Caspian Journal of Pediatrics
Non-communicable Pediatric Diseases Research Center
e-ISSN: 2383-3106
Babol University of Medical Sciences

Maternal factors influencing very low birth weight babies: A hospital-based case-control study from India

Seshagiri Koripadu (MD,DM) [1], Suchitra Pusapati (MD) [2], Geshmanjali Kakarala (MD)[3], Sarishma Chaparala (MD)[4 *], Harischandra YV (MD) [5]

1. Associate Professor, Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, India; seshagiri_neo@yahoo.co.in.
2. Assistant Professor, Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, India A.P, India; drsuchitrauk@gmail.com.
3. Assistant Professor, Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, India; kakarakageshma@gmail.com.
4. Assistant Professor, Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, India; sarishmach@gmail.com
5. Professor & HOD, Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, India; harivy1971@gmail.com.

Article Info.

Article type:
Research Article

Received: 28 June 2021
Revised: 27 July 2021
Accepted: 15 Aug. 2021
Published:

Keywords:
Breast milk, Breastfeeding, Exclusive, Infants

ABSTRACT

Background and Objective: This study aimed to estimate the prevalence of very low birth weight (VLBW) as well as to identify various maternal factors associated with VLBW among newborns delivered at a tertiary care teaching institute.

Methods: A hospital-based retrospective case-control study was done at the neonatal intensive care unit of GITAM Institute of medical sciences and research, Visakhapatnam from January 2019 to December 2021. Data were collected from a total of 250 mothers who delivered babies weighing <1.5 kilograms as cases, and age-matched 250 mothers who had babies weighing >2.5 kilograms as controls. Multiple factors that influenced VLBW were analyzed. These factors were maternal, neonatal and delivery factors.

Findings: The prevalence of VLBW babies was 2.5%. VLBW was high in babies of mothers from lower to lower-middle-class (68%), mothers with parity 4 or more (39.6%), anemic mothers (P<0.0001), preterm babies (62%) (P<0.0001), born through cesarean delivery (65.6%). Also, VLBW proportion was lower among babies born to mothers who took iron and folic acid (IFA) tablets compared to control (P<0.0001).

Conclusion: Several factors like illiteracy of mothers, number of living children, increased parity, inadequate consumption of IFA tablets, anemia during pregnancy were found to be associated with very low birth weight. Most of these factors are modifiable and can be managed easily by providing adequate antenatal care.

Cite this article: Koripadu S, Pusapati S, Kakarala G, Chaparala S,YV H. Maternal factors influencing very low birth weight babies: A hospital-based case-control study from India. *Caspian J Pediatrs* March 2022; 8(1): 634-644.

Publisher: Babol University of Medical Sciences

Introduction

Globally, the prevalence of VLBW babies was <2% of all births. In India, the neonatal mortality rate is 26 per 1000 live births with rural areas having an NMR of 30, more than double that of urban areas, which have an NMR of 15 [1, 2]. The neonatal mortality rate in Andhra Pradesh is 26 per 1000 live births, rural is 30, and urban is 13. In India, VLBW babies account for 4-7% of live births and approximately 30% of neonatal deaths [3, 4]. During their neonatal period, these neonates are at an increased risk of hypoglycemia, jaundice, infection and

*Corresponding Author: Dr Sarishma Chaparala (MD);
Address: Department of Paediatrics, GIMSR, Visakhapatnam – 530045, A.P, INDIA.
Tel: +91 9885277895 E-mail: sarishmach@gmail.com

re-hospitalization. In developing countries, VLBW is one of the most serious problems in maternal and child health. Factors associated with neonatal health care are (i) socioeconomic factors such as marital status, education, occupation, age, antenatal care (ANC) visits, parity and gravidity. (ii) Labor and delivery factors of mother and their association with neonatal mortality like a place of delivery, delivery assistance, mode of delivery, duration in labor, delivery complications. (iii) Newborn factors like sex of neonate, birth weight, Apgar score, gestational age, birth order, fetal presentation, birth spacing, birth asphyxia and neonatal infection [5]. Risk factors associated with neonatal deaths are: (a) maternal factors, (b) neonatal factors and (c) delivery factors.

a) Maternal factors include maternal knowledge (mother's understanding of the risks and danger signs of pregnancy, childbirth and newborn). b) Neonatal factors comprise gender, a record of complications during delivery, Apgar score, mother's report of health problems after birth, early initiation of breastfeeding and use of the kangaroo method of care are all neonatal factors. c) Delivery factors consist of place of birth delivery (at home or in a healthcare facility) and assistance during delivery [6- 12].

