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Original Research Article

Neonatal screening by chest circumference and a study of relationship between birthweight and other anthropometric parameters

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Abstract

Aims and objectives of the study: To record the chest circumference of the newborns as well as to find out the relationship between birth weight and other anthropometric parameters like head circumference, mid arm circumference and chest circumference.

Methods: This observational study includes a total no. of 2050 consecutive live singleton infants born between 28 to 42 weeks gestation in a 1 year period. Anthropometric parameters such as birth weight, crown heel length, mid arm circumference, head circumference and chest circumference were recorded.

Results: A mid arm circumference of 9cms can be used to detect low birth weight babies and chest circumference of 30cms has maximum sensitivity and specificity to detect low birth weight babies compared to other parameters.

Conclusion: Chest circumference and mid arm circumference are alternate parameters to identify low birth weight babies.

Keywords: Anthropometry, chest circumference, neonate

1.Introduction

Birth weight is generally used as a yard stick of maturity and is an important determinant of child survival and development [1]. Early prediction of the risks to which a child is exposed at birth allows for better organization of available resources, thus avoiding unnecessary controls and assuming maximum attention for those needy children.[2]

Perinatal risk assessment by weight percentile criteria has been shown to be insufficient, thus requiring the determination of additional or alternative anthropometricindices to improve evaluation. Further in developing countries like our India, 80% of births take place at home which are attended by traditional birth attendants or family members. In such situations due to lack of weighing scales, it is not possible to record the birth weight. So other anthropometric measurements like head circumference, chest circumference, mid arm circumference become important [3] and some of them like chest circumference and mid arm circumference can be used as surrogate markers for birth weight.[4]

Many studies were carried out to evaluate the mid arm circumference (MAC) and chest circumference as an alternative indicator of low birth weight. So the present study attempts to establish the norms for our populations.

2. Materials and Methods

2.1 Source of data

This observational study includes a total no. of 2050 consecutive live singleton infants born between 28 to 42 weeks of gestation in two Government Hospitals and one Private hospital in a

one year period. Babies with congenital malformations and those born to mothers with hypertension (diastolic BP >90mmHg on 2 determinations, diabetes and any other chronic illnesses were excluded. The data was collected between the time of birth to the day of discharge.

I. Anthropometry

i. **Birth weight:** Birth weight of the new born was recorded in grams by electronic balance with a difference of ±10gms within 12 hours of birth.

ii. **Crown heel length:** Crown heel length was recorded to the nearest of 0.1cms with an infantometer with the baby being supine, knees fully extended and soles of feet held firmly against the foot board and head touching fixed board.

iii. **Mid arm circumference:** For mid arm circumference the tape had been placed firmly but without compressing the tissues around the upper arm at a point midway between tip of acromion and olecrenon process.

iv. **Head circumference:** The head circumference was measured by passing a nonelastic tape over the occipital protuberance on the back and supra orbital ridges infront.

v. **Chet circumference:** it was measured at the level of nipple with same non elastic tape.

II. Gestational age assessment was done by new Ballard scoring system.

III. Descriptive data that included mean, standard deviation and percentiles were determined for various gestational age groups for different anthropometric parameters. Comparison between two groups was done by 'Z' test. Linear regression analysis was performed for predicting birth weight from other anthropometric parameters. For all the tests a p value of <0.05 was considered significant.

3. Observations and Analysis

Total no. of newborns, studied = 2050

Number of males = 1033 (50.46%)

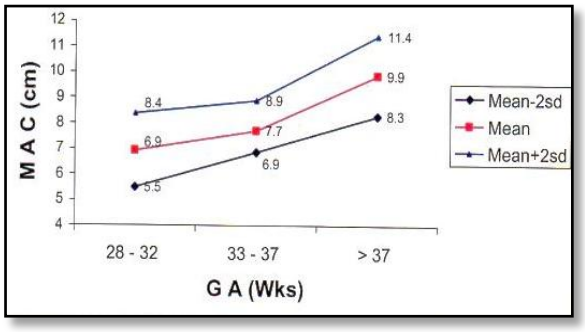
Number of females = 1017 (49.53%)

As per table 1, mean mid arm circumference was 6.9cms, 7.7cm and 9.9cms for gestational age 28-32wks, 33-37wks and >37 wks respectively (fig. 1).

Table 1: Distribution of new born babies according to mid arm circumference (cm) for gestational age

Gestational age (weeks)	Mid arm circumference (cm)		
	Mean – 2 SD	Mean	Mean + 2 SD
28-32	5.5	6.9	8.4
33-37	6.9	7.7	8.9
> 37	8.3	9.9	11.4

Fig. 1: Intrauterine growth curve for mid arm circumference with two standard deviations

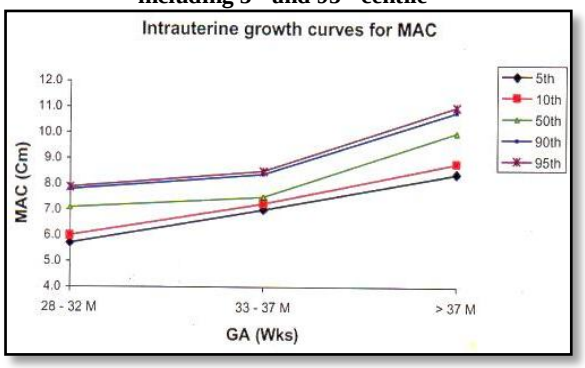


As per table 2, 5th centile and 95th centiles for mid arm circumference were 5.7cms and 7.8cm respectively to gestational age 28-32 weeks, 7cms and 8.5cms for gestational age 33-37 weeks, 8.4cms and 11cms for gestational age >37wks (Fig. 2).

