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ORIGINAL ARTICLE

DETECTION OF LOW BIRTH WEIGHT BABIES BY AN ANTHROPOMETRIC SURROGATE MEASURE: A HOSPITAL BASED STUDY

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ABSTRACT: INTRODUCTION: Birth weight is an indicator of both neonatal morbidity and mortality, maternal health, nutrition and quality of antenatal services. **OBJECTIVE:** To find out important anthropometric parameter(s) in the newborn as related to birth weight so that newborns with low birth weight can be identified. **MATERIAL AND METHODS:** A prospective cross sectional, analytical, hospital based study was conducted at Amritsar on 200 term low birth weight newborn babies(<2.5 kg) born during a period of 10 months and their various anthropometric measurements (HC, CC, MAC, TC, CFC) were taken according to standard techniques. **RESULTS:** The study showed a strong correlation (p <0.001) between mid-arm circumference (r = 0.834) and birth weight, followed by head circumference (r = 0.816) and birth weight. Other parameters were also strongly correlated (p < 0.001). A value of <9.2 cm and <7.6 cm for mid-arm circumference showed highest validity for picking up newborns weighing <2500 gm and <2000 gm respectively. **CONCLUSION:** Measurement of arm circumference is easier, convenient and statistically superior to other anthropometrical parameters in detection of low birth weight newborn babies. The researchers recommend designing of a simple 'Tri-colored tape' for early detection of 'At Risk' LBW newborns in rural communities for their timely management.

KEYWORDS: Low birth weight, anthropometry, nutrition.

INTRODUCTION: A low birth weight baby is defined as the one having birth weight of less than 2500 gms, irrespective of the period of gestation.[1] More common in developing than developed countries, birth weight below 2, 500 g contributes to a range of poor health outcomes.[2,3]

Birth weight has been accepted as the most reliable index of health status of the community and is an indicator of neonatal morbidity and mortality.[2] It also has predictive value regarding survival, future growth and development of the child.[4-6] It is a useful indicator of a baby's intrauterine environment. Indirectly, it is a reflection of the health and nutritional status of the mother and the care she receives during pregnancy.[7] It is an easy parameter to measure because it does not involve the use of expensive, sophisticated equipment and special expertise.[8]

However, in developing countries most of the deliveries are still conducted at home where birth weight is often not recorded and low birth weight accounts for 60-80% of neonatal deaths. In such poor resource settings where neonatal mortality remains high, the missed opportunities for either providing life-saving care at home or referral are many a times result of failure to identify high risk LBW newborns.

Early detection means early intervention thus leading on to decreasing morbidity and mortality of low birth weight newborns. Information on birth weight from developing countries is meagre.

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The reason (s) for this inadequate information are the following[8-10]:

- Home deliveries are conducted by personnel who are not provided with weighing scales.
- Birth attendants/relatives are illiterate; therefore they cannot record birth weight.
- The practice of confinement precludes outsiders from entering the room where mother and baby are kept.
- Even for deliveries in PHC/CHC, there is often a paucity of suitable weighing scales.

Every newborn child can be measured objectively by a method, other than record of birth weight, that can identify babies with LBW. Thus a suitable, low priced, reliable and acceptable method, usable by paramedical workers, has become an urgent need for third world countries, which contribute over 90% of the total infants with LBW. Many studies have been carried out to predict birth weight from simple anthropometric measurements.

But no single anthropometric surrogate to identify term LBW babies has been found out through this study, conducted in department of pediatrics and obstetrics and gynecology of Government Medical College, Amritsar, we have attempted to find correlation of birth weight with other anthropometric measurements in term LBW babies and to find a single measurement to identify term LBW babies.

MATERIAL AND METHODS: The study was conducted prospectively in Government Medical College, Amritsar. Two hundred apparently healthy looking, singleton, term (>37 weeks gestation) low birth weight newborns (<2.5 kg), born in obstetrics and gynecology wards during the study period of 10 months were included. Those with congenital anomalies, dysmorphic features, multiple births and gestational age of <37 completed weeks (pre-term babies) were excluded.

