Original Research Article

Determinants of low birth weight babies born in a secondary and tertiary level government hospital in Delhi: a matched case control study

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ABSTRACT

Background: Low birth weight (LBW) is caused by either a short gestation period (prematurity) or due to intrauterine growth retardation (IUGR) or a combination of both. LBW babies are more prone for perinatal and neonatal health problems such as immaturity, asphyxia, hypothermia and infections and also at high risk of developing diabetes, hypertension, coronary artery disease and stroke later in life. Though there are many studies none has comprehensively dealt with all the risk factors. Therefore, the present study was carried out with the objective to study the determinants of LBW babies born in a secondary and tertiary level government hospital.
Methods: This hospital based case control study was conducted in two hospitals in Delhi from January 2014 to December 2014. A semi-structured questionnaire was designed using knowledge obtained on various determinants and factors associated with low birth weight from the studies was administered.
Results: Illiterate mother, illiterate father, nuclear family, low socioeconomic class, heavy work, mother's height <145 cm , mother's weight <45 kg, anemia, not consuming green leafy vegetables during pregnancy, unregistered pregnancy, less than 4 antenatal visits, non-intake of IFA, female baby, gravida 4 or more, preterm birth, birth interval <2 years, tobacco chewing, exposure to second hand tobacco smoke, indoor air pollution and mental stress during pregnancy were associated with LBW.
Conclusions: Immediate interventions for the present and near future include adequate antenatal care, adequate dietary intake and rest during pregnancy, regular intake of iron and folic acid, preventing tobacco use and adequate birth spacing.

Keywords: Low birth weight, Preterm, Risk factors

INTRODUCTION

Low birth weight (LBW) is defined as birth weight less than 2500 g.[1,2] LBW is caused by either a short gestation period (prematurity) or due to intrauterine growth retardation (IUGR) or a combination of both. Prematurity is usually defined as a gestational age of less than 37 weeks. 20% of neonatal mortality is due to LBW alone. LBW and prematurity together constitute 35% of neonatal mortality.[1] The proportion of babies with a LBW is an indicator of a multifaceted public-health problem that includes long-term maternal malnutrition, ill health, hard

work and poor health care in pregnancy. On an individual basis, LBW is an important predictor of newborn health and survival and is associated with higher risk of infant and childhood mortality.[3,4]

The cycle of poor nutrition perpetuates itself across generations.[5] Globally the incidence of LBW is 15%. More than half of the LBW cases in the world belong to South Asia. India has a LBW incidence of 28%.[1]

In developing countries, LBW is mostly attributed to IUGR; while in developed countries it is mainly due to prematurity. LBW babies are more prone for perinatal and neonatal health problems such as immaturity, asphyxia, hypothermia and infections. Recent studies also suggested that low birth weight babies are at high risk of developing diabetes, hypertension, coronary artery disease and stroke later in life.[2,6]

In the post-independence era, improvements in obstetric practices, health care, maternal nutrition and socio-economic conditions brought down the incidence of LBW babies considerably. Still, the incidence is higher in India.

The main determinants of LBW brought out by various studies include - maternal pre pregnancy weight, maternal weight gain, maternal height <145 cm, inadequate antenatal check-up (<3 visits), maternal age <20 years, anemia, inadequate dietary intake during pregnancy, birth spacing, birth order, maternal education, economic status, heavy work during pregnancy, rest, smoking and alcohol consumption during pregnancy and other maternal health problems.[2,3,5,7]

There have been a number of studies on the incidence and determinants of low birth weight babies. However, these studies have either not considered comprehensively the factors associated with LBW or have been carried out either in secondary or tertiary level health care institutions where the relative role of different factors associated with LBW is likely to vary. Therefore, the present study was carried out to study the determinants of LBW babies born in a secondary and tertiary level government hospital.

Therefore, the present study was carried out to study the determinants of LBW babies born in a secondary and tertiary level government hospital set up in North India.

METHODS

This hospital based case control study was conducted in two hospitals in Delhi, Maharishi Valmiki Hospital (MVH), Pooth Khurd (a secondary level hospital) and Lok Nayak Hospital (LNH) (a tertiary level hospital) from January 2014 to December 2014. Prior Institutional ethical committee clearance was obtained. The participants were briefed about objectives of the study, confidentiality of information and participant's rights. Informed consent was obtained before the start of the

study. All newborn low birth weight babies were enrolled as cases and normal weight babies as controls whose mothers were residents of National Capital Territory of Delhi for at least 1 year were included in the study. Babies whose mothers were severely ill and could not be interviewed and Babies having congenital malformations, twins or multiple births and postdated babies, i.e. >40 weeks were excluded from the study.