The main killers of neonatal deaths are preterm birth complications 16%; intra partum related events 11%; sepsis or meningitis 7%; pneumonia 3%; others 3%; injury 1%; congenital anomalies 5%; tetanus 1%; diarrhea 0.3% [6, 7, 13].

Causes of neonatal mortality are (A.) low birth weight (B.) birth injury and difficult labor (C.) sepsis (D.) congenital anomalies (E.) hemolytic diseases of new-born (F.) conditions of placenta and cord (G.) diarrheal disease (H.) acute respiratory infections and (I.) tetanus. To improve the quality and utilization of ANC, WHO recommends at least eight ANC visits with each component containing five interventions: nutritional, maternal and fetal assessment, preventive measures, interventions for common physiological symptoms and health systems.

Hence, there is a scope for further research in finding the relation between VLBW and maternal factors associated with it. This facilitates us to take measures to decrease VLBW and infant mortality rates. The aim of the present study was to assess the various maternal factors influencing birth weight. This kind of study has not been done so far and it will be an eye-opener for VLBW care.

Methods

Study design

A hospital-based retrospective case-control study was undertaken by collecting the data from the medical records at the neonatal intensive care unit (NICU) of the Department of Pediatrics, GITAM Institute of medical sciences and research (GIMSR), Visakhapatnam during the study duration January 2019 to December 2021.

Sample size and sampling method

Sample size was calculated by the Epi Info, a program developed by the Centers for Disease Control and Prevention available via the link: https://www.cdc.gov/epiinfo/index.html. First, “STATCALC” option was selected for sample size calculation and then, selected “unmatched case-control studies”.

The sample size estimation was done by taking 95% confidence level, 80% power of study, ratio of control to case 1 : 1, 5% alpha error, and 2 as anticipated odds ratio, and proportion of control exposed 35% [14].This data was submitted and checked the final table for the calculation results. The results table shows a sample size of 500 participants.

Two hundred and fifty cases and the same number of controls were included in the study (250 live births per group). The sample size was cross-checked using software nMaster 2.0 version.

Data collection

The total sample size was 500. Data were collected from 250 mothers who delivered babies weighing <1,500 gm as cases. Similarly, age-matched 250 mothers who had babies weighing >2500 gm were taken as controls.

All newborns were admitted to NICU with a bodyweight <1500gms, regardless of gestational age, and mothers of singleton pregnancies were included. Still, births, multiple pregnancies and newborns with major congenital anomalies were excluded. In comparison, newborns weighing >2500 gm were chosen as control using a technique convenience method, regardless of gestational age.

Study Variables

Data available on maternal factors, neonatal factors and delivery factors were noted.

Maternal factors were the age of the mother, parity, gravida, socioeconomic status, ANC, intake of iron and folic acid (IFA) tablets, pregnancy-induced hypertension, diet intake, anemia, eclampsia, preeclampsia, oligohydramnios, polyhydramnios, thyroid disease, uterus and cervical anomalies, seizures, infections and so on.

Neonatal factors included respiratory distress syndrome, birth asphyxia and so on.

Delivery factors consisted of type of delivery, bad obstetric history, weight gain during pregnancy, high-risk pregnancy, previous cesarean delivery, preterm delivery, and risks associated with preterm delivery.

Nutritional status of mother recorded such as type of diet/additional diet during pregnancy, iron and folic acid supplementation during pregnancy, height of the mother, and mid arm circumference of the mother. The mid arm circumference was measured by using a non-stretchable tape to the nearest 0.1 cm. For uniformity, the right mid arm circumference was measured at a point between the tip of the Olecranon process of ulna and the Acromian process of scapula. While measuring the circumference, the tape was pressed gently. Weight of new-born was measured by electronic weighing scale of accuracy 10grams, its measuring accuracy was checked by supervisors before actual measurement takes place. Nurses who are currently working are involved in data collections.