All the newborns were weighed and their anthropometric measurements carried out by the same person within 24 hours after birth at a temperature of 28-30 degree C in good diffuse light in front of the mother. They were weighed naked on digital weighing scales to the nearest of 10 gm. The weighing machine was checked daily by known standard weight (1.00 kg) before weighing.

Circumferences of head, chest, mid arm, thigh and calf were measured to the nearest 0.1 cm using a non-elastic, flexible, fiber glass measuring tape on left side of body according to standard techniques as described by Jellife:

a) Head circumference (HC): measured between glabella anteriorly and along the most prominent point posteriorly.[11]
b) Chest circumference (CC): measured at the level of nipples at the end phase of expiration.[11]
c) Mid arm circumference (MAC): measured at the midpoint between the tip of acromion process and olecranon process of the left upper arm.[11]
d) Thigh circumference (TC): in supine infants, the maximum thigh circumference recorded at the level of the lowest furrow in the gluteal region with the tape being placed perpendicular to the long axis of the lower limb.[12]
e) Calf circumference (CHC): measured at the most prominent point in semi-flexed position of the leg.[13, 14]

The data was collected, analyzed manually and by software SPSS (Statistical Package for Social Sciences) version 20.0 and appropriate statistical tests like percentage, chi square and correlation analysis were used to determine mean, SD, correlation coefficient and cut off values of

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different parameters. Regression equation for all anthropometric parameters was derived from simple linear regression analysis. Chi square test was also used to find the influence of various maternal factors on birth weight of newborns.

OBSERVATIONS:

ANTHROPOMETRY	MEAN (MALE)	SD(MALE)	MEAN (FEMALE)	SD (FEMALE)
WEIGHT(gm)	2219.31	191.97	2197.42	204.89
HC(cm)	31.27	0.81	31.29	0.83
CC(cm)	28.3	1.37	28.2	1.63
MAC(cm)	7.56	0.59	7.54	0.70
TC(cm)	12.4	0.66	12.55	0.61
CFC(cm)	8.66	0.52	8.63	0.68

Table 1: Sexwise anthropometric characteristics of newborns

Out of the 200 newborns included in the study, 93 were males and 107 females. The mean birth weight for male newborns was 2219.31 ± 191.97 gms and for female newborns 2197.42 ± 204.89 gms. Anthropometric values for birth weight, chest circumference, mid arm circumference and calf circumference were higher in males compared to those in females whereas values like head circumference and thigh circumference were lower in males compared to those in females.

ANTHRO-POMERTY	WEIGHT	MAC	HC	CFC	CC	TC
WEIGHT	1.000	0.834	0.8161	0.794	0.580	0.430
HC	0.816	0.718	0.571	0.679	0.571	0.389
CC	0.530	0.675	0.718	0.611	1	0.271
MAC	0.834	1	0.389	0.879	0.675	0.518
TC	0.430	0.518	0.679	0.547	0.271	1
CFC	0.794	0.879		1	0.611	0.847

Table 2: Matrix of Zero Order Correlation Coefficient between birth weight and other anthropometric measurements in newborns

Table 2 shows correlation coefficients between birth weight and other anthropometric measurements. Our study shows that all parameters - weight, head circumference, chest circumference, mid arm circumference, thigh circumference and calf circumference were significantly correlated with one another. Statistical analysis by applying chi square test showed p value of weight in relation to every parameter to be highly significant i.e. < 0.001. However, the correlation of weight was highest with mid arm circumference (r = 0.834) followed by head circumference (r = 0.816) and lowest with thigh circumference (r = 0.430).

ANTHRO-POMETRIC PARAMETERS	REGRESSION EQUATION (y is birth weight in gms, x in cms)	R^2	CUT OFF VALUE (WT<2500 GM)	CUT OFF VALUE (WT<2000GM)
MAC(x)	y = 253.7x + 290.3	0.695	9.2	7.6
HC(x)	y = 197.9x – 3986	0.665	33.3	31.1
CFC(x)	y = 256.8x - 13.6	0.630	11.4	8.4
CC(x)	y = 100.5x - 628.9	0.336	31.1	28
TC(x)	y = 134.2x + 531.6	0.185	14.7	12.9

Table 3: Regression equation for determining birth weight of newborns

Table 3 shows simple regression equation for estimating birth weight (y) of babies with birth weight less than 2500 gms, in relation to various studied anthropometric variables with R^2 i.e. the predictive value. R^2 of birth weight was highest in relation to MAC followed by HC and lowest with TC.

