International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622

www.gynaecologyjournal.com
2020; 4(2): 07-11
Received: 04-01-2020
Accepted: 06-02-2020

Dr. Rakesh Kumar Kalra
Associate Professor, Department of Pediatrics, NC Medical College, Israna, Panipat, Haryana, India

Dr. Rupita Kulshrestha
Assistant Professor, Department of Obstetrics & Gynecology, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, India

Dr. Manish Raj Kulshrestha
Associate Professor, Department of Biochemistry, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Corresponding Author:
Dr. Rupita Kulshrestha
Assistant Professor, Department of Obstetrics & Gynecology, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, India

Cord blood thyrotropin versus anthropological parameters as predictors of short-term outcome of neonates

Dr. Rakesh Kumar Kalra, Dr. Rupita Kulshrestha and Dr. Manish Raj Kulshrestha

DOI: https://doi.org/10.33545/gynae.2020.v4.i2a.495

Abstract

Introduction: Birth weight (BW) has been used to predict neonatal outcome (morbidity and mortality). The present study aims to describe the features like BW, anthropological measurements, ventilator requirement and mortality in 1139 neonates on the basis of duration of their hospital stay (HS) and to find correlation between them and duration of HS, if any.

Materials and methods: Records of 1139 neonates in terms of BW, length and duration of hospital stay were taken. The cord blood was collected at birth for Thyroid Stimulating Hormone/ Thyrotropin (CBTSH) measurement. The BW and length measurements of the baby were obtained using standard procedures. The Body mass Index (BMI) and Ponderal Index (PI) was calculated using the standard formula. Study cases were divided into 4 groups on the basis of duration of HS. Data was finally analyzed with SPSS software. Receiver Operator Curve (ROC) and exponential curve were made as needed.

Results: Neonates with normal and above normal BW had shorter hospital stay. The neonates with below normal BW had longer HS. Length of HS increases as the BMI and PI decreases. CBTSH did not show any statistical significance. The BW, BMI and PI were significantly and negatively correlated with duration of HS suggesting that neonates with less BW, BMI, PI require prolonged HS.

Conclusion: BW significantly affects length of hospital stay. BW, BMI and PI have significant negative correlation with the duration of HS but the association of BW is most consistent. Length of HS increases as BW, BMI and PI decreases. to conclude, prediction of neonatal outcome can be done using anthropological parameters, BW being the most reliable one.

Keywords: Birth weight (BW), body mass index (BMI), ponderal index (PI), cord blood thyroid stimulating hormone (CBTSH), hospital stay (HS).

Introduction

Birth weight has long been a measure of neonatal outcome determining prognosis of neonates in terms of morbidity and mortality. The combination of two anthropometric parameters has been more appropriate to assess neonatal growth than any single parameter, with special attention to the Body Mass Index (BMI), as it relates both weight and length. The aim of present study is to study & describe the features like birth weight, anthropological measurements, ventilator intervention needed and mortality in 1139 neonates delivered at a tertiary care centre on the basis of length of their hospital stay and to establish correlation between them and duration of hospital stay, if any.

Materials and method

Records of 1139 neonates (delivered over a period of one year) in terms of birth weight, length and duration of hospital stay were taken from department of Pediatrics. The cord blood was collected from all of them at birth. Exclusion criteria were newborns with abnormalities such as hydrops fetalis, congenital malformations, congenital infections. The weight and length measurements of the baby were obtained using standard pediatric measurement procedures. The weight was determined when the baby was born; using a digital scale with an accuracy of 0.1 gram at the obstetric room, and the length was obtained by two trained pediatricians in the first 24 hours after birth. The length assessment was done using a wooden length board with a fixed head piece and a movable foot piece, perpendicular to the surface of the table. One of the pediatricians held the infant's head and the other held the infant's feet against the footboard, applying a gentle pressure to extend the infant's legs so that the heels of the infant touched the footboard firmly.

The BMI was calculated using the standard formula:

BMI = [weight (gm)/ length (cm)^2] [1].

The ponderal index (PI) was calculated by the following formula:

PI = Birth weight(gm) x 100/[Crown heal length (cm)^3] [9].

