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Determinants of Low Birth Weight in a Tertiary Care Hospital in Eastern India

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ABSTRACT

Introduction: In developing countries like India, low birth weight is a major public health issue. It is a leading cause of disease and mortality in infants. Low birth weight can be avoided by identifying at-risk pregnant women and taking the necessary precautions.

Methods: From January to June 2019, a facility based retrospective case control study was conducted among pregnant women who gave birth at the hospitals. The information was gathered from the antenatal care files and the delivery room register and records. SPSS version 24.0 was used to process the data. To find an independent predictor of low birth weight, researchers used binary and multiple bivariate logistic regressions.

Result: An aggregate of 450 neonatal birth records were reviewed in this study of which 150 were low birth weight babies and 300 were of normal birth weight. The mean ± SD and median [IQR] for birth weight of case group was [2.0±0.4kg, 2.2[1.8-2.4] kg] and that for control [3.1±0.4kg, 3.0[2.7-3.3] kg] respectively.

Conclusion: Preterm delivery, mothers with hypothyroidism have an increased chance of having low birth weight babies whereas mothers with regular antenatal check-up and mothers with primary and secondary education have a lesser possibility of having low birth weight babies.

Keywords: Birth Weight, Maternal Health, Neonatal, Preterm Delivery, Health Care

INTRODUCTION

Low birth weight is a challenging public health issue in underdeveloped and developing countries like India. Maximum low birth weight babies are born in low and middle income countries.[1,2] Worldwide about 20 million neonates are born with low birth weight every year.[3] In South Asia the rate of low birth weight is almost double the worldwide rate.[2] India alone contributes to 40 percent of lbw babies in the developing world.[4] Low birth weight is defined by World Health Organisation as infant born less than 2500gms at birth irrespective of gestational age.[5] These lbw babies are 20 times more prone to have perinatal death due to complications.[1,2] They have increased probability to suffer from growth impairment, cognitive disorders, motor delays and psychological issues. Chronic diseases like cardiovascular and other metabolic diseases may ensue in later life.[6,7] Odisha state is a less developed region of India with high infant mortality.[8] The infant mortality rate was estimated at 40 deaths before the age of one per 1000 live births in National family health survey - 4(2015-16).[8] Low birth weight is a major contributor to the high rate of mortality in infants.[9] Low birth weight is a preventable public health problem. As very few studies on low birth weight babies and its determinants have been conducted in this part of the country this study was taken up. Study is aimed to

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find out the prevalence and also the factors associated or leading to low-birth-weight babies among the deliveries **c**onducted in IMS and SUM hospital, Bhubaneswar, Odisha, India. The analyses of risk factors will help in identifying the at-risk mothers so that appropriate measures can be taken for timely intervention. Overall, this study helps in assessing the benefits of public health policies and can help in formulating future approaches in decreasing the prevalence of low birth weight in this part of the country.

MATERIALS AND METHODS

A facility based retrospective case control study was taken up amongst the mothers who delivered in IMS and SUM hospital during the period from January 2019 to June2019.The hospital is a tertiary care hospital in the capital city of Bhubaneswar in the eastern part of India, that caters to the nearby rural and urban population. This hospital is a teaching institute and also renders antenatal care and child health services and delivery services as well. A case was defined as a live new born baby born weighing less than 2500 grams, the next two deliveries with new born birth weight ≥2500gms were considered as controls. Babies from multiple pregnancies, still born babies and babies with congenital anomalies were not included in the study.

A case (low birth weight) was defined as a live new born baby weighing less than 2500 grams, with the following two delivery cases with new born weighing ≥ 2500 grams at birth serving as controls. The sample size was estimated by Open Epi version 2.3 using the method for unmatched case control and determined to be 441, 147 cases and 294 controls, assuming odds ratio of 2 desired to detect, a 95 percent confidence level, 80 percent power, and a control to case ratio of 2.