Among all maternal factors, only intake of IFA tablets showed correlation with low birth weight babies. Out of the 200 mothers, only 67 had taken IFA tablets. Statistical analysis by applying Chi square test showed that there was correlation between intake of IFA tablets and birth weight as 'p value' was 0.0089(< 0.05), hence significant.

DISCUSSION: In the present study, the mean birth weight of term newborns <2500 gm was 2207.6±198.79 gms. Maximum birth weight was 2490 gms and minimum 1500 gms. One hundred and seventy newborns(85%) had weight between 2000 gm to 2500 gm and 30 (15%) between 1500 gm and 2000 gm. Out of the 200 newborns, 93 were males and 107 females and we have analyzed data of both sexes. Our study showed that females (54%) had a higher rate of low birth weight than males (46%). The increased incidence of LBW among female babies is due to their lower average birth weight and genetic make-up of the female fetus.[15, 16]

Many researchers have attempted to identify a suitable anthropometric surrogate to identify LBW babies which is reliable, simple and logistically feasible in field conditions. Various studies done in our neighboring countries Nepal[17] and Bangladesh[18] showed head circumference and chest circumference respectively as the best parameter. Similar studies have also been conducted in some parts of India like Hyderabad[19] and Kanpur.[20]

Where calf circumference showed highest degree of correlation with birth weight. However, a study in Karad[21] showed thigh circumference to be the best surrogate measure for birth weight. As surrogate anthropometric measure to determine low birth weight babies is different in different populations, so it has to be determined for individual population groups. It was a need to determine best parameter in this region of country so that it can be applied in local community settings.

Our study shows that term LBW newborns can be identified using surrogate anthropometric measures on the first day of life and the most suitable parameter is MAC followed by HC. Values of <9.2 cm and <7.6 cm for mid-arm circumference showed highest validity for picking up newborns weighing <2500 gm (at risk) and <2000 gm (at high risk) respectively. The operational cut off determined by our study for the different measures were comparable to cut offs obtained in similar studies in some other settings. These cut off values were comparable with cut off value of MAC as 10.1 cm and 8.7 cm in studies conducted in Uganda[22] and Dhaka[18] respectively. Similarly in studies conducted in Kanpur[20] and Srinagar[23] in India, cut off values of mid arm circumference to identify low birth weight babies were 9 cm and 9.94 cm respectively.

MAC can be easily used for determining birth weight as it does not require full undressing of baby and also does not get altered by the process of labor. Measurement of head circumference may not be accurate due to moulding of head during birth, especially during prolonged and obstructed labor. For measurement of chest circumference, timing of phase of respiration was challenging. Moreover, full undressing has to be done while measuring chest circumference which is cumbersome and difficult especially in winter season. All these factors have implications for use of these measurements by community health workers.

Also, in the present study, only 33.5% mothers had taken IFA tablets and there was strong correlation between intake of IFA tablets and birth weight ($p<0.05$). Intake of IFA is advised during routine antenatal care visits. However, our study showed that only 67 mothers took IFA tablets out of the 87 who took antenatal care. This could be due to poor compliance because of adverse effects of iron and lack of knowledge on the part of mothers. Even a non-anemic mother is routinely advised 100 IFA tablets during pregnancy and in a developing country like ours most of the mothers are anemic and if they don't take IFA tablets there are more chances of having low birth weight babies.[24]

The results suggest that mid arm circumference with value <9.2 cm is an optimum anthropometric surrogate to identify and screen low birth weight babies in our settings. It is an easier, convenient and statistically superior parameter than other anthropometrical parameters in screening of term LBW newborn babies. We recommend designing of a simple 'Tri-colored tape' for early detection of 'At Risk' LBW newborns in rural communities of this part of the country (Punjab) for their timely management.