Data so collected was entered into excel sheets and analyzed for gender, mode of delivery, birth weight, cord blood TSH (CBTSH), BMI, PI, ventilator requirement, mortality and duration of hospital stay. Study cases were then divided into 4 groups on the basis of duration of hospital stay and categorized as group 1 (hospital stay ≤5 days, as in uncomplicated cases the babies are discharged as baby- mother duo after 5 days as per hospital protocol and severely ill babies who expired in less than 5 days), group 2(hospital stay 5-10 days), group 3 (hospital stay 10-20 days) group 4 (hospital stay > 20 days) [total n =1139]. Data was finally analyzed with SPSS software and tabulated. Receiver Operator Curve (ROC) and exponential curve were made as per requirement.

Observations: group 1 (hospital stay ≤5 days, n=611), group 2 (hospital stay 5-10 days, n=407), group 3 (hospital stay 10-20 days, n=89) group 4 (hospital stay > 20 days, n=32)

Table 1: Comparison among groups based on hospital stay

	Groups based on hospital stay				
	Group 1 n=611, (%)	**Group 2 n=407, (%)**	**Group 3 n=89, (%)**	**Group 4 n=32, (%)**	**p value**
Male	329 (53.85%)	242 (59.46%)	51 (57.30%)	26 (81.25%)	-
Female	282 (46.15%)	165 (40.54%)	38 (42.70%)	6 (18.75%)	-
NVD	542 (88.71%)	104 (25.55%)	32 (35.96%)	12 (37.50%)	<0.001
LSCS	69 (11.29%)	303 (74.45%)	57 (64.04%)	20 (62.50%)	-
Preterm (GA<37 weeks)	66 (10.80%)	87 (21.37%)	49 (55.05%)	25 (78.12%)	<0.001
Ventilator Requirement	4 (0.65%)	1 (0.25%)	3 (3.37%)	7 (21.88%)	<0.001
Mortality	6 (0.98%)	0 (0.00%)	1 (1.12%)	2 (6.25%)	0.001
Classification according to birth weight					
ELBW	2 (0.33%)	0 (0.00%)	1 (1.12%)	3(9.38%)	<0.001
VLBW	6 (0.98%)	1 (0.25%)	15 (16.85%)	18 (56.25%)	-
LBW	103 (16.86%)	120 (29.48%)	35 (39.33%)	9 (28.13%)	-
Normal	498 (81.51%)	284 (69.78%)	37 (41.57%)	2 (6.25%)	-
Macrosomia	2 (0.33%)	2 (0.49%)	1 (1.12%)	0 (0.00%)	-
Neonatal anthropometric & biochemical parameters					
BW (gm)*	2881.49±440.93	2794.83±498.22#	2291.27±762.35#	1582.72±667.54#	<0.001
BMI (gm/cm2)*	12.18±1.25	12.12±1.41	10.79±2.0#	9.46±2.05#	<0.001
PI (gm/cm3)*	2.51±0.26	2.53±0.32	2.37±0.39#	2.36±0.47	<0.001
CBTSH**	7.40 (6)	8.00 (6)	7.45 (7)	8.10 (10)	N.S.

NVD= Normal Vaginal Delivery, LSCS= Lower Segment Caesarean Section;
ELBW= Extremely Low Birth Weight, VLBW= Very Low Birth Weight, LBW= Low Birth Weight;
BW= Birth Weight, BMI= Body Mass Index, PI= Ponderal Index, CBTSH= Cord Blood Thyroid Stimulating Hormone.
* Value of BW, BMI and PI have been designated in mean±SD.
** CBTSH values has been expressed in median (IQR).
# p value significant in comparison to previous group

Table 2: p values among groups based on hospital stay

	BW	BMI	PI	CBTSH
Group 1 Vs Group 2	0.020	N.S.	N.S.	N.S.
Group 2 Vs Group 3	<0.001	<0.001	<0.001	N.S.
Group 3 Vs Group 4	<0.001	<0.001	N.S.	N.S.
Group 1 Vs Group 4	<0.001	0.018	<0.001	N.S.