The birth records were chosen using a sequential sampling process. Each time a baby is born with a low birth weight (new born weighing less than 2500 grams at birth), the next two deliveries with new born birth weight weighing ≥ 2500 grams were taken as controls. Using Open Epi, Version 3[10], open-source calculator of sample size for epidemiological studies, the sample size for unmatched Case-Control study have been calculated. The parameters taken are, two-sided confidence level (1-alpha) 95, power (% chance of detecting) 90, ratio of controls to Cases 2 and least extreme Odds Ratio to be detected =2.0. The total sample size calculated was 423, with 141 for cases, and 282 for control. Our actual sample size is more than the calculated one, 150 for cases and 300 for control.

Statistical Data Analyses: Collection of data was done after reviewing delivery room register and birth records and mother's ANC files. Data processing and analysis were studied by using statistical package for social science (SPSS) version 24.0. The association of categorical variables like age group, caste, occupation, education, gravida, BMI, gestational age, mode of delivery, type of caesarean delivery.

Table 1: Association of maternal and newborn characteristics with group

Variables	Case (n=150)	Control (n=300)	'p' value
Mothers age (years)			
≤20 years	8 (5.3)	6 (2)	0.153
21-30 years	109 (72.7)	229 (76.3)	
31-40 years	33 (22)	65 (21.7)	
Caste			
General	94 (62.7)	190 (63.3)	0.605
OBC	39 (26)	87 (29)	
SC	12 (8)	16 (5.3)	
ST	5 (3.3)	7 (2.3)	
Occupation			
House wife	130 (86.7)	257 (85.7)	0.773
Job	20 (13.3)	43 (14.3)	
Education			
Illiterate	52 (34.7)	47 (15.7)	0
Primary	26 (17.3)	75 (25)	
Secondary	72 (48)	178 (59.3)	
Gravida			
G1	93 (62)	178 (59.3)	0.904
G2	32 (21.3)	65 (21.7)	
G3	16 (10.7)	39 (13)	
G4 & more	9 (6)	18 (6)	
Body mass index			
Normal weight (18.5 - 24.9)	18 (12)	30 (10)	0.528
Overweight (25 - 29.9)	59 (39.3)	134 (44.7)	
Obese (≥30)	73 (48.7)	136 (45.3)	
Gestational age at the time of delivery			
28 - 32	8 (5.3)	6 (2)	0
32 - 37	69 (46)	28 (9.3)	
37 - 40	60 (40)	211 (70.3)	
>40	13 (8.7)	55 (18.3)	
Mode of delivery			
Normal vaginal delivery	71 (47.3)	133 (44.3)	0.547
Caesarean section	79 (52.7)	167 (55.7)	
Type of Caesarean delivery (n=246)*			
Emergency	66 (83.5)	119 (71.3)	0.037
Elective	13 (16.5)	48 (28.7)	
Maternal haemoglobin			
≤10	29 (19.3)	47 (15.7)	0.328
>10	121 (80.7)	253 (84.3)	
Gender of baby			
Male	65 (43.3)	153 (51)	0.125
Female	85 (56.7)	147 (49)	
Maternal hypertension			
No	133 (88.7)	285 (95)	0.014
Yes	17 (11.3)	15 (5)	
Gestational diabetes mellitus			
No	145 (96.7)	293 (97.7)	0.535
Yes	5 (3.3)	7 (2.3)	
Maternal Hypothyroidism			
No	136 (90.7)	293 (97.7)	0.001
Yes	14 (9.3)	7 (2.3)	
Antenatal check-up			
No	75 (50)	71 (23.7)	0
Yes	75 (50)	229 (76.3)	
Iron supplementation			
No	41 (27.3)	69 (23)	0.313
Yes	109 (72.7)	231 (77)	

*Cases=79 and Control=167; Figure in parenthesis indicate %

haemoglobin, gender of baby, hypertension in mothers, gestational diabetes mellitus, hypothyroidism, antenatal check-up and iron supplementation with groups (case & control) was made by using cross tabulation procedure and Chi-square test of independence. Comparison of mean ± SD of different variables were made by independent sample't' test. To find an independent predictor of low birth weight, researchers used binary and multiple bivariate logistic regressions. In all tests, the odds ratio (OR) with a 95 percent confidence interval (CI) and a 'p'<0.05 was considered significant.