Sample size was calculated using Epi Info version 6 (CDC, Atlanta). With alpha error = 0.05, power 80% and odds ratio 2.0 and ratio of cases to controls as 1:1, sample size came out to be 186 in each group, i.e. case and controls.

The study was conducted for a period of six months at each of the hospitals. A semi-structured questionnaire was designed using knowledge obtained on various determinants and factors associated with low birth weight from the studies which were reviewed. The questionnaire was devised in both English and Hindi versions, and the Hindi version was translated back into English for validation.

The questionnaire contained items on identification data of the mother and the baby, gender, birth weight and gestation of the baby; socio-demographic data like maternal age, maternal and paternal education and occupation, per capita income, type of family, religion and residence; possible factors affecting the incidence of LBW like maternal height, weight after delivery as a proxy for pre-pregnant state, haemoglobin level, birth spacing, birth order, antenatal care received, smoking or chewing tobacco during pregnancy, exposure to second hand smoke, type of fuel used for cooking, maternal diet during pregnancy, physical work, rest and medical problems during pregnancy.

Income was classified using updated B. G. Prasad socioeconomic classification. All babies were classified into term and preterm according to the period of gestation and physical maturity was assessed using New Ballard Score.[8]

Height was measured using an inelastic metallic tape to the nearest cm and weight was measured using a portable electronic weighing machine after standardization to the nearest 100 gms. Maternal diet during pregnancy was assessed using 24 hour recall method, an informal, qualitative method in which the subject was asked to recall all of the foods and beverages that were consumed in the last 24 hours (from midnight to midnight) before she was admitted in the hospital. From the data collected, total calorie and protein intake per day were calculated. Intake of green leafy vegetables during pregnancy was assessed qualitatively by inquiring the frequency of intake during the last one week. Mother's physical work was classified as sedentary, moderate or heavy as per ICMR Classification based on occupation (Table 2).[9] All

mothers were explained in detail on exclusive breast feeding practice and immunization schedule of the baby.

Statistical analysis

The data collected was entered in MS-Excel sheet and was analysed and statistically evaluated using SPSS version 16. Quantitative data was expressed by mean and standard deviation Odds ratio and 95% confidence interval were used to quantify the risk factors, p<0.05 was considered significant. Univariate analysis was followed by multivariate logistic regression to calculate adjusted odds ratios. Variables with a p value of 0.2 or less were used for adjustment in calculation of adjusted odds ratio.

RESULTS

A total of 412 new born babies (206 cases and 206 controls) were enrolled in the study. The cases in the study were low birth weight babies and the controls were normal birth weight babies. Of the 206 cases, four did not consent and two were excluded due to incomplete data recorded in the questionnaire. Of the 206 controls, three failed to respond, two were excluded due to incomplete data recorded and one was postdated pregnancy. So the final sample came out to be 200 cases and 200 controls. 100 cases and 99 controls were enrolled from the secondary care hospital and 100 cases and 101 controls were enrolled from the tertiary care hospital.

Table 1: Distribution of term and preterm births among cases and controls in the two hospitals.

Variable	Cases (n=200)		Controls (n=200)	
	Secondary care hospital (n=100)	Tertiary care hospital (n=100)	Secondary care hospital (n=99)	Tertiary care hospital (n=101)
	N (%)	N (%)	N (%)	N (%)
Preterm (<37 weeks)	27 (27)	25 (25)	2 (2)	2 (2)
Term (≥37 weeks)	73 (73)	75 (75)	97 (98)	99 (98)

Table 1 depicts the distribution of term and preterm births among cases and controls in the two hospitals. Among the cases 26% were of preterm birth and among the controls 2% were preterm. There was no difference in maturity among the cases between the two study hospitals. Similarly there was no difference in maturity among the controls between the two study hospitals. Table 2 depicts the distribution of birth weight of cases and controls. The mean birth weight of the cases was 2213.38±202.31 g 99% of the LBW babies were between 1500 to 2499 g Only two babies were very low birth weight (<1500 g) and there was no case of extremely low birth weight (<1000 g). The mean birth weight of the controls was 2997.19±282.19 g. Majority of the controls (92.5%) weighed less than 3500 g and 7.5% babies weighed above 3500 g at birth.