Table 2: Intra uterine growth in mid arm circumference (cm)

Gestational age (Weeks)	Percentiles				
	Mid arm circumference (cm)				
	5th	10th	50th	90th	95th
28-32	5.72	6	7.1	7.8	7.8
33-37	7	7.25	7.5	8.4	8.5
> 37	8.4	8.8	10	10.8	11

Fig. 2: Percentile curve for mid arm circumference including 5th and 95th centile



As per table no. 3 it can be observed that correlation coefficients of all the parameters are highly positive and are statistically significant.

Table 3: Correlation matrix between anthropometric variables for 2050 infants born in hospital

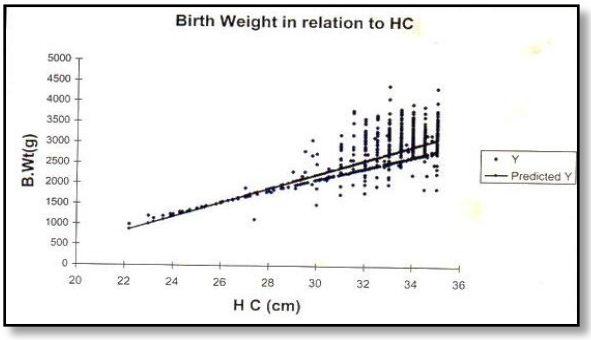
	HC	Length	Weight	MAC	CC
HC	-	r = 0.90 P < 0.001	r = 0.74 P < 0.001	r = 0.81 P < 0.001	r = 0.9 P < 0.001
Length	-	-	r = 0.82 P < 0.001	r = 0.83 P < 0.001	r = 0.89 P < 0.001
Wt	-	-	-	r = 0.71 P < 0.001	r = 0.80 P < 0.001
MAC	-	-	-	-	r = 0.79 P < 0.001
CC	-	-	-	-	-

All correlations P < 0.001

The figure no. 3 shows regression line of birth weight on head circumference. Using the statistical method, the following regression equation was derived. Birth weight = 173(HC) –2962.6. It can

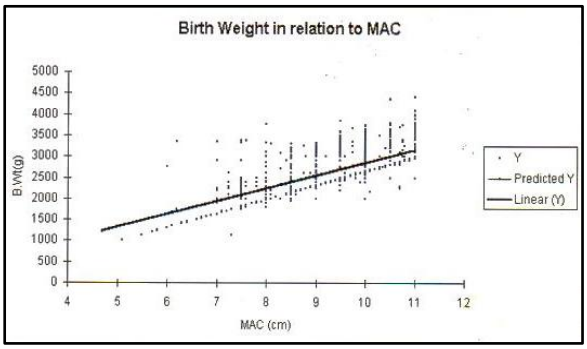
be observed that correlation coefficient (r=0.74) is positive and statistically significant (p<0.001).

Fig. 3: Scatter diagram showing birth weight in relation to head circumference



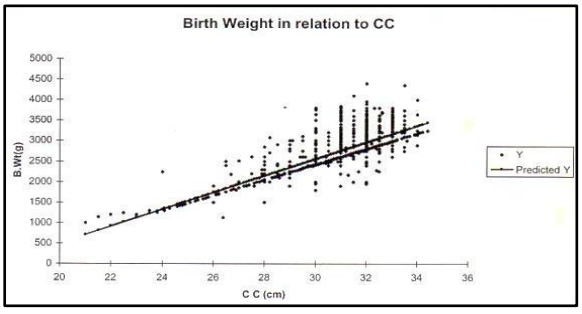
The figure no. 4 shows regression line of birth weight on mid arm circumference. Using the statistical method, the following regression equation was derived. Birth weight = 303.7 (MAC) – 189.8. It can be observed that correlation coefficient (r=0.71) is positive and statistically significant.

Fig. 4: Scatter diagram showing birth weight in relation to mid arm circumference



The figure 5 shows regression line of birth weight on chest circumference.Using the statistical method the following regression equation was derived. Birth weight = 203.5(cc) – 3555.2. It can be observed that correlation coefficient (r=0.80) is positive and statistically significant (p<0.001).

Fig 5: Scatter diagram showing birth weight in relation to chest circumference



As per table no. 4 it can be observed that chest circumference with a cut of value of <30cms has maximum sensitivity (87.5%) and specificity (96%) compared to other parameters like head circumference of <31.5cms (sensitivity 68%) and mid arm circumference of<9cms (sensitivity 69%).