RESULTS

An aggregate of 450 birth records of the babies were reviewed in this study, of which 150 were low birth weight babies (case) and 300 normal birth weight babies (control). Total number of deliveries of live born babies from January 2019 to June 2019 was 836.The prevalence of low-birth-weight babies was found to be 17.94%.

The age of mothers ranged from 18 to 40 years with majority in 21-30 years age group in both the groups. The majority of mothers belonged to general category and the dominant proportions were housewives. The majority of mothers were gravida 1. According to the BMI [body mass index] around 90% were overweight or obese. The mode of delivery was evenly distributed between normal and caesarean section. Above 80% of the mothers had haemoglobin level >10mg/dl. Cases of gestational diabetes mellitus were low. More than 70% of mothers had iron supplementation. These variables did not have significant association with groups (p>0.05).

Among education level of mothers, maximum proportion were secondary (Case -48%, Control- 59.3%) and the association was found significant (p=0.000). Among the Cases 46% had gestational age 32-37 weeks and that among control was 9.3% and the difference was significant (p=0.000). Out of 246 caesarean cases, 79 cases were low birth weight and 167 were normal birth weight. Among the low-birth-weight cases, higher proportion of emergency Caesarean 66(83.5%) took place than that of normal birth weight 119(71.3%) (p=0.037). Among the case group (LBW) Hypertension was 11.3% vis-à-vis 5.0% among the control (p=0.014).

Among the case group (LBW) hypothyroidism was 9.3% vis-à-vis 2.3% among the control (p=0.001). Antenatal check-up was significantly higher in normal birth weight i.e. (76.3%) than low birth weight cases (50%) (p=0.000). (Table 1) The mean ± SD and median (IQR) age of mothers of cases [27.2 ± 4.7, 27.0 (24.0-30.0 years)] and control [27.5 ± 4.6, 27.0 (24.0-30.0)] did not differ significantly (p=0.558).

The mean ± SD and median (IQR) of BMI of mother for cases was [28.9 ± 3.3 kg/m 2, 29.5(27.6-31.0) kg/m 2] and that for control [29.0 ± 2.8 kg/m 2, 29.5(27.6 – 31.0) kg/m 2] and the difference was not statistically significant (p=0.698). Mean ± SD and median (IQR) of gestational age of case group [36.1 ± 2.9, 36.0(34.0-38.0) weeks] was significantly lower than control [38.0 ± 1.8, 38.0(37.0-39.0) weeks] (p=0.000). Mean ± SD and median (IQR) of gravida are nearly equal in both the groups for case [1.6 ± 1.0, 1.0(1.0-2.0)] and control [1.7 ± 0.9, 1.0(1.0-2.0)] and the difference was not significant (p=0.700). The mean ± SD and median (IQR) of haemoglobin level for cases was [11.2 ± 1.3 mg/dl, 11.2(10.4-12.0) mg/dl] and that for control [11.2 ± 1.1 mg/dl, 11.1(10.4-12.0) mg/dl] and the difference was not significant (p=0.944). Mean ± SD and median (IQR) of birth weight for case group was [2.0 ± 0.4 kg, 2.2(1.8-2.4) kg] and that for control [3.1 ± 0.4 kg, 3.0(2.7-3.3) kg] and the difference was significantly high in control than case (p=0.000). The mean ± SD and median (IQR) of abortion for cases group was [1.3 ± 0.5, 1.0(1.0-1.5)] and for control [1.4 ± 0.7, 1.0(1.0-2.0)] and the difference was not significant (p=0.288). Table 2 depicts the details.