Statistical Analysis

Statistical analysis was performed using SPSS 23.0 (IBM, Chicago, Illinois) and p values <0.05 were considered statistically significant. Demographics, socioeconomic status of the woman, education and occupational status of the husband, type of family, and type of house were represented by frequency distributions. For discrete data, proportions and the Chi-square test were used. For continuous data, the mean, standard deviation and student's t-test were applied. Regression analysis was used for the prediction of strong predictors. The statistical significance was evaluated at 95% confidence interval.

Results

All analyses were performed on 250 cases compared to 250 control subjects. The majority (55.6 %) of the study mothers were between the ages of 20 and 25 with an average age of 24.9 years (P>0.05).

Maternal factors

The majority (37.2%) of illiterate mothers gave birth to VLBW babies, which was very high compared to mothers with primary (19.2%), middle (20.8%) and higher education (22.8%). The VLBW percentage was higher in unemployed mothers (67.2%) than employed mothers (32.8%). There was a significant association between VLBW and the literacy status of the father/mother (P=0.024). In the current study, mothers from rural areas had a higher percentage of VLBW babies (82%) than those from urban areas (18%). The percentage of VLBW babies was maximum (68%) in mothers from lower and lower-middle-class compared to those from the middle (19.6%)**,** upper-middle and upper (12.4%) classes (P>0.05).

The majority (80%) of study participants were married from 18 to 24 years, and 82% of study participants delivered their first child between the ages of 18-24 years. The relationship between the number of living children and the new birth born weight was not statistically significant (Table 1). The relationship between gravida and baby birth weight was statistically significant (P=0.033). The relationship between increasing parity and VLBW was statistically significant.

The percentage of VLBW babies in those who did not consume a minimum of 100 IFA tablets during pregnancy (62%) was very higher than that in those who took them as recommended. A highly significant association was found between low birth weight and IFA tablets consumption during the antenatal period (P< 0.0001) and maternal hemoglobin levels (P<0.0001). The percentage (66.4%) of VLBW was higher for women with a high-risk pregnancy than for others (P>0.05). High-risk pregnancy was observed in 42% of VLBW babies. The percentage of VLBW babies born to underweight mothers (body mass index (BMI)<18.5 (35.6%)) was significantly high compared to babies born to mothers with normal BMI (P<0.05) (Table 1). Obstetric complications were recorded in 85 cases and 32 control subjects with a significant association between them (p<0.0001). The distribution of obstetric complications is illustrated in figure 1.

The health status of the mother during pregnancy is presented in table 2.

About 79.6% of pregnant mothers in the study had <4 ANC visits and 43.2% of pregnant women utilized both government and private services. The VLBW proportion was higher in women with anemia (hemoglobin levels of less than 11 g%) (table 3).

Among the variables, maternal weight gain during pregnancy and milk consumption during the antenatal period emerged as strong predictors of the birth weight of the baby. Using a five-step multiple logistic regression analysis, maternal factors such as age, birth interval, height, weight, midarm circumference, education, family type and the presence of a bad obstetrics history influenced newborn birth weight (Table 4) (Table 5).

Neonatal factors

Neonatal factors included respiratory distress syndrome, birth asphyxia, congenital disorders, sepsis and so on (Figure 2).

Delivery factors

Preterm delivery was the most common cause of VLBW (62%). Preterm appropriate for gestational age (AGA) accounted for 52% of that preterm, while preterm small for gestational age (SGA) accounted for 10%. The remaining 38% were term SGA babies. 65% of the study subjects whose period of gestation<37weeks delivered VLBW babies, and this relationship had a high statistical significance. A higher percentage of VLBW babies was related to cesarean delivery (65.6%) compared to spontaneous vaginal delivery (30.4%). Moreover, 21% of neonates were sick.

Discussion

The current study aimed to estimate the prevalence of VLBW and identify various maternal factors associated with VLBW among newborns. The present study described risk factors for VLBW. The important finding of this study was that VLBW was high in babies of mothers from lower and lower-middle-class, mothers with parity 4 or more, anemic mothers, preterm delivery and cesarean delivery.

Maternal age, education and parity were significant maternal socio-economic determinants of VLBW in the present study. Teenage mothers are well known for adverse pregnancy outcomes. The proportion of VLBW neonates was highest in the current study among 20-25-year-old mothers. However, Kabilan S et al. reported the proportion of VLBW babies was highest among 21-30-year-old mothers (61.6%) [15]. This result is in contrast to other studies in India. Instead of teenage mothers, studies in India associated maternal weight and primiparity [16, 17].

