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Anatomy

The Use of Chest Circumference as an Anthropometric Surrogate in Prediction of Low Birth Weight: The Port Harcourt Study

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Abstract: Low birth weight (Birth weight < 2,500g) has been identified as the single most important underlying factor for neonatal deaths. In Nigeria, 36% of deliveries happen at home, in churches or with traditional birth attendants (TBAs) and neonatal mortality rate is 40 deaths per 1000 live births, with 11%ofnew-borns born with low birth weight (LBW).This study was aimed at evaluating chest circumference as simple, inexpensive anthropometric surrogate that can be used in the prediction of low birth weight in Port Harcourt. across sectional study in which birth Weight and Chest Circumference of 500 singleton babies were obtained within 24 hours of delivery was done during ten (10) month period. Minitab Statistical Software was used to analyze the data. Correlation analysis was done to determine the relationship between birth weight and chest circumference. 3.8% of the babies measured had low birth weight. The mean values for birth weight, and chest circumference were 3.326±0.512kg, and 33.21±2.414cm respectively. Chest circumference had a strong positive correlation with birth weight in both sexes (r= 0.897 for males and r= 0.899 in females). Measurement of chest circumference is a suitable, inexpensive surrogate that can be used in assessment of low birth weight in new-borns in areas where there is unavailability of the required resources to check birth weight and its measurement is very feasible as the nipple line is easily identifiable by both trained and untrained birth attendants.

Keywords: Anthropometric surrogate, Chest circumference, Low birth weight, Port Harcourt.

INTRODUCTION

It is generally accepted that birth size is an important marker for foetal and neonatal health in the context of the individual and the population. Birth weight in particular is strongly associated with foetal, neonatal and post-neonatal mortality, as well as infant and child morbidity[1]. Globally, about one-sixth of all newborns have low birth weight (LBW), which is the single most important underlying risk factor for neonatal deaths [2].

WHO [3] defined LBW as the weight at birth less than 2.5kg (5.5pounds); with measurement taken, not more than 24 hours after birth, before significant postnatal weight loss occurs. This practical "cut-off" for international comparisons is based on international epidemiological observations that infants weighing less than 25kg are approximately twenty times more likely to die than heavier babies[4] The Primary cause of LBW is Pre-term delivery, that is, before 37 weeks of gestation, as larger proportion of foetal weight is gain during the last trimester of pregnancy [5]. Another cause of LBW is Intrauterine Growth Retardation (IUGR), which is as a result of improper in-utero development caused by either maternal, foetal factors or both [5].

Available statistic from the WHO[6] showed that the incidence of LBW in Nigeria was 12%, with the exclusion of home delivery, churches or by traditional birth attendants which may not have been reported; however, records showed that other African countries such as Ghana (13%), Cote d' Ivoire (17%), Niger (27%) reported higher incidence [6] Oruamabo *et al*.[7] observed that the highest risk peaks was during the dry season and lowest during the rainy season. Mother's age, parity, height, ponderal index at delivery, and total maternal weight gain, as well as birth interval, each significantly affects the incidence of LBW. Studies within major cities in Nigeria showed that the incidence[8] and prevalence[9] of LBW in Port

Harcourt was 8.9% and 8.3% respectively in singleton birth while the prevalence in Ibadan was 8.3% [9] and incidence in Benin was 3.4%[10].

In bid to identify reliable, simple, and logistically feasible suitable anthropometric surrogate to identifying LBW babies, various studies have reported significant correlations between newborn anthropometric parameters and birth weight [11-16]. In one of such studies, WHO [11]. Recommended the use of chest circumference (CHC), mid-arm circumference (MAC) and head circumference (HC) as anthropometric surrogates to identify LBW babies; with better predictions reported for CHC [11]. Some other studies have recommended calf circumference (CC) and thigh circumference (TC) as suitable anthropometric surrogates to identify LBW babies;[12] however, CHC has been reported to the better alternative[13-16] as Dhar *et al*.[13] argued that the use of HC may not be accurate due to moulding of head during birth, especially during prolonged and obstructed labour.

