RESEARCH PAPER

Maternal Risk Factors Associated with Term Low Birth Weight Neonates: *A Matched-Pair Case Control Study*

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Objective: To study maternal risk factors associated with full term low birth weight (LBW) neonates.

Design: Matched pair case control study.

Setting: Multicenter study including 2 medical colleges and 1 civil hospital, between July 2009 to December 2009.

Patients: Of 2382 neonates screened, 274 full term LBW babies (of 638) and 274 pair matched controls (of 1744) were included in the study. 364 LBW babies were excluded because of premature delivery/gestational age not known (314), unavailability of suitable matched controls (18), and insufficient data (32).

Methods: Maternal factors including birth spacing, height, pre-delivery weight and pregnancy weight gain, age, parity, educational and economic status, type of family, antenatal care (ANC), maternal exposure to tobacco, hypertension and anemia were studied.

Results: Birth spacing <36 months, maternal height ≤145 cm, pre-delivery weight ≤55 kg, pregnancy weight gain ≤6 kg, exposure to tobacco, inadequate antenatal care, maternal hypertension, low socio-economic status, maternal anemia and less maternal education were associated with delivery of a low birth weight infants. Conditional logistic regression analysis showed that significant risk factors associated with low birth weight were inadequate ANC (OR-4.98, 95% CI-2.64 to 9.39), maternal weight before delivery ≤55 kg (OR-4.81, 95% CI-2.53 to 9.15) and height ≤145 cm (OR-4.13, 95% CI-2.04 to 8.37).

Conclusion: Maternal malnutrition, inadequate antenatal care and poor weight gain during pregnancy are significant predictors for delivery of a low birth weight neonate.

Key words: *India, Full term, LBW, Maternal risk factors.*

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Low birth weight (LBW) (neonate weighing <2500 g) is a multifactorial phenomenon [1]. Many maternal and fetal factors are found significantly to be associated with the low birth weight [2]. Many of these factors are interrelated and they can confound the results in addition to modifying the independent estimates of relative risk associated with a risk factor. We conducted this matched pair case control study to identify the maternal risk factors associated with full term low birth babies.

METHODS

The present multicenter study was carried out in Government Medical College, Latur; NDMVPS Medical College, Nashik, and Civil Hospital, Nashik. Required minimum sample size was calculated as 173 using the formula provided by Bhalwar [3] and considering following values: $\alpha = 0.05$, $\beta = 0.2$, (proportion of controls likely to have exposure 20% and odds ratio = 2.

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Singleton live births, delivered between July 2009 to December 2009, irrespective of the mode of delivery, were screened for inclusion in the study. Birthweight of every child was measured in gram using pretested and precalibrated weighing machines. World Health Organization definition of low birth weight (LBW) babies *i.e.* birth weight less than 2500 g [4] was used to label a child as LBW. Inclusion criteria were low birth weight child, singleton pregnancy, exact duration of amenorrhea

was known (to calculate the gestational age at the time of delivery), full term delivery (≥38 weeks of gestation), mother willing to participate in the study, and suitable matched control was available. If any of the above criteria was not fulfilled then the child was not included as a case in the study. A matched control, having birth weight more than 2500 g, was selected for every case. Birth date within 1 month, sex, *tehsil* and religion were matched for selection of the control in each and every pair. If two or more suitable matched controls were available for a case, only one was selected randomly.

Data about the maternal exposure to different risk factors in mothers of all cases and controls was recorded using a pretested questionnaire. Information included sociodemographic profile of the mother and her family; obstetric history of the mother, especially information about previous births/abortions; antenatal services obtained by the mother, including antenatal clinic (ANC) registration, antenatal visits and checkups, tetanus toxoid injections, consumption of iron and folic acid tablets, information relating to heavy work done, rest timings etc exposure to possible risk factors like hypertension, exposure to any form of tobacco, any other systemic disease; results of blood investigations (especially hemoglobin percentage plus any other result) done within 15 days prior to the delivery; weight of the mother before delivery in kg rounded to two decimals; and height in cm. This information was cross checked with the available records such as ANC cards and case sheets to minimize the recall bias.

