Regression Equations of Proxy Measurements of Birth Weight in Preterm Neonates

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Research Article

Abstract: **Introduction:** Globally 17% of approximately 142 million newborns have Low Birth Weight. World health report has stated the occurrence of low birth weight in India to be approximately 33% (2). Low birth weight or prematurity contributes to higher mortality in neonates many developing countries. The research aimed to find the proxy measurements for birth weight that is appropriate, practicable and cost effective. **Methods:** This study was undertaken in Sassoon General Hospitals, Pune. Block number 20, was the mainstay of this study where all postnatal mothers with their neonates are kept together. Study considered all babies born at < 37 weeks of gestation with weight less than 2500 gm during study period that is from 1st January 2004 to 30th June 2004. Therefore sample size obtained was 74. All measurements were taken by standard procedures. Signs of prematurity were studied. **Results:** In premature babies, the correlation between FL and LBW (r = 0.95) and FL and CHL (0.96) was pronounced. Birth weight and CHL of premature babies can therefore been estimated from these measurements. Birth weight showed highly significant relation (p<o.oo1) with all studied anthropometric measurements in preterm neonates in present study. Coefficient of variation and correlation coefficient were highly significant for all anthropometric parameters studied in preterm. **Conclusion:** All studied anthropometric measurements can be used as proxy measurement in preterm neonates.

Keywords: Regression Equations, Birth Weight, Preterm Neonates.

Introduction

The birth weight of newborn is the single most important determinant of its chances of survival as well as healthy growth and development. Globally 17% of approximately 142 million newborns have Low Birth Weight. This is however, not uniformly distributed but ranges from 4% in Netherlands to 50% in Bangladesh (1990). It is estimated that 95% of these are in developing countries. [1] World health report has stated the occurrence of low birth weight in India to be approximately 33%. [2] Low birth weights contributes to higher morbidity and mortality, half of perinatal and third of infant mortality and morbidity can be related to it. Therefore this study is conducted with an aim to find out an alternate simple, low cost and reliable predictor of birth weight to identify preterm LBW babies that can be used by trained or untrained persons.

Aim

- To study the neonatal anthropometric parameters in preterm LBW babies and to identify the most reliable parameter as a proxy to birth weight.

Objectives

- To study various neonatal anthropometric parameters in preterm LBW babies.
- To identify the most sensitive and reliable anthropometric parameter out of those studied as proxy to birth weight.
- To study the signs of prematurity among all preterm neonates.

Material and Methods

Place of Study:

This study was undertaken in Sassoon General Hospitals, Pune. Block number 20, was the mainstay of this study where all postnatal mothers with their neonates are kept together.

Study population:

Study considered all babies born at < 37 weeks of gestation with weight less than 2500 gm during study period that is from 1st January 2004 to 30th June 2004.

Methods

Myself recorded birth weight. The mothers of low birth weight newborns were interviewed to obtain information related to birth weight as per protocol. The protocol was pretested one. The purpose of the study was explained to mothers and informed consent was taken before enrolling them in the study.

Classification of Newborn: [3]

A) By Gestation:

1. Preterm: Before 37 weeks / up to 36 weeks of gestation
2. Term: 37-41 weeks of gestational age
3. Post term: gestational age 42 weeks or more.

B) By Birth weight

Low Birth Weight: Newborn weighing less than 2.5 kg irrespective of gestational age

Signs of prematurity were also studied in preterm babies.

1. Size of nipple
2. Flat elastic ear lobule
3. Development of rugosity of scrotum in male babies
4. Whether labia minora covered by L-majora in female babies
5. Development of solar / palmar creases
6. Development of hair
7. Development of nails.

Techniques

Every measurement has been taken 3 times and average was taken to minimize observer's error.

Anthropometric measurements that were studied:

Head circumference, crown heel length (CHL) Crown Rump Length (CRL), chest circumference (CC), calf circumference, foot length (FL), and weight of baby in (grams). All these measurements were taken by me to avoid observer's error. Procedure for taking these anthropometric measurements is described as follows: Left arm and left leg of all the infants were chosen for maintaining standard.

Tools used for taking the measurements

- Digital weighing machine
- Measuring tape
- Structured interview schedule
- Infantometer
- Foot length caliper

All the anthropometric parameters were taken within 24-48 hours of life. Techniques for taking anthropometric measurements:[4]

1) Weight

Measurement of weight is most reliable criteria for assessment of nutrition of children. For this study, weight was taken on electronic weight machine scale with an accuracy of10 gm.

2) Length

Infantometer was used for measuring Length.

3) CHL

Infant was placed supine on the infantometer. Mother was asked to keep vertex snuggly touching fixed vertical plank, legs were fully extended by pressing over knees and feet were kept vertical at 90^{o}, movable pedal plank was snuggly opposed against soles and length was read from the scale attached to board. It was difficult to extend both the legs while it was convenient and satisfactory to extend only one leg to record length, length recorded was called CHL.

4) CRL

Upper segment i.e. vertex to pubic symphysis i.e. crown rump length can be measured by infantometer. Here head was fixed against fixed vertical plank. A horizontal rod was placed over pubic symphysis while the length was recorded against vertical scale of infantometer.

5) Head Circumference

The occipitofrontal head circumference was measured with measuring tape. Tape was encircled over most prominent part of occiput and supraorbital frontal area and reading was taken with an accuracy of 0.1 cm.

6) Chest Circumference

It was measured with measuring tape at the levels of nipples to nearest to 0.1 cm.

7) Mid-arm Circumference (MAC)

Measured at midpoint between acromion and olecranon process measured by flexible measuring tape. Mid arm circumference remains almost constant during 1-5 years of age.