The majority of illiterate mothers gave birth to VLBW babies, which was significantly higher than for mothers with literacy. The high proportion of VLBW seen in the low socioeconomic status of mothers might be due to poor nutrition intake during pregnancy and certain cultural practices [18].

Table 1: Association between VLBW and Maternal Factors

Maternal Factors		Birth weight		X^2 value	P value
		Case	Control		
No. of living Children	1	65	74	1.813	0.403
	2	143	128		
	≥3	42	48		
Parity	1	79	72	49.982	< 0.00001
	2	30	86		
	3	42	49		
	≥4	99	43		
Gravida	1	79	52	8.6772	0.033
	2	59	79		
	3	69	73		
	≥4	43	46		
Birth Interval	< 2 years	145	64	53.9387	< 0.00001
	> 2 years	105	186		
Diet	Vegetarian	105	64	0.061	>0.05
	Mixed	145	186		
Eggs Consumption per week	Nil	70	74	31.50	<0.0001
	1-3	140	48		
	≥4	40	128		
Milk Consumption	Regular	105	196	59.70	<0.0001
	Not Regular	145	54		
Fruits Consumption	Regular	70	204	47.55	<0.0001
	Occasional	180	46		
Maternal Body Mass Index	Underweight	89	23	17.73	0.0005
	Normal	65	192		
	Overweight	52	26		
	Obese	44	9		
Mothers Height	<=140 cm	84	80	1.585	0.453
	141-149 cm	95	110		
	=>150 cm	71	60		
Mothers Weight	<=40 kg	89	23	12.588	0.002*
	41-49 kg	86	138		
	=>50 kg	75	89		
Mid Arm Circumference	≤ 20 cm	129	23	16.018	0.000*
	21-22 cm	68	95		
	>22 cm	53	132		

*Pearson Chi-Square, 2-sided

Various studies conducted in developing countries have identified maternal weight (<45kg), maternal height (<145cm), BMI as potential risk factors for LBW babies. In the current study, the percentage of babies born with VLBW to underweight mothers, i.e, BMI<18.5 (35.6%) was significantly high compared to babies born to mothers with normal BMI (P<0.05). Low socioeconomic status and low educational status resulted in low health consciousness, lower nutritional status and low antenatal attendance, leading to the higher risk of VLBW babies. Monitoring of weight gain on the prenatal visit can identify maternal nutrition. The measurement of the symphysis-fundal height provides a helpful measure to assess fetal growth. The umbilical artery Doppler should be performed in intrauterine growth restriction fetuses to formulate the antenatal management plans [19-22].

TABLE 2: Association between VLBW and health status of mother during pregnancy

Health status of mother during pregnancy		Case		Control		X^2	P-value
Health of mother during pregnancy	Healthy	151	60.4	218	87.2	46.4325.	<0.0001
	Sick	99	39.6	32	12.8		
Sick conditions	Eclampsia & pre-eclampsia	89	89.9	32	100	0.0769	0.7811
	Oligo-hydramnios & poly hydramnios	21	21.21	6	18.75		
	Maternal Fever	12	12.12	2	6.25		
	Anemia	2	2.02	0	0		
	Thyroid Disease	25	25.25	12	37.5		
	UTI/Renal disorders	5	5.05	2	6.25		
	Hepatitis-B	3	3.03	1	3.125		
	APH	2	2.02	0	0		
	Gestational diabetes mellitus	16	16.16	2	6.25		
	Heart disease complicating pregnancy	6	6.06	4	12.5		
	Uterus and cervical anomalies	2	2.02	1	3.125		
	Bronchial Asthma	3	3.03	2	6.25		
	Seizure disorder	16	16.16	2	6.25		

Table 3: Comparison of means of some maternal factors between VLBW & Normal birth weight babies