The mean age of mothers of cases was 24.7±4.176 years and mean age of mothers of controls was 23.8±3.389 years. 21.5% mothers of the cases were under 20 years of age compared to 16% mothers of the controls. 8.5% mothers of the cases were more than 30 years of age compared to 4% mothers of the controls. There were more mothers of cases in age groups less than 20 years and more than 30 years when compared to the mothers in control group. This difference was statistically significant ($\chi 2$=12.909, p value 0.01). Univariate analysis for determinants of low birth weight in study population is depicted in table 3. Among the anthropometric variables, mothers with a height of less than 145 cm had 6.89 times increased risk of delivering a LBW baby when compared to mothers taller than 145 cm. Mother's post-delivery weight less than 45 kg was associated with 8.32 times increased risk of LBW outcome compared to those weighing more than 45 kg.

Mothers who did not consume green leafy vegetables had 2.29 times increased risk of delivering an LBW baby when compared to mothers consuming green leafy vegetables during pregnancy. Mothers who were anemic during pregnancy (Hb <11 g%) had 3.58 times increased risk of delivering a LBW baby when compared to mothers having hemoglobin levels more than 11 g%. Among the factors relating to antenatal care received by the mothers, an unbooked or unregistered pregnancy had 5.71 times increased risk of delivering a LBW baby.

Mothers attending less than four antenatal checkups throughout pregnancy had 23.8 times increased risk delivering a LBW baby. Mothers without any intake of iron and folic acid supplementation during pregnancy had 3.41 times increased risk of LBW delivery compared to mothers consuming IFA supplementation. Mothers with inadequate antenatal care had 2.12 times increased risk of LBW outcome compared to mothers having adequate antenatal care.

Table 2: Distribution of birth weight of cases and controls.

Birth weight (in g)	Cases (n=200)		Controls (n=200)	
	N	%	N	%
<1000	0	0.0	0	0.0
<1500	2	1.0	0	0.0
<2500	198	99.0	0	0.0
2500-2999	0	0.0	107	53.5
3000-3499	0	0.0	78	39.0
≥3500 g	0	0.0	15	7.5
Mean±SD	2213.38±202.31		2997.19±282.19	

Table 3: Univariate analysis for determinants of low birth weight in study population.

Characteristic	Odds ratio	95% confidence interval	P value
Socio-demographic variables			
Maternal age <20 yrs	1.44	0.87-2.39	0.16
Maternal age >30 yrs	2.23	0.94-5.29	0.06
Illiterate mother	3.05	1.97-4.72	<0.001
Illiterate father	2.02	1.20-3.40	0.007
Nuclear family	1.80	1.20-2.69	0.004
Low socioeconomic class	1.58	1.03-2.40	0.03
Heavy work	2.02	1.83-2.23	0.04
Maternal nutrition			
Mother's height <145 cm	6.89	3.01-15.81	<0.001
Mother's weight <45 kg	8.32	4.50-15.36	<0.001
Not consuming green leafy vegetables during pregnancy	2.29	1.26-4.18	0.006
Anemia	3.58	2.27-5.65	<0.001
Antenatal care			
Unbooked case	5.71	2.88-11.36	<0.001
Less than 4 antenatal visits	2.38	1.59-3.57	<0.001
No intake of IFA	3.41	2.15-5.41	<0.001
No intake of folic acid	2.01	1.34-2.99	0.001
Inadequate ANC	2.12	1.42-3.16	<0.001
Birth characteristics			
Female baby	1.83	1.22-2.75	0.003
Primi gravid	1.52	1.01-2.31	0.05
Gravida 4 or more	2.23	1.06-4.71	0.03
Vaginal delivery	1.19	0.67-2.14	0.55
Preterm birth	17.24	6.10-47.62	<0.001
Birth interval <2 years	1.76	1.18-2.61	0.005
Exposure to tobacco			
Tobacco chewing	23.35	3.11-175.33	<0.001
Exposure to second hand tobacco smoke (SHTS)	3.78	2.39-5.98	<0.001
Indoor air pollution from fuels used for cooking	2.93	1.88-4.55	<0.001
Medical conditions in mother during pregnancy			
PIH	1.78	0.98-3.22	0.05
APH	1.49	0.88-2.53	0.14
Cardiac disease	1.26	0.33-4.75	0.74
GDM	0.88	0.45-1.76	0.73
Hypothyroidism	1.00	0.32-3.15	1.00
Rh negative mother	1.11	0.46-2.66	0.82
Mental stress during pregnancy	3.42	2.25-5.20	<0.001

Among the birth characteristics, primigravida, gravida of four or more and birth interval <2 years were associated with 1.52 times, 2.23 times and 1.76 times increased risk of LBW respectively. Preterm babies had 17.24 times increased risk of being LBW when compared to normal birth weight babies. There was no significant difference on mode of delivery between the study groups. Tobacco chewing during pregnancy was associated with 23.35 times increased risk of delivering a LBW baby compared to mothers who do not chew tobacco. Exposure to second hand tobacco smoke (SHTS) or passive smoking was associated with 3.78 times increased risk of LBW compared to mothers with no exposure to SHTS during pregnancy.