Adequate antenatal care was considered when the pregnant woman was registered at any time, had at least three antenatal checkups, was adequately vaccinated against tetanus, had consumed at least 100 tablets of iron and folic acid, was not involved in hard work, and had taken adequate rest during pregnancy (minimum 2 hours sleep during day and 8 hours sleep during night). Low socioeconomic status was considered if the family of mother belonged to a below poverty line family. Weight gain was calculated by subtracting weight of the mother at 12 weeks or before from weight of the mother at term, considering negligible weight gain up to 12 weeks of gestation [5]. Maternal exposure to tobacco meant use of any tobacco product such as tobacco or *gutkha* chewing, cigarette or *bidi* smoking, or any other form of smoking.

All the pairs were divided into four subclasses depending on the exposure of case and/or control to a risk factor, as follows: (*a*) number of pairs in which both, case and control, were exposed to the maternal risk factor; (*b*) number of pairs in which only case and not control was exposed to the maternal risk factor; (*c*) number of pairs in which only control and not case was exposed to the maternal risk factor and (*d*), number of pairs in which neither case nor control was exposed to the risk factor. Matched odds ratio with 95% confidence interval was calculated using the method suggested by Liddell [6]. McNemar chi square test, *z* test and *t* test were used to compare the qualitative and quantitative exposures in cases and controls, where applicable. Conditional logistic regression analysis was applied to find out the effect of the potential confounders. StatsDirect software was used for analysis of data.

RESULTS

Total babies screened for birthweight were 2382. Number of LBW babies born during the study period was 638 (26.78 %). Out of them 274 LBW babies were included in the study (***Fig.*1**). ***Table* I** shows the distribution of various factors among cases and controls.

Conditional logistic regression analysis was done to eliminate the effects of potential confounders and to identify the independent effect of various risk factors. It showed that the most important risk factors associated with low birth weight babies were inadequate ANC (OR -4.98, 95% CI -2.64 to 9.39), maternal weight before delivery ≤55 kg (OR-4.82, 95 % CI - 2.54 to 9.15) and height ≤145 cm (OR- 4.13, 95% CI- 2.04 to 8.37).

DISCUSSION

This multicenter matched pair case control study was done

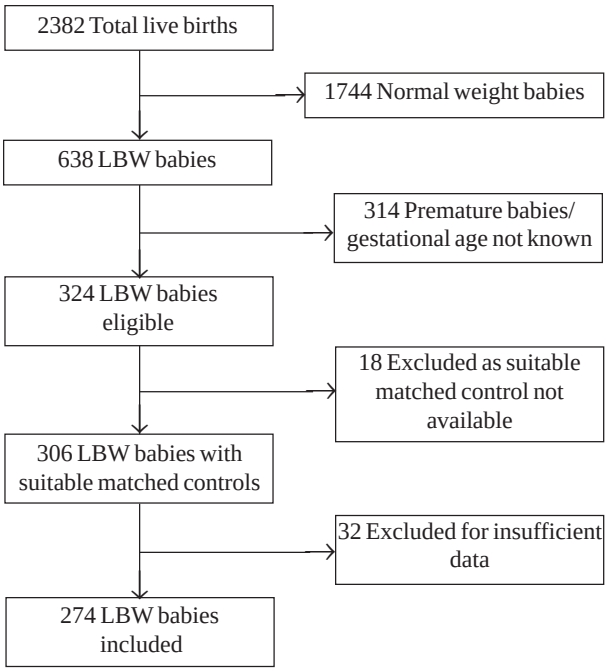

FIG. 1 *Flow chart showing process of case selection.*

TABLE I MATERNAL EXPOSURE TO VARIOUS RISK FACTORS IN LOW BIRTHWEIGHT BABIES AND CONTROLS

Maternal risk factor	*LBW*	*Normal birthweight*
Height (cm)	147.3 (4.79)	152.3 (4.88)
Spacing (mo)	26.42 (4.56)	31.25 (5.09)
Pre-delivery weight	61.6 (4.93)	56.7 (4.51)
#Weight gain (kg)	5.84 (1.42)	7.27 (1.06)
Age (years)	23.19 (3.37)	23.72 (3.53)
Parity 1	168 (61.3%)	146 (53.3%)
Anemia	143 (52.2%)	71 (25.9%)
Hypertension	64 (23.4%)	25 (9.1%)
Inadequate ANC	171 (62.4%)	87 (31.7%)
Nuclear family	143 (52.2%)	147 (53.7%)
Below poverty line	130 (47.4%)	65 (23.7%)
Tobacco exposure	73 (26.6%)	25 (9.1%)
†Maternal education	202 (73.7%)	166 (60.6%)
‡Paternal education	103 (37.6%)	102 (37.2%)

**Birth spacing; 106 LBW babies and 128 normal weight babies; #108 LBW babies and 192 normal weight babies; †Less than Higher secondary; ‡Higher secondary or more; LBW: Low birth weight.*

to identify the maternal risk factors associated with full term low birth weight babies. Proportion of low birth weight babies was 26.8%, which is more than the prevalence of LBW (21.5%) observed in National Family Health Survey (NFHS-3) [7]. This was expected as the study was carried out in tertiary care hospitals where many of the pregnant women are referred from the peripheral hospitals because of high risk pregnancy.

