Original Research Article

Study of the effect of maternal nutritional status on the birth weight of the new born

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Abstract

Aims and Objective: To study and prioritize the effect of various maternal dietary, anthropometric and socio-demographic parameters on the birth weight of the new born.
Key Words: Low birth weight, newborn, maternal nutrition.

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INTRODUCTION

A child has only one chance to develop normally and the protection of that one chance therefore demands the kind of commitment that will not be superceded by other priorities. The birth weight of the new born is the single most important determinant of the chances of the newborn to survive and to experience health growth and development. Low birth weight leads to risk of a higher infant mortality[1], increased morbidity[2], impaired mental developement[3], and the risk of chronic adult disease[4]. Infants who weigh 2000-2499 g at birth have a four-fold risk of neonatal death as compared to those who weigh 2500-3499 g[2]. There is, therefore, an urgent need to determine ways and means to prevent LBW and its consequences[1]. According to WHO, globally about 25 million low birth weight babies are born each year. Reported incidences of LBW babies in India in 2000-2007 equaled 28% of live births. Its public health significance may be ascribed to its high incidence, and its association with socio-economic underdevelopment. The causes of low birth weight are complex and interdependent, but the nutritional status of the mother reflected by her anthropometric indices and nutritional intake is an important modifiable factor[5,6]. Dietary intake is intricately related to SES of the women[7,8]. A healthy woman can produce a health child[9]. Nutritional requirement of a normal woman increases during pregnancy in order to meet the needs of the growing fetus and of the maternal tissues associated with pregnancy. So during pregnancy, a proper dietary intake is necessary to ensure sufficient energy, protein and micronutrients supply to the growing fetus without drawing on the mother's own tissues to maintain her pregnancy[10].

MATERIAL AND METHODS

A hospital based retrospective observational study was conducted from August 2011 to June 2012. A total of 365 mothers and their babies admitted consecutively during the study period, who delivered at Santosh Medical Hospital, Ghaziabad, during the study were enrolled. Data was collected through the process of a personal interview (recall-based). SES was assessed using Kuppuswamy (2007) scale. Babies born with birth weight less than or equal to 2.5 kgs were considered as low birth weight cases.

Inclusion Criteria

1. Only singleton deliveries were included.

Exclusion Criteria

1. Mothers who had any significant illness were excluded from the study

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2. Mothers who had any pregnancy related complications were excluded from the study
3. Newborns with any obvious chromosomal anomaly, intra-uterine infections or chromosomal syndrome were excluded from the study.

Method: *Outcome variable:* Neonatal weight

Predictor variable

- Nutritional status of the mother – weight, height, BMI and weight gain during pregnancy
- Dietary intake
- Anaemia

Maternal BMI was calculated using the formula

$$BMI = \frac{Weight}{Height(m) * Height(m)}$$

The haemoglobin level of the mother was recorded within 24 hours of the delivery. Mother's age, parity, details of ANC visits and/or care, education, family income, dietary consumption, and daytime rest was taken using a method of recall by interviewing the mother concerned.

RESULTS

A total of 365 newborns-mother pairs who fulfilled the inclusion criteria were included in the study. The prevalence of LBW babies was 27%. The overall mean (SD) birth weight was 2532 gm (245 gm). For boys it was marginally more at 2537 gm (301 gm) while for girls it was 2528 gm (149 gm) (Table 1). Among LBW babies, 27.1% were pre-term, while the rest were IUGR.

Table 1: The distribution of birth weight by Sex of the baby

Sex	Birth weight (g)								
	Observation	< 2500	>= 2500	χ2	Mean		SD		
	n	%	n	%	n	%	*(P)*	(g)	(g)
Females	202	55%	71	35%	131	65%	13.663	2528	149
Males	163	45%	29	18%	134	82%	*(<0.001)*	2537	301
Total	**365**		**100**		**265**				

Incidence of LBW was higher in female babies (35%) than in males (18%). Bivariate analysis showed that female gender was a significant predictor of Table 2 shows the Odds ratio and Risk Ratios for different factors for predicting LBW by bivariate analysis. Among the studied socio-demographic, maternal and anthropometric factors, mother's age and weight had highest OR and risk ratio. Both turned out to be pivotal factors in predicting the birth weight of the baby. Similarly, from dietary factors, Calorie and Protein intake are the stand out factors with a risk ratio of 10.137 and 5.292 respectively. Consumption of milk and eggs, which, in a way, is related to protein and calorie intake also had high OR and RR. Iron and Calcium supplementation during pregnancy was also found to have high OR.