Indoor air pollution resulting from use of cooking fuel in the form of biomass fuel (cow dung cakes, coal, wood) and kerosene was associated with an increased risk of 2.93 times when compared to mothers who used LPG fuel for cooking during pregnancy. Pregnancy induced hypertension (PIH) was associated with 1.78 times increased risk of delivering a LBW baby. Antepartum hemorrhage (APH), gestational diabetes (GDM), cardiac disease, thyroid disorder and Rh negative pregnancy did not have any significant association with LBW. Mental stress experienced by mother due to financial crisis or abuse during pregnancy was associated with 3.42 times increased of LBW.

Table 4: Multivariate analysis for determinants of low birth weight in study population.

Characteristic	Adjusted odds ratio	95% CI	P value
Preterm	21.31	6.41-70.86	<0.001
Illiterate mother	1.74	0.83-3.69	0.14
Illiterate father	1.53	0.66-3.53	0.32
Moderate and heavy	1.78	0.35-9.15	0.48
Anemic (Hb <11g)	2.15	1.05-4.40	0.03
Height <145 cm	15.51	4.94-48.75	<0.001
Weight <45 kg	8.60	3.73-19.81	<0.001
Inadequate AN care	15.15	2.90-76.90	0.001
Less than four AN visits	8.72	1.76-43.29	0.008
No IFA supplementation	2.83	1.19-6.76	0.02
Less than 2 years	1.83	0.78-4.26	0.16
Tobacco chewing	20.69	1.03-415.68	0.04
Exposure to second hand smoke	1.72	0.85-3.50	0.13
Indoor air pollution from Bio mass fuel	1.63	0.71-3.72	0.25
Pregnancy induced hypertension	1.15	0.47-2.79	0.76

Table 5: Multivariate analysis for determinants of preterm low birth weight and small for gestational age babies.

Characteristic	Adjusted odds ratio (95% CI)	
	Preterm LBW	**SGA**
Illiterate mother	5.25 (1.40-19.79)	2.23 (1.03-4.84)
Nuclear family	4.01 (1.05-15.28)	-
Maternal height <145 cm	-	15.78 (4.85-51.35)
Maternal weight <45 kg	34.33 (7.95-148.09)	12.13 (4.65-31.60)
Less than 4 antenatal visits	16.27 (1.67-158.92)	13.94 (2.46-78.86)
Non consumption of IFA	6.73 (1.44-31.53)	4.68 (1.75-12.53)
Anemia	-	2.92 (1.35-6.33)
Gravida 4 or more	14.21 (3.01-67.20)	-
Ante partum hemorrhage	3.38 (1.01-11.33)	-
Daily calorie <1500 kcal	3.04 (1.10-8.45)	-
Inadequate antenatal care	23.25 (1.47-120.6)	16.95 (3.10-90.90)

All values are significant (p<0.05).

The factors which were found to be associated with a significant level of p<0.2 for preterm low birth weight and SGA babies separately on univariate analysis were taken up for multivariate logistic regression (Table 4) to adjust for the effect of confounding factors. On multivariate analysis, the determinants of preterm low birth weight identified in this study were illiterate mother (p=0.01), nuclear family (p=0.04), maternal weight <45 kg (p=0.001), less than 4 antenatal visits (p=0.02), non-consumption of IFA supplements (p=0.01), daily calorie intake <1500 kcal (p=0.03), gravida ≥4 (p=0.001), APH (p=0.05) and inadequate antenatal care (p=0.03).

Multivariate analysis for determinants of preterm low birth weight and small for gestational age babies is depicted in Table 5. On multivariate analysis, the determinants of small for gestational age babies identified in this study were illiterate mother, maternal height <145 cm, maternal weight <45 kg, less than 4 antenatal visits, non-consumption of IFA supplements, non-intake of folic acid, anemia, tobacco chewing and inadequate antenatal care.

