Association between maternal undernutrition and low birth weight: A hospital-based study in Chennai

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ABSTRACT

Background: Birth weight is an important predictor of a child's growth and survival and this is dependent on the maternal health and nutrition during pregnancy. **Objective:** The objective of this study was to study the association between maternal nutritional status as measured by anthropometry, sociodemographic characteristics, and the birth weight of neonates. **Materials and Methods:** A hospital-based cross-sectional study was conducted among 100 singleton term newborns and their mothers between September 2017 and December 2018. Demographic and socioeconomic details such as maternal age, education, occupation, religion, and household income were recorded using a pre-structured questionnaire. The weight and height of all the mothers were measured. The babies were examined and the weight was recorded at birth. **Results:** The prevalence of low birth weight was found to be 21%. The mean birth weight was 2955±418 g. Maternal undernutrition (p=0.03), maternal short stature (p=0.04), maternal illiteracy (p=0.01), and lower socioeconomic status (p=0.05) were significantly associated with increased prevalence of low birth weight. **Conclusion:** The prevalence of low birth weight was found to be high. Maternal undernutrition was significantly associated with low birth weight. Hence, there is a need for continued focus on maternal nutrition for optimal intrauterine growth, thereby reducing the prevalence of low birth weight in India.

Key words: *Anthropometry, Literacy, Low birth weight, Maternal body mass index, Maternal height, Socioeconomic status*

Low birth weight (LBW) is an important determinant of infant mortality and morbidity. In developing countries including India, (LBW) continues to be a major public health problem. Globally, 22 million newborns, i.e., an estimated 16% of all babies are born with LBW [1]. In the United States, approximately 8% of live-born neonates weigh <2,500 g [2]. In India, the prevalence of LBW is high at 18.2% [3]. In developing countries like India, the majority of LBW infants are due to intrauterine growth restriction.

Birth weight is influenced by a variety of factors such as maternal nutrition, education, parity, and socioeconomic status [4]. LBW babies are prone to develop early-onset coronary artery disease, hypertension, and obesity and insulin resistance. This is referred to as Barkers hypothesis [5]. Maternal nutritional status before conception replicates the nutritional reserves that are available intrauterine for the growing fetus. This leads to LBW in the undernourished mothers [6].

The previous studies [7-9] have looked into the role of maternal nutritional status to predict the outcomes of pregnancy. Indicators such as maternal pre-pregnancy weight, weight gain during pregnancy, body mass index (BMI), height, and mid-arm circumference have been used as markers of nutritional status of the mother [10]. Although there is considerable work done in this direction in other countries [11,12], it is important to find out the burden of LBW and its determinants from time to time among different populations. Hence, the present study was done in a selected population in Chennai, Tamil Nadu, to study the association between maternal nutritional status as measured by anthropometry, sociodemographic characteristics, and the birth weight of the neonates in our area. The study may identify this "high-risk" group so that timely interventions can be done to reduce the prevalence of LBW infants.

MATERIALS AND METHODS

This study was done as a hospital-based cross-sectional study in the neonatal unit of the Department of Pediatrics, of a tertiary care institution of Chennai from September 2017 to December 2018. Singleton term newborns and their mothers who were willing to participate were included in the study. Mothers with chronic systemic illness, pregnancy-associated complications such as pre-eclampsia, gestational diabetes, intrauterine infections, and placental abnormalities such as abruption placenta and with multiple gestations were excluded from the study. Neonates with major congenital anomalies were also excluded from the study.

The sample size was calculated considering the prevalence of LBW as 18.2% in India based on the NFHS-4 data and with an

alpha error of 5% and precision of 8% and a non-response of 5%; the sample size calculated was 100. One hundred singleton term newborns and their mothers were included in the study. The data collection tools included a pre-tested structured questionnaire and anthropometric measurements. Demographic and socioeconomic details such as maternal age, education, occupation, religion, and household income were recorded using a pre-structured questionnaire.

Maternal anthropometry was done at the time of registration. Mother's weight was measured by an electronic weighing scale to the nearest 100 g. The height was measured with a stadiometer to the nearest 0.1 cm. The BMI was calculated using the formula weight in kg/height in m^2. All the babies were examined. The weight was measured to the nearest 10 g using a portable electronic weighing machine. The gestational age was calculated from the date of the last menstrual period and by the New Ballard score done within 24 h of birth.