Table 3 depicts the results of univariate logistic regression and multiple logistic regressions using forward stepwise conditional method for analyzing the factors, for higher likelihood of low-birth-weight babies. In the multiple regression analysis 15 variables namely age, caste, occupation, education, gravida, BMI, gestational age, mode of delivery, maternal haemoglobin, gender of baby, maternal hypertension, gestational diabetes mellitus, maternal hypothyroidism, antenatal check-up and iron supplementation were considered in the model. The step wise forward conditional multiple regressions run into 5 steps. Five variables were selected in the model at the fifth stage. The multiple regression results as well as univariate regression results are presented in comparison to each other.

Table 2: Comparison of different variables between groups

Variables	Case			Control			p' value*
	N	Mean ± SD	Median (IQR)	N	Mean ± SD	Median (IQR)	
Age in year	150	27.2 ± 4.7	27.0(24.0-30.0)	300	27.5 ± 4.6	27.0(24.0-30.0)	0.558
BMI kg/m2	150	28.9 ± 3.3	29.4(26.7-31.0)	300	29.0 ± 2.8	29.5(27.6-31.0)	0.698
Gestational age	150	36.1 ± 2.9	36.0(34.0-38.0)	300	38.0 ± 1.8	38.0(37.0-39.0)	0.000
Gravida	150	1.6 ± 1.0	1.0(1.0-2.0)	300	1.7 ± 0.9	1.0(1.0-2.0)	0.700
haemoglobin	150	11.2 ± 1.3	11.2(10.4-12.0)	300	11.2 ± 1.1	11.1(10.4-12.0)	0.944
Baby weight	150	2.0 ± 0.4	2.2(1.8-2.4)	300	3.1 ± 0.4	3.0(2.7-3.3)	0.000
History of abortion	33	1.3 ± 0.5	1.0(1.0-1.5)	58	1.4 ± 0.7	1.0(1.0-2.0)	0.288

*Independent sample't' test 'p' value

Table 3 (A): Bivariate analyses of different variables with low birth weight

Variables	Case (n=150)	Control (n=300)	p' value
Mother age in years			
≤20 yr	8(5.3)	6(2)	0.062
21-30 yr	109(72.7)	229(76.3)	
31-40 yr	33(22)	65(21.7)	0.791
Caste			
General	94(62.7)	190(63.3)	
OBC	39(26)	87(29)	0.668
SC	12(8)	16(5.3)	0.301
ST	5(3.3)	7(2.3)	0.540
Occupation			
House wife	130(86.7)	257(85.7)	
Job	20(13.3)	43(14.3)	0.773
Education			
Illiterate	52(34.7)	47(15.7)	
Primary	26(17.3)	75(25)	0.000
Secondary	72(48)	178(59.3)	0.000
Gravida			
G1	93(62)	178(59.3)	
G2	32(21.3)	65(21.7)	0.813
G3	16(10.7)	39(13)	0.455
G4 & more	9(6)	18(6)	0.918
Body mass index			
Normal wt (18.5 - 24.9)	18(12)	30(10)	
Overweight (25 - 29.9)	59(39.3)	134(44.7)	0.358
Obese (≥30)	73(48.7)	136(45.3)	0.737
Gestational age			
28–32	8(5.3)	6(2)	0.006
32–37	69(46)	28(9.3)	0.000
37–40	60(40)	211(70.3)	
>40	13(8.7)	55(18.3)	0.588
Mode of delivery			
Normal vaginal	71(47.3)	133(44.3)	
Caesarean	79(52.7)	167(55.7)	0.886
Type of Caesarean delivery (n=246)*			
Emergency	66(83.5)	119(71.3)	
Elective	13(16.5)	48(28.7)	0.040
Maternal haemoglobin			
≤10	29(19.3)	47(15.7)	0.329
>10	121(80.7)	253(84.3)	
Gender of baby			
Male	65(43.3)	153(51)	0.126
Female	85(56.7)	147(49)	
Maternal Hypertension			
No	133(88.7)	285(95)	
Yes	17(11.3)	15(5)	0.016
Gestational diabetes mellitus			
No	145(96.7)	293(97.7)	
Yes	5(3.3)	7(2.3)	0.537
Maternal Hypothyroidism			
No	136(90.7)	293(97.7)	
Yes	14(9.3)	7(2.3)	0.002
Antenatal check-up			
No	75(50)	71(23.7)	
Yes	75(50)	229(76.3)	0.000
Iron supplementation			
No	41(27.3)	69(23)	
Yes	109(72.7)	231(77)	0.314

