Previous studies did not specify such criteria and also included pre term babies in the studies. [14, 15]

The proportion of LBW was high in our study which was similar to studies reported earlier where the proportions of LBW varied from 10% to 46%.[16,17,18] In Pakistan different studies have reported a prevalence of low birth weight which varies from 5% to 23% in different settings. [19,20]

Many researchers have attempted to identify a suitable anthropometric surrogate to identify LBW babies which is reliable, simple and logistically feasible in field conditions. Some studies have recommended that Chest circumference (CHC), MUAC and Head circumference (HC) can be used as anthropometric surrogates to identify LBW babies. [9, 14] In our study only MUAC was used as anthropometric surrogate to identify LBW babies. In our study maximum sensitivity and specificity for MAUC was at cut off point of MAUC< 9.3 centimeters. The higher mean birth weight of newborns may be the reason for a slightly higher cutoff point obtained in our study. A study from Bangladesh reported maximum sensitivity (96.2%) and specificity (97.3%) of MAUC at cut off point of < 9 cm possibly because of low mean (2538 gram) of low birth weight reported in Bangladesh. The cutoff point obtained by analysis was relatively higher than those suggested by previous studies. [9]

Further studies are necessary to define a more precise cut off point for Pakistani newborns.

In most developing countries including Pakistan about 75% deliveries occur in rural communities and are attended mainly by traditional birth attendants (TBAs) or relatives, Recording weights for every baby at birth is not feasible in all cases. The present study shows that a simple measurement, like mid-arm circumference can be used as an alternative to weight recording for identifying newborns with low birth weight. It would be logical to assume that this variable would be useful in predicting neonatal outcome. It also would be quite rational to develop some simple device, which would be user friendly and easy for mothers to comprehend and remember where needed in future. A color coded tape indicating weight < 2500 gram may serve the purpose reliably. All health personnel including TBAs can be provided with simple tape or a similar color coded tape as a component of the delivery kit which may be conveniently introduced into the existing health care delivery system as a quick, reliable, practical and cost effective alternative to weighing newborn babies

CONCLUSION

The results of our study suggested that mid upper arm circumference may be used as anthropometric surrogate to identify low birth weight newborns. Further studies are required to validate our results in the field setting and define an optimal cut-off value. A color coded, measuring tape may be suggested for use by health workers to identify LBW newborns in the community setting.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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