Table 3: The Pearson's correlation of hospital stay with BW, BMI, PI and CBTSH along with area under curve in receiver operator curve (with hospital stay cut off 5 days)

		Pearson's correlation		ROC	
		r value	p value	AUC	p value
HS	BW	-0.409	< 0.001	0.586	0.014
	BMI	-0.329	< 0.001	0.579	0.024
	PI	-0.134	< 0.001	0.578	0.026
	CBTSH	0.046	0.575	0.448	0.135

HS= Hospital Stay; AUC = Area Under Curve and ROC = Receiver Operator Curve.

Table 4: Area under curve on ROC analysis (cut off for hospital stay was taken 5 days)

Test Result Variable(s)	Area	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
BW	0.573	.017	.513	.632
BMI	0.585	.005	.525	.646
PI	0.577	.012	.517	.637

Table 5: Sensitivity and specificity for increased hospital stay (as determined by ROC analysis)

Birth weight Category	Sensitivity	Specificity
ELBW	100%	99.4%
VLBW	99.0%	95.7%
LBW	79.6%	73.6%
Normal		
PI <2	98%	97.4%

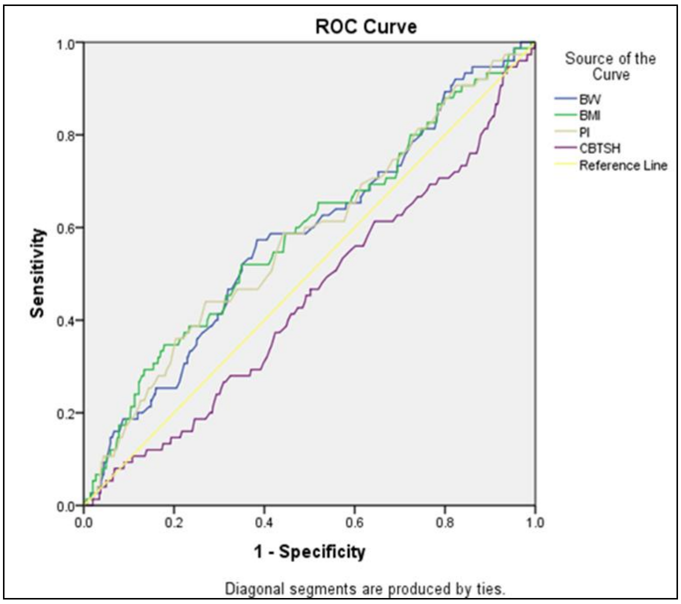

Fig 1: The ROC analysis of BW, BMI, PI and CBTSH with hospital stay cut off at 5 days

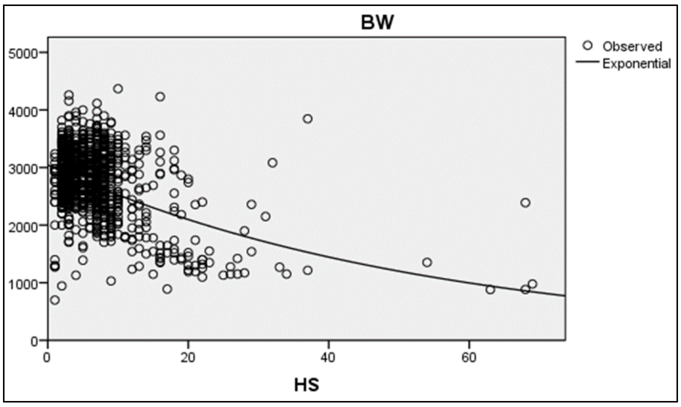

Fig 2: The exponential curve relationship between hospital stay and birth weight (r=0.482; p= <0.001)

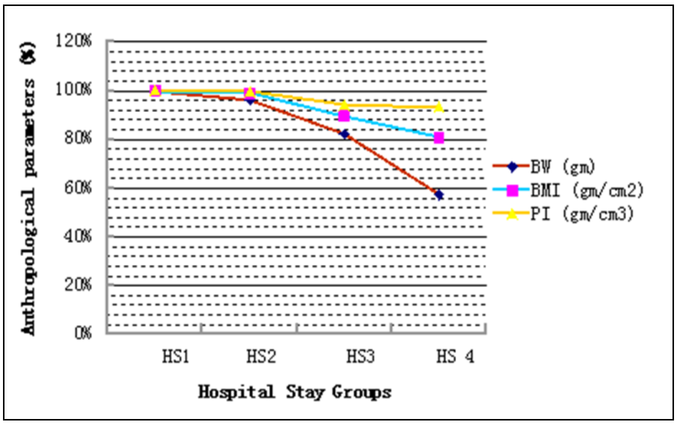

Fig 3: Percentage decline of anthropological parameters ((BW, BMI & PI) in each subgroup of hospital stay