Maternal factors	Neonatal weight	Mean	SD*	t value	p-value
Mother age	<1.5 kg- Case	23.46	3.696	-0.703	0.483
	2.5 or more-Control	23.87	3.754		
Age at Marriage	<1.5 kg- Case	18.90	2.055	-0.601	0.548
	2.5 or more-Control	19.90	11.530		
Age at 1st pregnancy	<1.5 kg- Case	18.83	2.470	-1.103	0.271
	2.5 or more-Control	20.31	2.790		
Birth Interval	<1.5 kg- Case	1.3438	2.28342	-0.820	0.413
	2.5 or more-Control	2.0300	1.22267		
Weight gain	<1.5 kg- Case	8.38	2.818	-5.278	0.000
	2.5 or more-Control	11.42	2.388		
Height	<1.5 kg- Case	152.96	4.257	-1.701	0.090
	2.5 or more-Control	153.96	3.634		
Hemoglobin	<1.5 kg- Case	8.085	1.4255	-1.824	0.069
	2.5 or more-Control	11.769	6.3559		

* SD: standard deviation

In the ongoing study, the percentage of VLBW in mothers with ≥ 3 living children was 16.8%, while it was 57.2% in those with two living children. A short interpregnancy interval was associated with VLBW. These findings are contradictory to the study of Patel et al. [9]. The previous history of abortion and ANC visits were also associated with VLBW, which was supported by Amin N et al. [23].

Table 4: The predictors of very low birth weight are shown in a regression table.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
Age	0.194	0.87	0.776	24.446	0.001	0.64	23.52
BMI	0.06	0.039	0.055	1.675	0.005	0.04	0.57
Midarm Circumference	0.24	0.60	0.061	1.015	0.000	2.90	30.74
Mother Education	-0.001	0.015	-0.002	-0.056	0.955	-0.031	0.029
Antenatal care visit	0.87	0.33	0.061	1.521	0.008	1.25	4.54
Living child	0.010	0.064	0.010	0.159	0.874	-0.116	0.136
Gravida	0.044	0.034	0.061	1.317	0.189	-0.022	0.110
Parity	-0.065	0.070	-0.069	-0.938	0.349	-0.203	0.072
IFA* days	0.205	0.210	0.132	0.974	0.331	-0.209	0.618
IFA tablets	-0.137	0.199	-0.090	-0.685	0.494	-0.529	0.256
Weight gain	0.194	0.008	0.776	24.446	0.000	0.178	0.209
Eggs	0.065	0.039	0.055	1.675	0.095	-0.011	0.141
Milk/day	-0.159	0.055	-0.110	-2.909	0.004	-0.267	-.051
Fruits	-0.034	0.044	-0.026	-0.768	0.443	-0.121	0.053
Hemoglobin	0.042	0.047	0.031	0.902	0.368	-0.050	0.134
Baby gender	-0.067	0.041	-0.051	-1.630	0.104	-0.148	0.014
Term/Pre	-0.074	0.094	-0.025	-0.787	0.432	-0.260	0.112

* IFA: IRON AND FOLIC ACID.

Table 5: Findings from a multivariable logistic regression analysis of maternal factors to predict VLBW

Variables	OR (95%CI)	p-value
Mother's Age	1.005 (1.003 – 1.007)	0.001*
BMI	2.673 (1.375 – 5.197)	0.004*
Midarm Circumference	4.555 (1.659 – 12.510)	0.003*
Antenatal care visit	0.247 (0.109 – 0.560)	0.001*
Birth Interval	1.213 (1.003 – 1.957)	0.001*
Weight gain	2.912 [1.318- 16.398]	0.000*
Education	4.649[1.318- 16.398]	0.000*
Bad obstetrics history	0.456 (0.231 - .0.903)	0.02*
Vaginal breech presentation	0.069 (0.013 – 0.364)	0.002