*Cases=79 and Control=167; Figure in parenthesis indicate %

In the univariate analysis the R2 for these five variables were 0.062 for education, 0.237 for gestational age, 0.031 for hypothyroidism, and 0.092 for antenatal check-up and 0.003 for iron supplementation. The univariate analysis revealed less likelihood of low-birth-weight babies with educational level primary (COR: 0.313, 95% CI: 0.173 – 0.568) and secondary (COR: 0.366, 95% CI: 0.226 – 0.591) with reference to illiterate (p<0.001). The mothers with gestational age 28-32 weeks (COR: 4.689, 95% CI: 1.566 – 14.039) and 32-37 weeks (COR: 8.666, 95% CI: 5.129 – 14.642) have significantly higher likelihood of LBW baby (p<0.001). The mother with hypothyroidism (COR: 4.309, 95% CI: 1.700 – 10.919) is more likely than without hypothyroidism to have LBW baby (p<0.001). Mother who had proper antenatal check-up is less likely to have LBW baby (COR: 0.310, 95% CI: 0.204 – 0.470, p=0.000). The mother with iron supplementation, however did not have significant COR (p=0.314). The multiple logistic regressions produced adjusted odds ratio (AOR) that implied the contribution of the factor, while the other factors in the model are kept at constant level.

This multiple logistic regression model with five factors, education, gestational age, hypothyroidism, antenatal check-up resulted in an increased in R2 value up-to 0.331 indicating 33.1% variation in the dependent variable was explained by the multiple logistic regression model. All the five variables did have significant role in the model. Education with primary level has significantly less likelihood of LBW baby with AOR: 0.363, 95% CI: 0.161-0.818 with reference to illiterate mothers. The mother with gestational age at 28-32 and 32-37 weeks has significantly more likelihood of LBW baby with AOR: 4.254, 95% CI: 1.310-13.816 and AOR: 7.732, 95% CI: 4.458-13.412 respectively, with reference to 37-40 weeks (p<0.001). The mother with hypothyroidism (AOR: 3.317, 95% CI: 1.103 – 9.972) is more likely than without hypothyroidism to have LBW baby (p<0.001). Mother who had proper antenatal check-up is significantly less likely to have LBW baby (AOR: 0.259, 95% CI: 0.119 – 0.564, p=0.001). The mother with iron supplementation is significantly more likely to result in LBW baby (AOR: 2.090, 95% CI: 1.031-4.241, p=0.041).

DISCUSSION

Prevalence of low-birth-weight newborns in our study was determined to be 17.94%. In a cross-sectional study by Pal et al during September2016 to June2018 in West Bengal 21.49% babies were born low birth weight.[11] The prevalence of low birth weight in India according to NFHS-4[2015-16] was 16.4%. [8] In this study it was found that gestational age at birth of less than 37 weeks was predominantly associated with low birth weight. Similar findings of strong association between prematurity and low birth weight have been pointed out in a community based cross sectional study conducted in West Bengal.[11] This is also supported by studies worldwide like in northern Ethiopia and Kualalumpur, Malaysia where premature delivery is a major predictor of low birth weight. [12,13]