Results

The normal birth weight and macrosomic neonates were most prevalent among shorter hospital stay groups (group 1 and 2). The ELBW, VLBW and LBW neonates were mostly prevalent in group 3 and 4. In group 4 (hospital stay > 20 days), 95% neonates were underweight (LBW, VLBW & ELBW) while in group 1 (hospital stay ≤5 days) only 18.37% neonates were underweight (none of them was being ELBW and only 0.93% were VLBW) (Table 1).

BMI and PI also appear to have significant association with length of hospital stay. Length of hospital stay increases as the BMI and PI decreases. BMI was highest in group 1 (12.18±1.25 gm/cm2) while lowest in group 4 (9.46±2.05 gm/cm2). Similarly, PI was maximum (2.51±0.26 gm/cm3) in group 1 and while minimum in group 4 (2.36±0.47 gm/cm3) (Table 1).

Among preterm neonates 78.12% require prolonged hospitalization (group 4) and only 10.80% were discharged in <5 days (group 1) (Table 1).

CBTSH did not show any statistical significance amongst the various groups (Table 2)

As depicted in ROC Curve, the area under curve was 0.586 for birth weight (p=0.014) and 0.579 for both BMI (p=0.024) and PI (p=0.026) when the cut off for hospital stay was taken as day 5.

The neonatal anthropological parameters (BW, BMI and PI) were significantly and negatively correlated (r= -0.409, -0.329 and 0.134 respectively; *p* value <0.001 for all the three) with hospital stay. (Table 3)

Mortality and ventilator requirement were negatively correlated with birth weight (r = -0.234; *p*<0.001 and r = -0.205; *p*<0.001 respectively) and BMI (r = -0.187; *p*<0.001 and r = -0.145; *p*<0.001 respectively) but not with PI

As depicted in figure 3, neonates with less BW, BMI, PI require prolonged hospital stay their association with duration of hospital stay is significant but BW is best predictor as compared BMI and PI. Thus, we can say that anthropological measurements can predict neonatal outcome NICU stay but BW is a more reliable marker as compared to BMI and PI.

Discussion

Despite technological advances, anthropometric parameters continue to represent the most practical method of assessing nutritional status and growth in the pediatric years, particularly during the neonatal period [4].

Prematurity is the second leading cause of infant mortality, after congenital anomalies, and a major determinant of neonatal and infant morbidity. Preterm infants are at risk for developing complications that result from anatomic or functional immaturity. The risk of developing complications decreases with increasing gestational age and birth weight the complications seen most frequently are hypothermia, respiratory abnormalities, patent ductus arteriosus (PDA), intracranial hemorrhage, hypoglycemia, necrotizing enterocolitis (NEC), infection, chronic lung disease, and retinopathy of prematurity (ROP) [2-4].

Several studies have looked at the trends of mortality and morbidity of babies with birth weights of <1500 g (VLBW infants). In the last 20 years, survival of these VLBW infants has increased, but the incidence rates of the main neonatal complications remain unchanged [5]. The increased survival is attributed mainly to improvements in obstetric and neonatal care, the widespread use of antenatal corticosteroids for women at risk for preterm birth, and the use of surfactant for prevention and treatment of respiratory distress syndrome (RDS) [5].

The long-term outcomes of preterm infants have been reported in several studies, as well as complications such as cerebral palsy, cognitive delay, learning difficulties, deafness, blindness, and behavioral problems. The frequency of such complications is inversely related to gestational age. In terms of predicting the long-term outcome as a result of the neonatal morbidities, a large study has shown that bronchopulmonary dysplasia (BPD), ultrasonographic signs of brain injury, and severe ROP are independently correlated with the 18-month outcome in extremely low-birth-weight (ELBW) infants (<1000grams) [5].