This study was therefore carried out to determine the reliability of the use of chest circumference (CHC) as an alternative for determining low birth weight among Nigerian newborn singlet.

MATERIALS AND METHOD

This study was designed as cross-sectional analytical research involving anthropometric measurement of a total of 500 newborns (263 males and 237 females) full-term singleton live births at University of Port Harcourt Teaching Hospital (UPTH) and Braithwaite Memorial Specialist Hospital (BMSH) within a period of 40 weeks (10months), from February to November 2014.

All measurements were obtained within the first 24hrs of delivery. Birth weight and chest circumference (Fig. 1) were measured using standard methods as described by WHO[17]. Two consecutive (repeated) measurements were taken for each variable and the mean value calculated to the nearest 0.01kg or 0.01cm. Newborns with major congenital abnormalities or IUGR were excluded from the study. Parental informed signed consent was sought and obtained from the parents of the newborn subjects.

Fig-1: Measurement of chest circumference (CHC) of a baby

STATISTICAL ANALYSIS

Minitab Statistical Software was used to analyse the data. The mean and standard deviation was reported for the continuous variables. Categorical variables were given as the number or percentage of subjects with the characteristic of interest (LBW). Z-test was used to determine sex associated differences in mean values while Pearson's correlation evaluated the strength of the relationship between the birth weight and the chest circumference (CHC). $P<0.05$ was taken to be significant.

Ethical Considerations

Approval for this study was obtained from The Research Ethics Committees of the University of Port Harcourt, Braithwaite Memorial Specialist Hospital and the University of Port Harcourt Teaching Hospital.

RESULTS

19 out of the 500 infants (3.8%) had birth weight less than 2.5kg.Their mean birth weight was 3.38±0.52kg for males and 3.27±0.50kg for females. The mean CHC of the male newborns was 33.43±2.30cm and 32.98±2.52cm for females.

Table-1: Mean, standard deviation (SD) and range of measured parameters and Z-test of the mean differences

Parameter	Total (n=500)	Range (min-max)	Male (n=263)	Female (n=237)	Z-test (P-value)	Inf.
Birth weight (kg)	3.33±0.51	5.00 - 1.70	3.38±0.52	3.27±0.50	2.405 (0.017)	S
CHC (cm)	33.21±2.41	39.00 - 23.00	33.43±2.30	32.98±2.52	2.088 (0.037)	S

Note: *n=distribution, Max=Maximum, Min=Minimum, CHC=Chest Circumference. Inf.=Inference (S=Significant)*

The mean values for the birth weight and chest circumference were significantly higher in the male newborns when compared to females ($P<0.05$). The correlation analysis carried out showed CHC had a significant strong positive correlation with birth weight; r^2 = 0.895 for males (Fig. 2), r^2 = 0.896 for females (Fig. 3) while r^2 = 0.896 for the general population (Fig. 4).

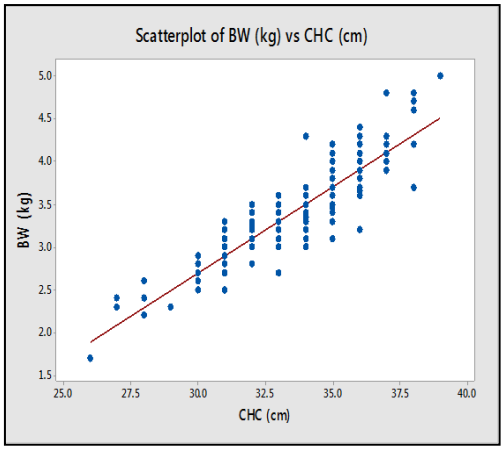

Fig-1: Correlation between Birth Weight (kg) and Chest Circumference (cm) in male neonates (r= 0.895)