OR: Odds Ratio; CI: Confidence Interval; p<0.05 significant

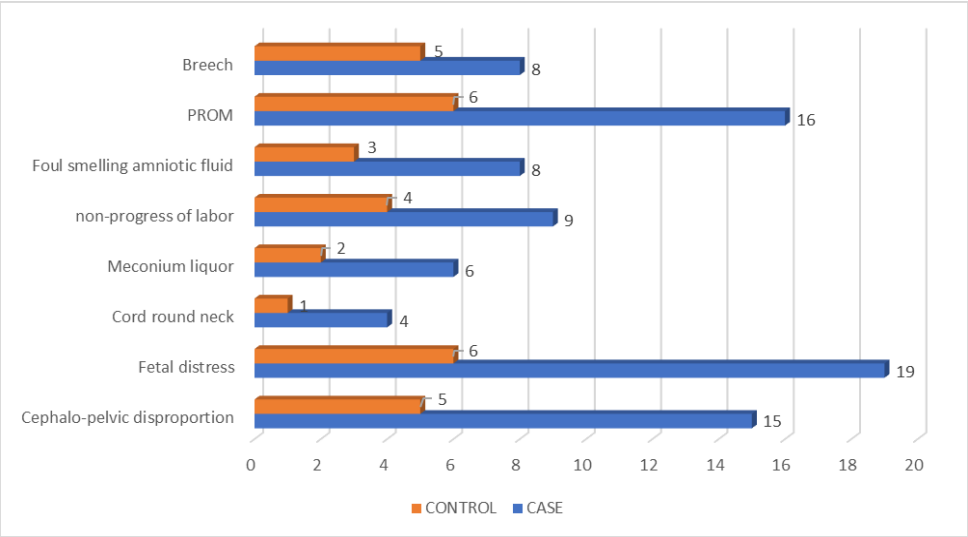

Figure 1. Distribution of obstetric complications between case & control neonates

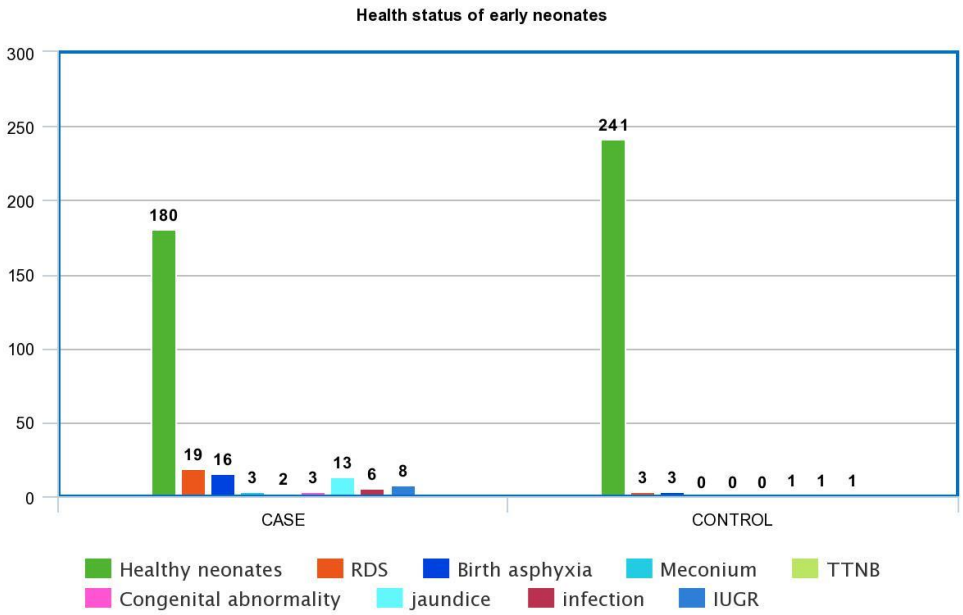

Figure 2: Distribution of newborn complication between case & control neonates

In the present study, the percentage of VLBW in those who did not consume a minimum of 100IFA tablets during pregnancy (62%) was very high than in those who took them as recommended. This could be due to a failure to consider the quality of ANC.

Kabilan S et al. reported predictors for VLBW such as the maternal co-morbidities related to 33% of mothers were at high risk because of pregnancy-associated complications including preeclampsia (5.1%), gestational hypertension (9.6%), oligohydramnios (6%), and hypothyroidism (4.8%) [15]. There was no association between the incidence of VLBW and some of the maternal factors like hypertension, anemia and so on in this study. This could be due to the shared fetal or genetic factors operating in both study and control groups. This is inconsistent with the study of Arif MA et al. who found a strong association between pregnancy-induced hypertension and antepartum hemorrhage with VLBW [24].

In the ongoing study, 65% of the study subjects whose period of gestation was < 37 weeks delivered VLBW babies, and this relationship was statistically significant. Kabilan S et al. reported gestational age of 33-36 weeks delivered VLBW babies, and this association had high statistical significance [15].

In the present study, the percentage of VLBW babies was higher in newborns delivered through cesarean delivery (65.6%) compared to spontaneous vaginal delivery (30.4%). Kabilan S et al. stated spontaneous vaginal delivery (61.7%) delivered VLBW babies than lower segment cesarean section and assisted labour [15].