Following definitions were used: Term gestation: A baby is considered term if he or she is born between 37 and 42 weeks of gestation. BMI: Calculated as weight (kg)/ht $(m)^2$. According to the International Classification, individuals with a BMI 18.5–24.9 were classified as normal. Underweight: The cutoff point of BMI <18.5 was set as underweight as per the WHO standards [13]. Short stature: A cutoff point of 145 cm was used to define short stature as per NFHS-3 [14]. The study was approved by the Institutional Ethics Committee of Sree Balaji Medical College and Hospital. The study objective was clearly explained to the mothers and written consent was obtained from them before recruitment.

Data entry and analysis of the variables were done using the Statistical Package for the Social Sciences (SPSS) version 16 software. Statistics including frequency, percentage, mean, and 95% confidence interval (CI) was done. The odds ratio was calculated with 95% CI to evaluate the association between maternal characteristics and birth weight. Chi-square test was used as a statistical test of significance. $p<0.05$ was considered as statistically significant.

RESULTS

One hundred mothers and their term newborns were included in the study. Among the selected 100 newborns, 45 (45%) were male and 55 (55%) were female. The birth weight ranged from 1800 g to 3929 g and the mean birth weight 2955±418 g. The mean birth weight of males was 2971±363 g and that of females was 2911±457 g. It was found that 21 infants (21 %) had an LBW (<2500 g). The details are given in Table 1.

The details of the maternal sociodemographic and nutritional characteristics are shown in Table 2. The mean age of the mothers was 25.9±3.4 years. The mean BMI of the mothers was 22.1±3.6 kg/m^2 and the mean height was 154±5.5 cm. Socioeconomic classification was done based on the modified BG Prasad's scale. It was found that majority of them (36 %) belonged to Class II followed by (24%) Class III and (21%) Class IV.

Table 1: Maternal anthropometry and sociodemographic characteristics

Maternal characteristics	(Mean±SD) (%)
Mother's age	25.9±3.4 years
Mother's BMI	22.1±3.6 kg/m^2
% Below cutoff (18.5 kg/m^2)	24%
Mean BW of babies born to mothers <18.5 kg/m^2	2874 g
Mother's height	154±5.5 cm
% Mothers below cutoff (145 cm)	11%
Mean birth weight of babies born to mothers <145 cm	2724 g
Mother's education	
Illiterate	12%
School	62%
College	26%
Socioeconomic status	
I	10%
II	36%
III	24%
IV	21%
V	9%
Mother's religion	
Hindu	82%
Christian	7%
Muslim	11%

It was seen that 37.5% (9) of mothers with a low BMI and 16.2% (12) of mothers with a normal BMI had LBW infants. The chance of an infant to be LBW was 3.1 times higher for those mothers with a low BMI compared to those mothers with a normal BMI and this was statistically significant (OR 3.1, 95% CI: 1.1–8.7, p=0.03). It was seen that 45.5% (5) of mothers with short stature and 18 % (16) of mothers with a normal height had LBW infants. The chance of an infant to be LBW was 3.8 times higher for those mothers with short stature compared to those mothers with a normal height, but this was not statistically significant (OR 3.8, 95% CI: 1.03–14.01, p=0.04).

It was seen that 50% (6) of illiterate mothers and 17 % (15) of literate mothers had LBW infants. The association between the maternal literacy and LBW was statistically significant (OR 4.9, 95% CI: 1.4–17.2, p=0.01). The respondents were divided into three socioeconomic groups as follows: High (Group I), middle (Groups II and III), and low (Groups IV and V). It was found that mothers from low SES had a 2.7 times higher chance of having an LBW infant (33.3%) when compared to mothers from high and middle social class (15.7%). The association between the socioeconomic status and LBW was statistically significant (OR 2.7, 95% CI: 1.0–7.3, p=0.05). The details are given in Table 2.