Table 2: Odds Ratio and Risk Factor for 20 studied predictor variables on birth weight of the new born by Bivariate analysis

	Risk Factor	χ2	*p*	Odds Ratio (OR)	95% CI for OR	Risk Ratio (RR)	Ranking based on RR
Neonate Factors	Sex – Female	13.6	*<0.001*	2.5	1.5-4.1	1.9	15
	Period of Gestation < 37 wks	49.9	*<0.001*	5.8	3.4-9.7	3.6	12
Maternal Factors 1. Anthropometry	Mother's Weight < 45 kgs	257.5	*<0.001*	178.9	74.1-432.2	27.3	2
	Mother's Height < 145 cm	445.8	*0.035*	2.1	1.0-4.4	1.8	18
	BMI < 19 kg/m^2	47.0	*<0.001*	6.1	3.5-10.8	3.9	9
2.Dietary factors	Protein Intake < 40 g/day	50.6	*<0.001*	8.3	4.3-15.9	5.2	6
	Calorie Intake < 1500 kcal/day	83.4	*<0.001*	18.3	8.5-39.4	10.1	3
	Consumption of milk < 2/day	51.6	*<0.001*	9.4	4.7-19.0	6.0	4
	Consumption of Eggs 0-1/day	51.6	*<0.001*	9.4	4.7-19.0	6.0	5
	Consumption of fruits< 1/day	14.1	*<0.001*	2.4	1.5-3.8	1.8	16
3.AN Care	Registration Status = No	66.2	*<0.001*	8.1	4.7-14.0	3.6	13
	No. of AN Visits ≥ 3	7.8	*0.005*	4.5	1.4-14.1	2.3	14
	TT Dose < 2/ preg	6.7	*0.009*	1.8	1.1-2.9	1.5	20
	Daytime rest < 3 hrs/day	38.7	*<0.001*	5.5	3.1-9.8	3.7	10
	Hb < 10 gm%	10.7	*0.001*	5.3	4.2-9.3	3.7	11
4.SES and Demographic factors	Fe and Ca supplements < 2/day	43.6	*<0.001*	7.2	3.8-13.9	4.7	7
	Mother's Age < 24 yrs	165.5	*<0.001*	87.5	30.8-248.3	33.2	1
	Mother's Education < 11 yrs	49.1	*<0.001*	6.9	3.8-12.5	4.4	8
	Birth Order = 1	10.8	*0.001*	2.2	1.3-3.6	1.8	17
	SES >3	5.7	*0.016*	1.9	1.1-3.3	1.6	19

Keeping aside the first four factors (maternal age, weight and intake of calorie and proteins), a multivariate logistic regression was run with the other variables to find out the relative significance of these factors with LBW. Basically, all factors with a very high odds ratio were removed from multivariate logistic regression to avoid skewness of results, and primarily because there was no doubt about their significance in predicting LBW. Table 3 below presents the results of multivariate logistic regression.

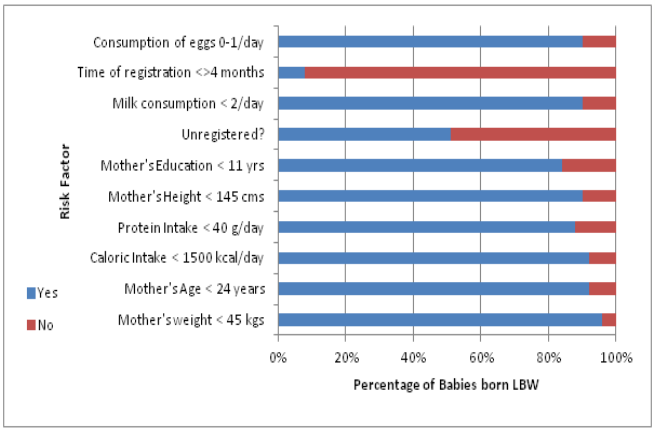
Table 3: Odds Ratio of selected predictor variables from Multivariate Analysis

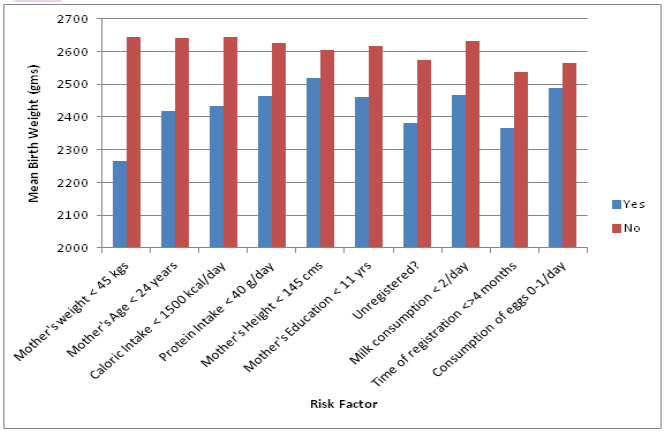
Risk Factor	χ2 (Walds)	*p*	Odds Ratio (OR)	95% CI for OR
Mother's Height < 145 cm	11.253	*0.001*	178.328	8.628-3.686E3
Mother's Education < 11 yrs	31.436	*<0.001*	152.089	26.260-880.848
Registration Status = No	31.696	*<0.001*	100.409	20.179-499.638
Consumption of milk < 2/day	8.317	*0.004*	11.894	2.211-63.993
No.of AN visits > 3	7.548	*0.006*	8.677	1.858-40.533
Consumption of Eggs 0-1/day	6.301	*0.012*	8.427	1.596-44.507
Period of Gestation < 37 wks	3.712	*0.054*	3.647	0.978-13.599
Sex - Female	9.885	*0.002*	3.116	1.534-6.330
Daytime rest < 3 hrs/day	7.059	*0.008*	0.04	0.004-0.429
BMI < 19 kg/m^2	18.172	*<0.001*	0.002	0.000-0.038