Preterm delivery was the most common cause of VLBW in this study, accounting for 62% of all cases. Preterm AGA accounted for 52% of that preterm, while preterm SGA accounted for 10%. The remaining 38% was made up of term SGA babies. When the birth interval was less than 2 years, the incidence of VLBW was higher than when the birth interval was more than 2 years. This could be because it takes a minimum of 2-3 years for the mother's nutrition and general health to reach pre-pregnancy levels. In addition, Deshmukh JS et al. and Shanthi Ghosh et al. supported this association [25, 26].

In the current study, there was a strong association between poor obstetric history in previous pregnancies and VLBW. Maruoka K et al. [27] supported these results. In the ongoing study, 34% of mothers who delivered VLBW had obstetric complications. Only 79.6% of pregnant mothers in the current study had <4 ANC visits, and 43.2% of pregnant women in the study used both public and private services. This may be associated with a lack of awareness about the importance of ANC services and their utilization.

The proportion of VLBW was high in mothers who had undergone cesarean section. This disparity could be attributed due to differences in maternal activity/factors.

In present study, RDS, neonatal jaundice, and prematurity were the leading morbidities associated factors with VLBW. Another study presented sepsis and prematurity as the leading cause [28]. National Neonatal Perinatal Database shows that sepsis (36%) is the most common morbidity followed by prematurity (26.5%) and perinatal asphyxia (10%) responsible for low birth weight neonatal admission [29].

The findings of the present study emphasize the need for increased quality and the utilization of ANC to improve weight gain during pregnancy and proper management of risk factors.

Limitations of the study

We could not take more information on certain other risk factors during pregnancy because of the lack of available data from the records. This study provides baseline information from a single tertiary hospital; hence, the results cannot be applicable to another center, and there is a need for multi-centric studies which can give an imperative conclusion that can help with possible intervention regarding maternal and newborn health in the future.

Conclusion

The birth interval of < 2 years has a higher incidence of VLBW. Maternal nutrition is directly related to mid-arm circumference, mothers with MACs <20 cm are more likely to have a baby with VLBW. The rate of VLBW is higher in primigravida than in multigravida. Illiterate mothers have a higher risk of having a baby with a VLBW. VLBW is significantly related to per capita income. Using a five-step multiple logistic regression analysis, maternal factors such as age, birth interval, height, weight, education, family type and the presence of a bad obstetrics history influence the newborn birth weight.

Acknowledgments

The authors acknowledge the staff of the pediatric ward and ICU for support in collecting the data.

Ethics Approval

This study was conducted according to the guidelines of the Institutional Ethics Committee, GIMSR, Visakhapatnam, A.P, INDIA (IEC/GIMSR/Paed.2019). The parent/guardian's informed consent was taken as per GIMSR Hospital norms and pros before admission of the patient. The Ethics Committee waived off this study, as this was a retrospective study, in which the data were collected from the Hospital Records (NICU) by taking permission from the concern.

Funding:

This study was self-funded.

Conflict of Interest

The authors declared no conflict of interest.