Table 4: Validity indicators of cut-off value of head circumference, chest circumference, mid arm circumference in the detection of birth weight < 2500 grams

	HC		CC		MAC	
Birth weight	<31.5 cm	≥31.5 cm	< 30 cm	≥30 cm	< 9 cm	≥9 cm
<2500g	318	152	411	59	325	145
≥2500g	58	1522	61	1519	93	1487
Sensitivity	68%		87.5%		69%	
Specificity	96%		96%		94%	

4. Discussion

In developing countries, where about eighty percent of births occurs at home or in the community, logistic problems present the weighing of every newborn child. So many workers have tried correlating anthropometric measures with one another mostly with the birth weight to find out the surrogate marker for birth weight. Low birth weight with its consequent morbidity and mortality may be tackled by detecting low birth weight babies and giving them care on a priority basis. As chest circumference and midarm circumference can identify infants with low birth weight with a fair degree of accuracy they can be used by paramedical workers which is has been urgent need for third world countries.[5]

The table no 6, 7 and 8 below show cut off values of chest circumference, midarm circumference and head circumference of the present study as compared to similar studies.

Table 6: Cut off value of CC with sensitivity and specificity patterns

	Huque *et al*[6]	Bhargava *et al*[4]	Dhananjay*etal* [7]	Present study
Chest Circumference	30.14 cm	30 cm	28.5 cm	30 cm
Sensitivity	89.78 %	82.88%	94.26%	87.5%
Specificity	93.75 %	83.89%	87.26%	96%

Table 7: Cut off value of MAC with sensitivity and specificity patterns

	Gozal *et al*[8]	Kulkarni AP *et al*[9]	Kulkarni ML *et al*[10]	Present study
Mid arm circumference	9.5 cm	9 cm	9.1 cm	9 cm
Sensitivity	85%	93.65%	92.6%	69%
Specificity	74%	80.72%	94.5%	94%

Table 8: Cut off value of HC with sensitivity and specificity patterns

	Dhananjay *et al*	Present study
Head circumference	31.5 cm	31.5 cm
Sensitivity	82.94%	68%
Specificity	86.36%	96%

As per our study, among the three indices, chest circumference has the highest correlation with

birth weight, partly because its measurement is more replicable.[11] In contrast to our studies, many authors have found that mid arm circumference correlates better with the birth weight than chest circumference.[8][9][10]

We feel that head circumference measurement in detecting Low birth weight babies is not a useful parameter because it is affected by moulding and caput succedaneum as has been said in the literature [10] and it is to be noted that estimation of body length and head circumference is particularly prone to error because standard methods and precision instruments are not always used in the routine measurement of these variables.

5. Conclusion

This study shows that chest circumference is a simple, quick and reliable indicator for predicting Low birth weight and neonatal outcome in the community

Limitations of the study

This study has not looked into factors governing the birth weight and other parameters.

Contributions

CKR conducted the study, collected the data and drafted the manuscript and review of literature was done by BPR also CKR shall act as guarantor of the paper.

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References

[1] Ahmed F, Karim E, Bhuiyan S. Mid arm circumference at birth as predicator of low birth weight and neonatal mortality. *J. Biosoc. Sci* 2000; 32: 487-493.

[2] Georgieff MK, Sasanow SR, Chockalingam UM, Pereira GR. A comparison of the midarm circumference/ head circumference ratio and ponderal index for the evaluation of newborn infants after abnormal intrauterine growth. *Acta Pediatr Scand* 1988; 77:214-9.

[3] Shivaprasad SR, Manmohan, Kumar A, Kapani V. Intrauterine growth curves for midarmand thigh circumferences. *Indian Paediatr* 1989; 26: 343-7.

[4] Bhargav S K, Ramji S, Kumar K, Manmohan, Maswa J, Sachdev HPS. Mid arm and chest circumference at birth as predictors of low birth weight and neonatal mortality in the community. *BMJ* 1985; 29: 1671-1679.

[5] Lockwood CJ, Weiner S. Assessment of fetal growth. *Clin Perinatol* 1986; 13: 3-35.

[6] Huque F, Hussain Z. Detection of low birth weight newborn babies by anthropometric measurements in Bangladesh. *Indian. J. Pediatr* 1991; 58: 223-31.

[7] Naik DB, Kulkarni AP, Aswas NR. Birth weight and anthropometry of newborns. *Indian J Pediatr* 2003; 70:145-6.

[8] Gozal D, Ndombo PK, Minkand JZ, Kago I, Tetanye E, Mbede J. Anthropometric measurements in a newborn population in west Africa: A reliable and simple tool for the identification of infants at risk for early post natal morbidity. *J Pediatr* 1991; 118:800-5.

[9] Kulkarni AP, Sathe AP. Relationship between birth weight and anthropometric measurements of newborn. *Ind J Comm Med* 1993; 18:141-8.

[10] Kulkarni ML, Rehman A. Neonatal assessment beyond birth weight. *Indian Pediatr*. 1991; 28:929-31.

[11] Diamond ID, EI-Alum AM, Alimy, Mostafa SA, EI-Nashar SM, Guidotti RJ. The relationship between birth weight, and arm and chest circumference in Egypt. *J Trop pediatr* 1991; 37:323-6.