This study has shown that full term low birth weight was significantly associated with inadequate antental care, pre-delivery weight ≤55 kg, height ≤145 cm, weight gain ≤6 kg, spacing <36 months, maternal exposure to any form of tobacco hypertension, low socio-economic status, and anemia.

Kramer's meta-analysis [8], and other studies conducted in developing countries [9-14] have identified maternal weight (<45kg), maternal height (<145cm) as potential risk factors for LBW babies. Low socioeconomic status and low educational status leads to low health consciousness, lower nutritional status and low antenatal attendance, leading to the increased risk of LBW babies [15]. The finding of significant association of low socioeconomic status and LBW babies shown by this study is consistent with previous studies [7,13,16,17]. Present study has not identified maternal age and parity as significant risk factors for LBW babies. This finding is consistent with the findings of Mavalankar [10], Fikree [11] in Pakistan and Acharya, *et al.* [14]. Many studies

TABLE II CONDITIONAL LOGISTIC REGRESSION ANALYSIS

Factor	*Odds ratio*	*95% CI*	*P value*
Inadequate ANC#	4.98	(2.64-9.39)	<0.00
Weight ≤55 kg*	4.81	(2.53-9.15)	<0.00
Height ≤145 cm	4.13	(2.04-8.37)	<0.00
Tobacco exposure	4.10	(1.85-9.06)	<0.00
Anaemia	3.36	(1.91-5.88)	<0.00
Hypertension	3.32	(1.55-7.10)	0.002
Low SES	3.27	(1.81-5.91)	<0.001
Parity 1	1.55	(0.85-2.80)	0.148
Maternal education	1.17	(0.67-2.04)	0.580
Paternal Education	1.10	(0.60-2.00)	0.755
Nuclear family	0.91	(0.55-1.50)	0.711
Age of the mother	0.53	(0.24-1.19)	0.123

**Pre-pregnancy; SES:Socioeconomic status; #Antenatal care.*

[15,17] have; however, shown that young maternal age and parity are significant risk factors of LBW. The finding of maternal stature as a significant risk factor for LBW is consistent with the literature [1,18] Risk of delivering LBW was 4.1 times high in women exposed to any tobacco product as compared to those who were not exposed to tobacco. The finding is confirmatory to the findings of Deshmukh, *et al*. [1], Gupta, *et al.* [19] and Ward [20]. Thus not only smoking, which is widely accepted as an independent risk factor for LBW, tobacco chewing is also a risk for the same.

Spacing and weight gain could not be included in the conditional logistic regression analysis because there were only 53 and 82 pairs in which data were available. Imputation method to deal with these missing values was not used, as spacing is not applicable at all for primigravida. There were 192 (70.07%) pairs in which data related to weight gain in case and/or control was missing. The confounding effect of maternal education was probably due to its association with low socioeconomic status.

Thus findings of this study emphasizes the need for improving the quality and utilization of antenatal care, nutritional education to improve the weight gain during pregnancy, spacing, avoidance of tobacco, and prevention and proper management of risk factors like anemia and hypertension.

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WHAT IS ALREADY KNOWN?

- Predictors of full term LBW babies have been previously described.

WHAT THIS STUDY ADDS.

- Inadequate antenatal care, maternal weight ≤55 kg at the time of delivery, height ≤145 cm, weight gain ≤6 kg or spacing <36 month are important predictors of full term LBW baby.

Contributors: SSM conceived and designed the study. He also analyzed and interpreted the data; GM and RD coordinated data collection in Government Medical College, Nashik and were involved in manuscript writing; SY coordinated the data collection in Civil Hospital Nashik and MT and KP in NDMVPS Medical College, Nashik. They were involved in critical evaluation and necessary modifications in the contents of the manuscript. All the authors approved the final manuscript.
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