In general, the classification of newborn infants, by plotting their anthropometric parameters as birth weight, length and head circumference on standard growth curves, has provided us with information regarding the risk of neonatal mortality and metabolic complications such as hypoglycemia and polycythemia [3, 6, 12].

The anthropometric parameters are important in reflecting intrauterine growth and to define a baseline to follow-up the nutritional progress of the infant. Many authors have proposed that the assessment of body proportions may be more useful than single measurements for age alone for assessing newborn nutrition [6-9].

The Body Mass Index (BMI) or Quetelet index was calculated based on the formula: BMI = weight (gm)/ length $(cm)^2$. This index provides a high estimate of body fat mass as it has a positive correlation with skinfold thickness and other methods of estimating the percentage of body fat, for example the bioelectrical impedance and densitometry [12].

Furthermore, this index takes advantage of the physiologic principle regarding sparing length at the expense of weight during mild to moderate malnutrition [1].

The Body mass index has been intensely used for nutritional assessment in adolescents and adults, and has already been validated for children from 0 to 36 months as a good way to evaluate adiposity and body proportions. However there is a lack of reference values during the neonatal period. The validity of body mass index as an index of overweight and underweight depends on its degree of independence from length [7, 8].

Many previous studies have shown concern about the correlation between birth weight, and intrauterine growth restriction, with clinical risk factors for cardiovascular diseases, including hyperlipidemia, elevated insulin and high blood pressure. Previous studies of Guihard-Costa *et al.*, have shown that male newborns have higher weights and lengths, and the females have higher subscapular and tricipital skinfold thickness [1], but when the comparison of some weight-for-length indexes was performed, the gender's difference was small or even disappeared, especially in preterm newborns [1].

BMI for newborns in different gestational ages is available. It might be a useful parameter for newborn classification, helping in the detection of intra-uterine growth disturbances and also assisting to validate the nutritional therapy through the time [1].

The association detected between greater BMI at birth and greater adulthood BMI confirms the findings of other studies that have proved the association between greater birth weight and greater adulthood BMI [13, 14].

Ponderal index (PI) can be used to identify infants whose soft tissue mass is below normal for the stage of skeletal development. The PI is arrived at by the following formula: PI = birth weight x 100 / (Crown heal length) [3]. This can affect the long-term outcome. Thus, all intra uterine growth restricted infants may not be SGA and all SGA infants may not be small due to growth restrictive process. A low neonatal PI is defined as less than 1 SD below a mean 2.0 Foetal ponderal index can also be calculated by ultrasound examination and compared with the neonatal PI [15].

PI is does not seem to be a superior predictor than either BW or BMI for selected short-term outcomes in newborns.

Birth weight / length ratios, PI, placental weight and BW/placental weight ratios have been correlated with perinatal mortality and morbidity. But studies have also shown that except for PI, other parameters mentioned above are affected by ethnicity, gender and manner of placental preparation [15].

Our results correspond with another study done by Tamim *et al* which also concluded that BW is a crude measure of fetal growth & is a better predictor than either BMI- a measure of adiposity in adult and children or PI –a measure of thinness at birth, for selected short-term outcome in newborn neonates [16].

In our study we found that BW is a better marker than BMI or PI while another study under taken at Nepean Hospital showed that PI appears to be a better measure of infants with IUGR problems than birth weight percentiles [17]. In a study done by Maliheh Kadivar, Reza Parsaei, and Arya Setoudeh the duration of hospitalization did not show considerable differences among the patients with Hypothyroxinaemia and those with normal thyroxine levels [18]. In this study also CBTSH did not show any statistical significance with duration of hospital stay.

Conclusion

Birth weight significantly affects length of hospital stay. LBW, VLBW and ELBW neonates are more likely to have invasive interventions like ventilator thus requiring a prolonged hospital stay and even have higher mortality.

Birth weight, BMI and PI have significant negative correlation with the duration of hospital stay but the association of BW is most consistent amongst all three.

The neonates with prolonged NICU stay have highest mortality as compared with those with short NICU stay. (Table 1)

Length of hospital stay increases as BW, BMI and PI decreases, clearly indicating IUGR babies and babies with poor body fat are more-sick, require more interventions like ventilator & have prolonged hospital stay(table-1).