8) Calf circumference

Calf circumference was measured at most prominent point in semi flexed position of leg with measuring tape with an accuracy of 0.1 Cm. [5]

9) Foot Length: (FL)

Foot length was measured by specially designed FL caliper. It has readings for foot length on one side. The babies left foot was held in examiners (myself) hand, FL caliper in right hand. The sole was placed inside the caliper against platform. It has sliding portion, which was moved towards first metatarsal or great toe. The reading was taken with an accuracy of 0.1cm. Statistical analysis was done by using regression analysis and correlation coefficient.

Table 1: Distribution of signs of prematurity in preterm babies

Signs	n=74	%
Breast Nodule <5mm in size	58	78.4
Soft elastic flat ear cartilage	21	28.4
Development of scrotal rugosity in case of male babies	17/31	54.8
Whether Labia-minora not covered by L-majora	19/43	44.2
Development of solar /palmar creases	28	37.8
Hair development	59	79.7
Nail development	59	79.7

Table 2: Mean and S. D. for anthropometric parameters in preterm

Anthropometric Parameters	Mean (cm)	S.D.
CHL	39.26	4.92
CRL	26.29	1.92
MAC	8.88	0.68
Calf circumference	9.12	0.49
Chest circumference	27.42	2.08
Head circumference	29.79	1.94
Foot Length	6.21	0.28

Table 3: Anthropometric parameters in preterm

Anthropometric Parameters	Mean (cm)	S.D.	Coefficient of Variation (%)	Correlations Coefficient(r)
CHL	39.26	4.92	19.7	0.444*
CRL	26.29	1.92	10.5	0.324*
MAC	8.88	0.68	58.0	0.762*
Calf circumference	9.12	0.49	47.1	0.686*
Chest circumference	27.42	2.08	43.5	0.660*
Head circumference	29.79	1.94	20.7	0.454*
Foot Length	6.21	0.28	29.1	0.539*

* p<0.001 highly significant

Table 4: Correlation Coefficient In Anthropometric Parameters And LBW In Preterm (n=74)

Anthropometric Parameters	CHL	CRL	MAC	Calf C.	Chest C.	Head C.	Foot Length	Birth Weight
CHL	1	-	-	-	-	-	-	-
CRL	0.356*	1	-	-	-	-	-	-
MAC	0.392*	0.225	1	-	-	-	-	-
Calf circumference	0.315*	0.333*	0.813*	1	-	-	-	-
Chest circumference	0.429*	0.08	0.607*	0.430*	1	-	-	-
Head circumference	0.428*	0.138	0.262*	0.167*	0.713*	1	-	-
Foot Length	0.152	0.187	0.600*	0.335*	0.559*	0.436*	1	-
Birth Weight	0.444*	0.324*	0.762*	0.686*	0.660*	0.454*	0.539*	1

* p<0.001 highly significant

Results

Out of total 74 preterm babies, 31(41.89) were males and remaining 43 (58.1%) were females. In 58 newborns, breast nodule size was <5mm. Scrotal rugosity was less developed in 17(54.8%) male premature babies. In 19 female newborn babies Labia minora was not covered by Labia majora. Solar and palmar creases were poorly developed in 28 (37.8%) babies. Hair development was poor in 59(79.7%) premature babies. Similarly, nail development was poor in 59(79.7%) premature babies. (Table1). Mean and S.D. of various anthropometric parameters that were studied in preterm babies are shown in table 2. Coefficient of Variation and Correlations Coefficient for various anthropometric parameters that were studied in preterm are shown in table 3. Correlation matrix of different parameters with birth weight is depicted in table 4. Birth weight showed highly significant relation (p<0.001) with all anthropometric parameters that were studied in preterm babies. Simple Regression Analysis to predict LBW using various anthropometric parameters in preterm

1. For CHL BW=22.46CHL+974.7 R^2=19.7% P<0.001
2. For CRL BW=41.86CRL+756.15 R^2 =10.5% P<0.001
3. For MAC BW=279.70MAC+627.63 R^2 =58.0% P<0.001
4. For Calf Circum BW=348.38 Calf Circum- 1322.46 R^2 =47.10% P<0.001
5. For Chest Circum, BW=78.92 Chest Circum - 3407.65 R^2 =43.50% P<0.001
6. For HC, BW=58.44 HC + 115.57 R^2 =20.7% P<0.001
7. For Foot Length BW=470.33 Foot Length - 1066.88 R^2 =29.1% P<0.001

By using simple regression analysis, birth weight was predicted by above equations. P value was <0.001 for all the parameters to predict birth weight, which was highly significant i.e. all these parameters were highly reliable to predict LBW in preterm babies. By using multiple regression analysis, BW=181.56 MAC+36.66 Head Circumference + 121.21 Calf Circumference – 1945.2 R^2 =67.0% I.e. 67% of the variation is explained by MAC, Head Circumference and Calf Circumference combinely.

Discussion and Conclusions

In the present study, proportion of male premature babies was 41.89% and that of female premature babies was 58.1%.Hair, nail breast nodules were poorly developed in 79.7% and 78.4% respectively. Scrotal rugosity was less developed in 54.8% male premature babies. Labia minora

not covered with labia majora in 44.2% of female prematures. In premature babies, the correlation between FL and LBW (r = 0.95) and FL and CHL (0.96) was pronounced. Birth weight and CHL of premature babies can therefore been estimated from these measurements. Gohil *et al*[6] also showed significant relationship between FL and other parameters. A formula of height = FL X 6.5 ± 20 mm; correlated in 95% babies so according to this study determination of length from foot length measurement is more convenient in preterm sick neonates without disturbance to them. Birth weight showed highly significant relation(p<o.oo1)with all studied anthropometric measurements in preterm neonates in present study . Coefficient of variation and correlation coefficient were highly significant for all anthropometric parameters studied in preterm.

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