DISCUSSION

The nutritional status of mothers has a bearing on the birth weight of infants. The problem of LBW infants is among the strongest determinants of infant mortality and morbidity. In the present study, the mean birth weight was 2955±418 g. This is similar to

Table 2: Association between maternal characteristics and low birth weight

Particulars	Low birth weight (%)		Odds ratio	95% CI	p value
	Yes	No			
BMI kg/m^2					
Low (<18.5 kg/m^2)	9 (37.5)	15 (62.5)	3.1	1.1–8.7	0.03
Normal (>18.5 kg/m^2)	12 (16.2)	62 (83.8)			
Height					
Short (<145 cm)	5 (45.5)	6 (54.5)	3.8	1.03–14.01	0.04
Normal (>145 cm)	16 (18.0)	73 (82.0)			
Mother's education					
Illiterate	6 (50)	6 (50)	4.9	1.4–17.2	0.01
Literate	15 (17)	73 (83)			
Socioeconomic status					
Lower	10 (33.3)	20 (66.7)	2.7	1–7.3	0.05
Middle and higher	11 (15.7)	59 (84.3)			

BMI: Body mass index, CI: Confidence interval

the national average birth weight of 2844 g [14]. The prevalence of LBW was 21% in our study. This is similar to the national average of 18.2% as per the NFHS 4 report [3].

In the present study, it was found that the chance of an infant to be LBW was 3.1 times higher for mothers with a low BMI compared to mothers with a normal BMI (OR 3.1, 95% CI:1.1–8.7, p=0.03). The above findings are in agreement with the previous studies where low maternal BMI was significantly associated with LBW of an infant [15-17]. Low maternal BMI is a marker of marginal tissue nutrient reserves that affect fetal growth.

In the present study, it was found that the chance of an infant to be LBW was 3.8 times higher for those mothers with short stature compared to those mothers with a normal height (OR 3.8, 95% CI: 1.03–14.01, p=0.04). Similarly, Bisai *et al*. [18] in the study from Kolkata reported that short mothers (height ≤145 cm) had 2.74-fold greater risk of having an LBW baby. These findings are in concurrence with other studies which observed that shorter maternal height was associated with LBW [19-21]. Maternal height is an outcome of several factors including optimal nutrition during her childhood and adolescence period. Public health interventions to improve nutrition status of women in childbearing age as well as female children are crucial to reduce the prevalence of LBW in India.

It was found that 12% of the mothers were illiterate. The association between lower educational status of the mother and increased prevalence of LBW was statistically significant. The previous studies by Borah *et al.* and Kader *et al.* have also shown a significant association between mother's education and birth weight of infants [22,23]. Literacy influences the health-seeking behavior and the financial condition of the mothers, and therefore, literacy plays a key role in determining the birth weight of infants.

The association between lower socioeconomic status and increased prevalence of LBW was also statistically significant. The association of a low socioeconomic status with LBW has been reported previously by Radhakrishnan *et al.* [24]. Such an association may be related to several potential mechanisms. A poor maternal nutritional intake during pregnancy, which is more likely among low socioeconomic groups and also certain sociocultural practices among them, may contribute to LBW.

There were a few limitations of our study. One limitation of this study was the small sample size. Another limitation of this study was the selection of patients from a referral center (Tertiary care hospital) rather than from a primary care level/community center. The selection bias from relying on a referral practice with high-risk mothers may be unavoidable.

CONCLUSION

Nutritional status of the mothers has a significant bearing on the birth weight of infants. In the present study, the prevalence of LBW was found to be high. Maternal undernutrition was significantly associated with babies with LBW. Hence, there is a need for continued focus on maternal nutrition right from the time of conception, through childhood and adolescence, and throughout pregnancy for optimal intrauterine growth, thereby reducing the prevalence of LBW in India.