References

1. Brock RS, Falcão MC, Leone C. Body mass index values for newborns according to gestational age Department of Pediatrics. Medical School. University of São Paulo. Brazil. 2Public Health School. University of São Paulo. Brazil Nutr Hosp. 2008; 23:487-492.
2. Horbar JD, Badger GJ, Carpenter JH, Fanaroff AA, Kilpatrick S, LaCorte M, *et al*. Trends in mortality and morbidity for Very Low Birth Weight Infants, 1991-1999. Pediatrics. 2002; 110:143-51. [PubMed: 12093960]
3. Lemons JA, Bauer CR, Oh W, Korones SB, Papile LA, Stoll BJ, *et al*. Very Low Birth Weight outcomes of the National Institute of Child Health and Human Development Neonatal Research Network, January 1995 through December 1996. Pediatrics. 2001; 107:1-8. [PubMed: 11134465]
4. Fanaroff AA, Stoll BJ, Wright LL, Carlo WA, Ehrenkranz RA, Stark AR, *et al*. NICHD Neonatal Research Network. Trends in morbidity and mortality for very low birthweight infants. Am J Obstet Gynecol. 2007; 196:147-e1.8. [PubMed: 17306659]
5. Fahad Al Hazzani, Saleh Al-Alaiyan, Jihan Hassanein, and Emad Khadawardi Ann Saudi Med. 2011; 31(6): 581-585.
6. Caiza Sánchez ME, Díaz Rosselló JL, Simini F. Ponderal index to describe a term neonatal population. An Pediatr (Barc) 2003; 59:48-53.
7. Van't Hof MA, Haschke F. Euro-Growth references for body mass index and weight for length. Euro-Growth Study Group. J Pediatr Gastroenterol Nutr 2000; 31 Supl. 1:S48-59.
8. Tanaka T, Matsuzaki A, Kuromaru R, Kinukawa N, Nose Y, Matsumoto T *et al*. Association between birth weight and body mass index at 3 years of age. Pediatr Int 2001; 43:641-6. 13. Yajnik CS, Fall CH, Coyaji KJ, Hirve SS, Rao S, Barker DJ *et al*.

9. Hemachandra AH, Klebanoff MA. Use of serial ultrasound to identify periods of fetal growth restriction in relation to neonatal anthropometry. Am J Hum Biol. 2006; 18:791-7.
10. Sesmero MA, Mazariegos M, Pedrón C, Jones J, Solomons NW. Bioimpedance electrical spectroscopy in the first six months of life: some methodologic considerations. Nutrition. 2005; 21:567-73.
11. Cardoso LEMB, Falcão MC. Nutritional assessment of very low birth weight infants: relationships between anthropometric and biochemical parameters. Nutr Hosp 2007; 22:322-9.
12. Nagano M, Suita S, Yamanouchi T. The validity of bioelectrical impedance phase angle for nutritional assessment in children. J Pediatr Surg. 2000; 5:1035-9.
13. Sorensen HT, Sabroe S, Rothman KJ, Gillman M, Fischer P, Sorensen TJA. Relation between weight and length at birth and body mass index in young adulthood: cohort study. BMJ. 1997; 315:1137.
14. Rasmussen F, Johansson M. The relation of weight and ponderal index at birth to body mass index and overweight among 18-year-old males in Sweden. Eur J Epidemiol. 1998; 14:373-80
15. Jabeen Fayyaz. Ponderal Index Department of Paediatrics, Dow University of Health Sciences and Civil Hospital, Karachi.
16. Tamim H, Beydoun H, Intani M. Predicting neonatal outcomes: birth weight, body mass index or ponderal index?. J Perinat Med. 2004; 32:509-13.
17. Fay RA, Dey PL. Ponderal index; a better definition of the "At risk" group with intrauterine growth problems than birth- weight for gestational age in term infants. Aust N Z J Obstet Gynaecol. 1991; 31:17-19.
18. Maliheh Kadivar, Reza Parsaei, and Arya Setoudeh Short-term outcome of very low-birth-weight infants in a tertiary care hospital in Saudi Arabia Acta Medica Iranica. 2011; 49(2):93-97.