Table 3(B) Binary logistic regression models for Low birth weight

Variables	Multiple logistic regression [Forward Stepwise (Conditional)]				Univariate logistic regression			
	χ^{2*}	p'	AOR (95% CI)	$R^{2@}$	χ^2	p'	COR (95% CI)	$R^{2@}$
Education								
Illiterate	7.831	0.02	1	0.331			1	0.062
Primary	5.979	0.014	0.363(0.161-0.818)		14.59	0	0.313(0.173-0.568)	
Secondary	0.345	0.557	0.751(0.29-1.949)		16.87	0	0.366(0.226-0.591)	
Gestational age								
37-40	63.425	0	1				1	0.237
28-32	5.804	0.016	4.254(1.31-13.816)		7.626	0.006	4.689(1.566-14.039)	
32-37	52.994	0	7.732(4.458-13.412)		65.115	0	8.666(5.129-14.642)	
>40	0.946	0.331	0.702(0.344-1.432)		0.293	0.588	0.831(0.426-1.623)	
Hypothyroidism	4.559	0.033	3.317(1.103-9.972)		9.48	0.002	4.309(1.700-10.919)	0.031
Antenatal check-up	11.599	0.001	0.259(0.119-0.564)		30.395	0	0.310(0.204-0.470)	0.092
Iron supplementation	4.175	0.041	2.090(1.031-4.241)		1.015	0.314	0.794(0.507-1.244)	0.003

* Wald Chi-square; @Nagelkerke R^2; AOR=Adjusted Odds Ratio; COR=Crude Odds Ration

This finding is in line with studies done in Nepal, Ethiopia and Kenya. [14-16] Any chronic medical disease or gynaecological condition predisposing to preterm birth should be recognised and treated appropriately. Regular antenatal check-up of mothers was less likely to be associated with low-birth-weight babies in this study. These mothers who had three or more antenatal checkups were less prone to have low birth weight neonates. Similar findings have been seen in studies done in Nepal and west Bengal. [14,11] Proper ANC services can deliver iron and folic acid tablets, tetanus toxoid vaccine, early detection and treatment of medical and obstetric complications in pregnancy and also provide strict foetal surveillance as required. Good referral services can also be achieved in time if needed through regular antenatal care services. Overall good antenatal care reduces maternal and foetal morbidity and mortality. The odd of having low birth weight baby was higher among women who did not receive primary education. Illiterate and less educated women tend to have a lower health awareness and low standard of living and hence poor utilisation of antenatal care services. They lack nutritional awareness as also poor acceptance of health information. Poor standard of living, unhealthy sanitary conditions harbour and promote chronic diseases during pregnancy which again adversely lead to low birth weight. This finding was consistent with studies from Bangladesh, Ethiopia and Northern India. [17-19] In this study it was found that pregnant mothers who did not consume iron and folic acid tablets or consumed lesser number of tablets (less than 100) were more likely to deliver low birth weight babies. Our study is consistent with the study conducted in west Bengal [11], Tripura [21.] Maternal hypothyroidism is also a risk factor for low birth weight in our study. Preconception counselling should also be given priority and as a part of maternal care services so that chronic diseases like chronic hypertension, hypothyroidism, and diabetes can be detected prior to conception and can be treated to get healthy mother and baby.

CONCLUSION

In this study various factors like preterm birth, illiteracy, lesser and irregular ANC, chronic medical illness like hypothyroidism in mothers, were primary risk factors detected as cause of low birth weight. Maternal health programs should be designed and directed towards identifying and monitoring of at-risk mothers especially those prone for preterm delivery. More focus should be given towards identifying pregnant mothers with chronic medical illness like hypothyroidism and provide timely disease specific counselling and treatment by skilled medical professional. State government should provide all means to impart at least primary level education to all especially female literacy rate to be improved. Awareness building programs especially for antenatal mothers should be focussed on along with training and motivation of frontline health workers.

STUDY LIMITATION

In this study many determinants of LBW were analysed but some important predictors like nutritional intake during pregnant period, socioeconomic status, inter pregnancy interval, hardwork during antenatal period could not be studied.

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