On multivariate analysis, the determinants of preterm low birth weight identified in this study were illiterate mother, nuclear family, maternal weight <45 kg, less than 4 antenatal visits, non-consumption of IFA supplements, daily calorie intake <1500 kcal, gravida ≥4, APH and inadequate antenatal care. On multivariate analysis, the determinants of small for gestational age babies identified in this study were illiterate mother, maternal height <145 cm, maternal weight <45 kg, less than 4 antenatal visits, non-consumption of IFA supplements, non-intake of folic acid, anemia, tobacco chewing and inadequate antenatal care.

DISCUSSION

This study was conducted to determine and compare the factors associated with low birth weight in a secondary and tertiary level government hospital in Delhi. The occurrence of preterm birth was almost equally distributed among the two hospitals in the study.

Maternal age less than 20 years and more than 30 years was associated with increased risk of delivering a LBW baby respectively. The association of low maternal age with LBW was also observed in other studies conducted in India, Srilanka and Ethiopia.[5,10-16] Mothers belonging to nuclear families had a slightly higher risk of delivering a LBW baby and an increased risk of delivering a preterm LBW baby when compared to mothers from joint families. Bharati et al in India and Carmelo et al in in Italy had similar results.[17,18] Strain of domestic chores and household activities and less rest during pregnancy may be the factors responsible for increased LBW incidence in nuclear family. Parental literacy has an increased risk in delivering preterm babies. Maternal education is strongly associated than paternal (5.2 times Vs 2 times). Similar results were obtained by other studies.[5,10,12,15,19,20] Low birth weight is associated with mothers belonging to the lower classes and living in poor income families. Several studies conducted in India also reported similar association between LBW and low SES.[12,21]

Mothers height <145 cm was associated with higher risk of delivering a LBW baby. This observation was consistent with several other studies conducted in India and Southeast Asia and Western countries.[7,14,15,19,22-25] Mothers weighing less than 45 kg were associated with very high risk of delivering a LBW baby. Several studies concluded the same results.[7,13,15,19,21,22,26,27] Maternal pre-pregnancy weight is influenced by both genetic and environmental factors and reflects nutritional stores potentially available to the growing fetus.[3]

Anemia was associated with increased risks of LBW and SGA. Balaranjan et al in a study in India in 2006 estimated that 58% of pregnant women were anemic.[12] Strong association of anemia and LBW was also reported in several other studies in India.[7,19,21,26,27] Female babies were at a slightly increased risk when compared to male babies. Studies in India, Italy, Nepal, Sri Lanka and

Indonesia also reported the same.[10,11,15-20,24,28] Some studies in India reported that there is no significant difference in LBW incidence with respect to sex of the baby.[7,14,19,26]

Higher Birth order and lower birth interval are directly proportional to the risk of LBW. Similar results were observed in many studies.[7,11,13,15,16,19,21-23] Inadequate and irregular antenatal checkup, inadequate intake of iron and folic acid were associated with higher incidence of LBW babies. Similar results were noted in many studies.[5,12,15-18,26,28-33] Medical conditions pregnancy induced hypertension (PIH) and GDM, life style factors smoking(active and passive) and tobacco chewing were associated with LBW babies. Similar results were obtained in other studies too.[5,7,13,15,21,23,25,26,28,34-38]

Heavy work during pregnancy was associated with increased risk of delivering a LBW baby and a preterm LBW baby when compared to sedentary work. Khattar et al in a study conducted in India concluded that women in the highest physical activity level in the 1st trimester were 1.58 times more likely to have a LBW baby. Similar results were obtained by other authors too.[5,19,39]

It was observed that indoor air pollution resulting from use of cooking fuel in the form of biomass fuel (cow dung cakes, coal, wood) and kerosene was associated with an increased risk when compared to mothers who used LPG fuel for cooking during pregnancy. Use of biomass fuel and the resulting indoor smoke have been observed to be associated with low birth weight in a number of other studies.[15,36,40]

CONCLUSION

Adequate growth and nutrition of the female child during childhood and subsequently during adolescence are the most important prerequisites for reducing the incidence of low birth weight babies. Immediate interventions for the present and near future include adequate antenatal care, adequate dietary intake during pregnancy, regular intake of iron and folic acid and preventing tobacco use. Meeting the unmet need for contraception, counseling for small family for health of the mother and newborn should also reduce the number of mothers with gravid ≥ 4. Further detailed studies are required before drawing conclusions on association of strenuous maternal work, indoor air pollution, religion, genital tract infection, anxiety and stress with low birth weight.

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