This study reinforces the fact that maternal factors, especially treatment of anemia by IFA tablets do influence birth weight. There is a need to strengthen the existing maternal and child health services to reduce the incidence of low birth weight.

REFERENCES:

1. World Health Organization. International statistical classification of diseases and related health problems, tenth revision. Geneva: WHO; 1992.
2. Kramer MS. Determinants of Low Birth Weight: Methodological assessment and meta-analysis. Bull WHO 1987; 65(5): 663-737.
3. Singh M. Care of the newborn, 7thed. New Delhi: Sagar publications; 2010. p 234-53.
4. Ashworth A. Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. Eur J Clin Nutr 1998; 52 (Suppl 1): 34-42.
5. McGregor SM. Small for gestational age, term babies, in the first six years of life. Eur J Clin Nutr 1998; 52 (Suppl 1): 59-64.
6. Barker DJP. Mothers, babies and health in later life. Edinburgh: Churchill Livingstone; 1998.
7. Bhargava SK, Ghosh S. Nomenclature for the newborn. Indian Pediatr 1974; 11: 443-4.
8. Kumar V, Datta N. Birth weight as indicator of health. Indian Pediatr 1984; 21: 113-8.

9. McCormick MC. The contribution of low birth weight to infant morbidity and childhood mortality. N Eng J Medicine 1985; 312: 82-90.
10. Sreeramareddy CT, Chuni N, Patil RK, Singh D, Shakya B. Anthropometric surrogates to identify low birth weight Nepalese newborns: a hospital based study. BMC Pediatrics 2008; 8: 16.
11. Bhatia BD, Tyagi NK. Birth weight: Relationship with other fetal anthropometric measures. Indian Pediatr 1984; 21: 833-38.
12. Sharma JN, Saxena S, Sharma U. Thigh circumference at birth as the best predictor of low birth weight babies. Indian Pediatr 1989; 26: 18-21.
13. Neela J, Raman L, Balakrishna N. Usefulness of calf circumference as a measure for screening of low birth weight infants. Indian Pediatr 1991 Aug; 28(8): 881-4.
14. Dhar B, Mowlah G, Nahar S, Islam N. Birth weight status of newborns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh. J Health Popu Nutr 2002; 20(1): 36-41.
15. Feleke Y, Enquoselassie F. Maternal age, parity and gestational age on the size of the newborn in Addis Ababa. East Afr Med J 1999 Aug; 76(8): 468-71.
16. Lawoyin TO, Oyediran AB. A prospective study on some factors which influence the delivery of low birth weight babies in a developing country. Afr J Med Sci 1992 Oct; 21(1): 33-9.
17. Sreeramareddy CT, Chuni N, Patil RK, Singh D, Shakya B. Anthropometric surrogates to identify low birth weight Nepalese newborns: a hospital based study. BMC Pediatrics 2008; 8: 16.
18. Dhar B, Mowlah G, Nahar S, Islam N. Birth weight status of new borns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh. J Health PopuNutr 2002; 20(1): 36-41.
19. Neela J, Raman L, Balakrishna N. Usefulness of calf circumference as a measure for screening of low birth weight infants. Indian Pediatr 1991 Aug; 28(8): 881-4.
20. Gupta V, Hatwal SK, Mathur S, Tripathi VN, Sharma SN, Saxena SC, Khadwal A. Calf circumference as a predictor of low birth weight babies. Indian Pediatr 1996; 33(2): 119-21.
21. Kadam YR, Somaiya P, Kakade SV. A study of surrogate parameters of birth weight. Indian J Comm; 2009; 30(3).
22. Elizabeth NL, Christopher OG, Patrick K. Determining an anthropometric surrogate measure for identifying low birth weight babies in Uganda: A hospital based cross sectional study. BMC Pediatrics 2013; 13: 54.
23. Bhat IA, Dhar GM, Shah GN, Neelofar K, Shehzada A. Efficiency of various anthropometric measurements in determining low birth weight babies. Indian J Matern Child Health 1995; 6 (2): 40-2.
24. Allen LH. Anemia and iron deficiency: effects on pregnancy outcome. Am J ClinNutr2000; 71(5): 1280-84.

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