REFERENCES

1. Low Birth Weight-UNICEF Data. Available from: https://www.data.unicef.org/topic/nutrition/low-birthweight. [Last accessed on 2019 Jul 12].
2. Carlo WA. The high-risk infant. In: Kliegman RM, Stanton BF, St. Geme JW, Schor NF, Behrman RE, editors. Nelson Text Book of Pediatrics. 20th ed. New Delhi: Elsevier Division of Reed Elsevier India Pvt. Ltd.; 2016. p. 818-31.
3. International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-4), 2015-016, India: Vol. I. Mumbai: IPS; 2014. Available from: http://www.nfhsindia.org. [Last accessed on 2019 Jul 12].
4. Park K. Nutrition and health. In: Park K, editor. Park's Textbook of Preventive and Social Medicine. 25th ed. Jabalpur: Bhanot Publications; 2019. p. 695-97.
5. Barker DJ, Osmond C, Kajantie E, Eriksson JG. Growth and chronic disease: Findings in the Helsinki birth cohort. Ann Hum Biol 2009;36:445-58.
6. Kramer MS. Determinants of low birth weight: Methodological assessment and meta-analysis. Bull World Health Organ 1987;65:663-737.
7. Moghaddam Tabrizi F, Saraswathi G. Maternal anthropometric

measurements and other factors: Relation with birth weight of neonates. Nutr Res Pract 2012;6:132-7.
8. Britto RP, Florêncio TM, Benedito Silva AA, Sesso R, Cavalcante JC, Sawaya AL, *et al.* Influence of maternal height and weight on low birth weight: A cross-sectional study in poor communities of northeastern Brazil. PLoS One 2013;8:e80159.
9. Devaki G, Shobha R. Maternal anthropometry and low birth weight: A review. Biomed Pharmacol J 2018;11:815-20.
10. Shrivastava J, Agrawal A, Giri A. Maternal anthropometry in relation to birth weight of newborn: A prospective hospital based study. Indian J Child Health 2016;3:59-63.
11. Onubogu CU, Egbuonu I, Ugochukwu EF, Nwabueze AS, Ugochukwu O. The influence of maternal anthropometric characteristics on the birth size of term singleton South-East Nigerian newborn infants. Niger J Clin Pract 2017;20:852-9.
12. Syed W, Kamathi VC. Maternal short stature: A risk factor for low birth weight in neonates. J Med Allied Sci 2012;2:62-5.
13. Physical Status: The use and Interpretation of Anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 854. Available from: https://www.who.int/childgrowth/publications/physical_status/en. [Last accessed on 2019 Jul 12].
14. National Family Health Survey (NFHS-3) 2005-06: India. I. Mumbai: IIPS. International Institute for Population Sciences (IIPS) and Macro International; 2007. Available from: https://www.dhsprogram.com/pubs/pdf/frind3/frind3-vol1andvol2.pdf. [Last accessed on 2019 Jul 12].
15. Muftah S. Maternal under-nutrition and anaemia factors associated with low birth weight babies in Yemen. Int J Community Med Public Health 2016;3:2749-56.
16. Jananthan R, Wijesinghe DG, Sivananthawerl T. Maternal anthropometry as a predictor of birth weight. Trop Agric Res 2009;21:89-98.
17. Mohanty C, Prasad R, Reddy AS, Ghosh JK, Singh TB, Das BK, *et al.* Maternal anthropometry as predictors of low birth weight. J Trop Pediatr 2006;52:24-9.
18. Bisai S. Maternal height as an independent risk factor for neonatal size among adolescent Bengalees in Kolkata, India. Ethiop J Health Sci 2010;20:153-8.
19. Mumbare SS, Maindarkar G, Darade R, Yenge S, Tolani MK, Patole K, *et al.* Maternal risk factors associated with term low birth weight neonates: A matched-pair case control study. Indian Pediatr 2012;49:25-8.
20. Inoue S, Naruse H, Yorifuji T, Kato T, Murakoshi T, Doi H, *et al.* Association between short maternal height and low birth weight: A hospital-based study in Japan. J Korean Med Sci 2016;31:353-9.
21. Elshibly EM, Schmalisch G. The effect of maternal anthropometric characteristics and social factors on gestational age and birth weight in Sudanese newborn infants. BMC Public Health 2008;8:244.
22. Borah M, Agarwalla R. Maternal and socio-demographic determinants of low birth weight (LBW): A community-based study in a rural block of Assam. J Postgrad Med 2016;62:178-81.
23. Kader M, Perera NK. Socio-economic and nutritional determinants of low birth weight in India. N Am J Med Sci 2014;6:302-8.
24. Radhakrishnan T, Thankappan KR, Vasan RS, Sarma PS. Socioeconomic and demographic factors associated with birth weight: A community based study in Kerala. Indian Pediatr 2000;37:872-6.

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