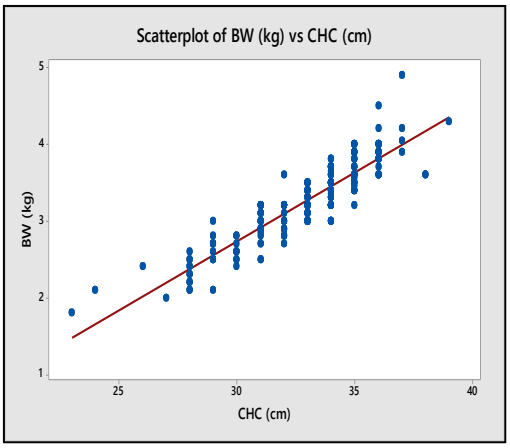

Fig-2: Correlation between Birth Weight (kg) and Chest Circumference (cm) in female neonates (r= 0.896)

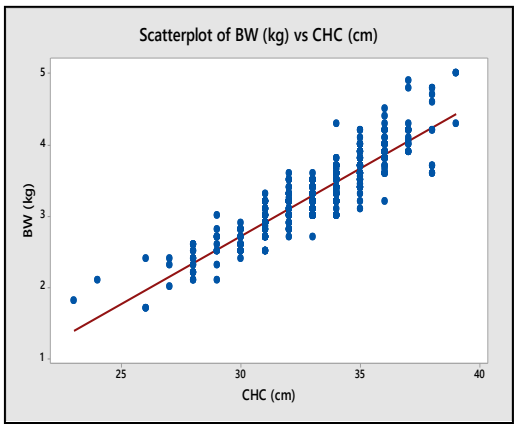

Fig-3: Correlation between Birth Weight (kg) and Chest Circumference (cm) in the total neonates (r= 0.896)

A regression equation to predict Birth Weight from CHC for the general studied population was derived as follows; BW (Kg) = -3.00 + 0.19 (CHC). Using this regression equation, 29cm was derived as the "cut-off" for LBW from the chest circumference. Therefore 29cm was equivalent to 2.5Kg. Thus, Chest circumference <29cm indicates LBW. This can be used as an Anthropometric Risk Indicator (ARI) for LBW.

DISCUSSION

The study observed that the male newborns were heavier and also had significantly greater chest circumference (CHC) when compared to the female newborns. The prevalence of LBW in this study was 3.8% which was almost similar to the incidence of 3.4% in Benin[10] but lower than the 8.3% for Port Harcourt[9] and other parts of the Nigeria[9] and other countries which had prevalence of ranging from 8.5% to 17.3%.[11,12] In this study, CHC had a significantly high positive correlation of with birth weight in both sexes. This strong relationship suggests that CHC is a good anthropometric parameter capable of accurately predicting LBW and this finding has also been reported by WHO[11] Sajjadian *et al*.[14]. Kapoor *et al*.[16] and Goto[20].

This study also derived a regression formula for the estimation of Birth Weight from CHC; *Birth weight (kg) = -3.00+0.190(CHC)* which also used to defined the "cut-off" value for CHC at 2.5kg was 29cm. However, this was quite different from the WHO values which recommended a CHC "cut-off" of 29cm and 30cm as "highly at risk" and "at risk" newborns respectively among other studies. Therefore, neonates with CHC <29cm should be considered as LBW and referred for essential care. From the result it could be inferred that neonates with CHC less than 29cm are >80% likely to have birth weight below 2.5kg.

Chest circumference had a strong positive correlation with birth weight and therefore a good parameter that that can predict birth weight. It is an anthropometric surrogate for birth weight with a cut-off of 29cm. Therefore, Nigerian neonates whose measurements fall below the cut-off should be considered to be at risk and given the essential medical intervention they require in order to increase their chances of survival.

CONCLUSION

Chest circumference is indeed a reliable anthropometric surrogate for the identification of LBW Nigerian new-borns. In other to obtain this measurement, no professional skill is required, therefore it will very applicable in local setting. Measuring chest circumference with a calibrated plastic-coated tape is inexpensive and easy, making it operationally feasible in areas where there are no professional to carry out the measurements.

RECOMMENDATION

It is therefore recommended that midwives and other traditional and religious birth attendants should be sensitized on the application of chest circumference as a good anthropometric surrogate for birth weight.

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