References

1. Sample registration system statistical report - 2014, Office of the registrar, general of India, 2010.
2. Benson JB. Encyclopedia of infant and early childhood development. Elsevier; 2020 Mar 13.
3. Basu S, Rathore P, Bhatia BD. Predictors of mortality in very low birth weight neonates in India. Singapore Med J 2008; 49(7): 556.
4. UNICEF. Division of Communication. Tracking progress on child and maternal nutrition: a survival and development priority. Unicef; 2009.
5. Ndayisenga T. Maternal and Newborn Risk Factors associated With Neonatal Mortality in Gitwe District Hospital in Ruhango District, Rwanda. Int J Med Public Health 2016; 6(2): 98-102.
6. World Health Organization. Implementation of ANC guidelines and recommendations. In: WHO recommendations on Antenatal Care for a Positive Pregnancy Experience, Luxembourg: Green Ink; 2016:105-117.
7. Mekie M, Taklual W. Magnitude of low birth weight and maternal risk factors among women who delivered in Debre Tabor Hospital, Amhara Region, Ethiopia: a facility based cross-sectional study. Italian J Pediatrs 2019; 45(1): 1-6.
8. Soujanya M, Sravanthi NL, Vijayalakshmi B, kumari K. Maternal risk factors for term low birth weight neonates: a retrospective hospital based study at Guntur district, Andhra Pradesh. Indian J Pediatr 2016; 3(6): 433-9.
9. Patel PB, Bavarva NR, Patel MJ, et al. Socio-demographic and obstetrical factors associated with low birth weight:Community based retrospective study in an urban slum of Western India. Applied Med Res 2015; 1(3): 94-8.
10. Pal DK, Mondal T, Ghosh AR. Study on the Factors Associated With Low Birth Weight of Tribal Women in a Rural Area of West Bengal. J Dent Med Sci 2016; 15(2): 78-9.
11. Dayanithi M. Low birth weight and premature births and their associated maternal factors. Int J Community Med Public Health 2018; 5(6): 2277-85.
12. Agarwal G, Ahmad S, Goel K, et al. Maternal risk factors associated with low birth weight neonates in a tertiary care hospital, Northern India. J Community Med Health Educ 2012; 2(9): 1000177.
13. Yoder BA, Young MK. Neonatal Outcomes of teenage pregnancy in a military population Obstet Gynecol 1997; 90 (4 Pt 1): 500-6.
14. Dean AG, Sullivan KM, Soe MM. "Openepi: open source epidemiologic statistics for public health," Version 3.01 Updated 2013/04/06, https://www.openepi.com/Menu/OE_Menu.htm.
15. Kabilan S, Kumar MS. Morbidity and mortality pattern of very low birth weight infants admitted in SNCU in a South Asian tertiary care centre. Int J Contemp Pediatr 2018; 5(3): 720-5.
16. Mavlankar DV, Gray RH, Trivedi CR. Risk factors for preterm and term low birthweight in Ahmedabad, India. Int J Epidemiol 1992; 21(2): 263-72.
17. Acharya D, Nagraj K, Nair NS, Bhat HV. Maternal determinants of intrauterine growth retardation: a case control study in Udupi District, Karnataka. Indian J Community Med 2004; 29(4): 181-2.

18. Mondal B. Risk factors for low birth weight in Nepali infants. Indian J Pediatr 2000; 67(7): 477-82.
19. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. Bull World Health Organ 1987; 65(5): 663-737.
20. Ferraz EM, Gray RH, Cunha TM. Determinants of preterm delivery and intrauterine growth retardation in north-east Brazil. Int J Epidemiol 1990; 19(1): 101-8.
21. Zhu BP, Rolfs RT, Nangle BE, Horan JM. Effect of the interval between pregnancies on perinatal outcomes. New Engl J Med 1999; 340(8): 589-94.
22. Ashwani N, Rekha NA, Babu MS, et al. Maternal risk factors associated with intrauterine growth restriction: hospital based study. Int J Med Res Rev 2016; 4(12): 2125-9.
23. Amin N, Abel R, Sampathkumar V. Maternal risk factors associated with low birth weight. Indian J Pediatr 1993; 60(2): 269-74.
24. Arif MA, Qurreshi AH, Jafarey SN, et al. Maternal sociocultural stauts: a novel assessment of risk for the birth of small for gestational age, low birth weight infants. J Obstet Gynaecol Res 1998; 24(3): 215-22.
25. Deshmukh JS, Motghare DD, Zodpey SP, Washva SK. Low Birth weight and associated maternal factors in an urban area. Indian Pediatr 1998; 35(1): 33-6.
26. Ghosh S, Bhargava SK, Bhargava V. Growth pattern in the first year. Indian Pediatrics 1970; 7: 374-7.
27. Maruoka K, Yagi M, Akazawa K, et al. Risk factors for low birth weight in Japanese infants. Acta Paediatr 1998; 87(3): 304-9.
28. Gauchan E, Basnet S, Koirala DP, Rao KS. Clinical profile and outcome of babies admitted to Neonatal Intensive Care Unit (NICU). J Inst Med 2011; 33(2): 1-5.
29. Investigators of the National Neonatal Perinatal Database (NNPD), National Neonatology Forum of India (see Appendix for complete list of Investigators). Morbidity and mortality among outborn neonates at 10 tertiary care institutions in India during the year 2000. J Trop Pediatrs 2004; 50(3): 170-4.