Further analysis using multivariate logistic regression revealed that following ten determinants had the most significant effect on the birth weight of the baby:

1. Mother's weight
2. Mother's Age
3. Caloric Intake of the mother during pregnancy
4. Protein Intake of the mother during pregnancy
5. Mother's Height
6. Mother's Education
7. Whether the mother is registered or not
8. Consumption of milk
9. Number of antenatal visits during pregnancy ≥ 3
10. Consumption of eggs

These predictors are arranged in decreasing order of their odds ratio. It is apparent that most are related to maternal nutrition and modifiable factors and can be improved upon by nutritional intervention. Fig.1 and Fig.2 summarize the important results for the above risk factors. Fig.1 represents the percentage of babies born LBW in the various risk categories, Fig.2 shows the mean birth weight of the LBW ($p<0.001$).





Legend

Figure 1: Percentage of LBW babies in relation to significant maternal predictor variables; **Figure 2:** Mean birth weight of the newborn in relation with significant maternal variables

DISCUSSION

The retrospective and cross sectional study on neonatal birth weight and related various maternal variables included a total of 365 mothers and their newborn pairs. Studied maternal predictor variables were related to socio-demographic data, antenatal care, dietary intake and anthropometry. Studied neonatal predictors in the present study for their effect on birth weight were sex of the baby and gestational age. On regression analysis of all these variables, ten most significant variables were shortlisted, of which weight turned out to be the strongest predictor of LBW. We concluded that the following factors had a significant impact on the birth weight of the new born in the following order:

1. Mother's weight: Mothers weighing less than 45 kg gave birth to babies with a mean birth weight (SD) of 2265 gm (238 gm). This is significantly less than the mean birth weight of babies born to heavier mothers.
2. Mother's Age: The rate of LBW decreased with increasing age of mothers after 18 years. Young mothers (< 19 years of age) delivered a significantly higher rate of LBW baby than those aged 19 years and above.
3. Caloric Intake during pregnancy: There is a significantly higher prevalence of LBW babies in pregnant women with mean caloric intake of less than 1500 kcal. 53% of all the LBW occurrences were found in mothers having a caloric intake of less than 1500 kcal. The mean birth weight of babies of mothers having a low calorie intake was also significantly lower.
4. Protein Intake of the mother during pregnancy: 58% of the mothers having a protein intake of less than 40 gm delivered LBW babies.
5. Mother's Height: Mothers less than 145 cm in height gave birth to babies with a mean birth weight (SD) of 2518 gm (249 gm). Babies born to taller mothers on the other hand, had a higher birth weight, with the mean (SD) at 2604 gm (207 gm).
6. Mother's Education: Mothers with the less than 12 years of education gave birth to babies with a lower mean birth weight babies born to mothers having had a higher education.
7. Status of AN registration: 63% of the unregistered mothers gave birth to LBW babies (Table 13).
8. Consumption of milk: Mothers consuming more milk gave birth to babies with a higher mean birth weight (SD) of 2631 gm (141 gm) as compared to 2466 gm (275 gm) for babies born from mothers having a lesser consumption of milk
9. Antenatal visits ≥3: Mothers with three or more antenatal visits gave birth to babies with a lower mean birth weight of 2366 gm as compared to 2538 gm for mothers with less than three antenatal visits.
10. Consumption of eggs: Mothers consuming more eggs gave birth to babies with a higher mean birth weight (SD) of 2627 gm (140 gm) as compared to 2469 gm (277 gm) for babies born to mothers having a lesser consumption of eggs

CONCLUSION

Maternal anthropometry and dietary intake have a significant role to play in determining the birth weight of the new born and could be amenable to nutritional intervention and supplementation. It is therefore necessary to take care of the health of the females both during pregnancy and also otherwise so as to have a healthy progeny.

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