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A Case-Control Study on Maternal Determinants of Low Birth Weight at a Tertiary Care Hospital in Surendranagar District

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ABSTRACT

Introduction: Low birth weight is included as a primary outcome indicator in the core set of indicators for the Global Nutrition Monitoring Framework. Maternal factors play a crucial role in determining babies' birth outcomes, Birth weight, future survival and experiencing healthy growth & development.
Objective: 1) To find out the maternal risk factors of LBW. 2) To determine the association between various risk factors and LBW.
Methodology: A Hospital- based case-control study was carried out at a tertiary care teaching hospital in Surendranagar district from April to August 2024. This study included 350 women (175 cases & 175 controls) selected purposively from postnatal care wards who delivered singleton babies at term. Data were collected by a pre-designed, pre-tested, semi-structured questionnaire through personal interview, medical records, & MCP card. Data were entered in MS Excel and analysed in SPSS.
Result: Sociodemographic factors like living in a rural area (OR=1.92), Labourer (OR=2.47), socioeconomic class - 5 (OR=12.50) and Maternal factors like Undernutrition (OR=1.94), Less Weight gain during pregnancy (OR=5.82), Low Interpregnancy interval (OR=3.19), and health problem in the current Pregnancy (OR=3.36) were significantly associated with LBW. ANC Services-related determinants like Late registration of pregnancy (OR=3.27), Inadequate ANC visits (OR=3.26), inadequate IFA tablets & calcium consumption (OR=6.47, 3.74), non-utilisation of take-home ration (OR= 2.28), Anemia during pregnancy (OR=7.19) were found to be significantly associated.
Conclusion: Women living in rural areas, of low socioeconomic class, with undernutrition, high-risk pregnancy and less utilisation of ANC services were found to be significantly associated with LBW.

Keywords: *Low birth weight (LBW) baby, case-control study, maternal determinants, Antenatal care, tertiary care hospital.*

INTRODUCTION

The World Health Organisation (WHO) defined Low birth weight (LBW) as birth weight of less than 2500 grams (5.5 pounds), regardless of the duration of gestation. Birth weight is preferably recorded within the first hour of life. LBW includes both preterm infants born before 37 completed weeks of gestation and small-for-gestational-age (SGA) infants whose birth weight falls below the 10th percentile for their gestational age and sex due to intrauterine growth restriction.[1]

Low birth weight (LBW) is recognised as an important public health indicator and has been included as a key outcome measure in the Global Nutrition Monitoring Framework. It is also part of the World Health Organisation's Global Reference List of 100 Core Health Indicators, highlighting its significance in assessing maternal and child health worldwide. [2]

Globally, around 19.8 million babies were born with LBW in 2020, representing 14.7% of all births. Low birth weight remains a major public health concern, as affected infants are more vulnerable to death during the neonatal period. Survivors often face lifelong challenges, including growth retardation, poorer cognitive outcomes, and a greater likelihood of developing non-communicable diseases such as obesity and diabetes in adulthood. [3]

According to the National Family Health Survey (NFHS-5, 2019–21), the prevalence of low birth weight (LBW) in India was 17.29% (95% CI: 17.01–17.57).[4]In comparison, the prevalence of LBW reported through the Health Management Information System (HMIS) for the year 2020–21 was 13.4% in Gujarat and 8.7% in Surendranagar district.[5]

Recognising the significant public health burden posed by low birth weight, the World Health Organisation's Global Nutrition Targets 2025 aimed to achieve a 30% reduction in the number of infants born weighing less than 2500 grams by 2025. Achieving this target would require an average annual relative reduction of 3% between 2012 and 2025, decreasing the global number of low-birth-weight infants from approximately 20 million to about 14 million.[6]

The aetiology of low birth weight is multifactorial and may vary across different geographical regions and populations. Maternal factors play a crucial role in determining birth outcomes, including birth weight, neonatal survival, and the child's subsequent growth and development. Therefore, understanding the local determinants of low birth weight is essential for developing effective interventions. With this objective, a case–control study was undertaken to assess the maternal determinants of low birth weight in Surendranagar district.

Objective:

1. To find out the maternal risk factors of Low-birth-weight.
2. To determine the association between various risk factors and Low-birth-weight.

METHODOLOGY:

A Hospital- based case-control study was carried out at a tertiary care teaching hospital in Surendranagar district from April to August 2024. The Study participants were selected using purposive sampling from mothers who were admitted to postnatal care (PNC) wards and had delivered a singleton term baby. Mothers who delivered babies weighing less than 2,500 grams were classified as cases, while those who delivered babies weighing 2,500 grams or more were considered controls. For each case, a control was selected by pair matching (1:1) for two variables, maternal age and parity. Mothers who delivered more than one baby or were not willing to participate in the study were excluded.

Sample size was estimated by using formula $n=[(r+1)/r]\ [\ p(1-p)\ (Z\beta + Z\alpha/2\ )^2]/(p1-p2)^2]$ where n is Required number of samples, r is the ration of control to cases (We are using1:1), p is average proportion exposed, $Z\alpha/2$ is standard normal variate for 5% level of significance is 1.96, $Z\beta$ is standard normal variate for power of study for 80% is 0.84, p1 and p2 are proportion in cases (58.67 %) and controls (43.33 %) respectively of important variables of LBW was maternal undernutrition (Body mass index < 18.5 kg/m2) from the previous study in Gujarat by Gohel et al. [7According to that sample size of around 174, each was estimated for cases and controls. For better implications, we had selected 175 cases and 175 controls, a total of 350 for the present study.

Data were collected by a pre-designed, pre-tested, semi-structured questionnaire through personal interview and careful observation of medical records & MCP (Mother and Child Protection) card. Data were entered in Microsoft Excel version 2021. The Descriptive (Mean, SD, Percentage, etc.) and Inferential statistics were analysed using the Statistical Package for Social Sciences (SPSS) version 26. Every study participant was informed about the purpose and entire process of the study in the local language (Gujarati), and their written consent was taken. Prior approval was obtained from the Institutional Ethics Committee before the study was initiated.

RESULT

A total of 350 mothers with their respective newborns (175 cases and 175 controls) were included in the study. The mean birth weight was 2.37 ± 0.07 kg for cases and 2.95 ± 0.26 kg for controls.

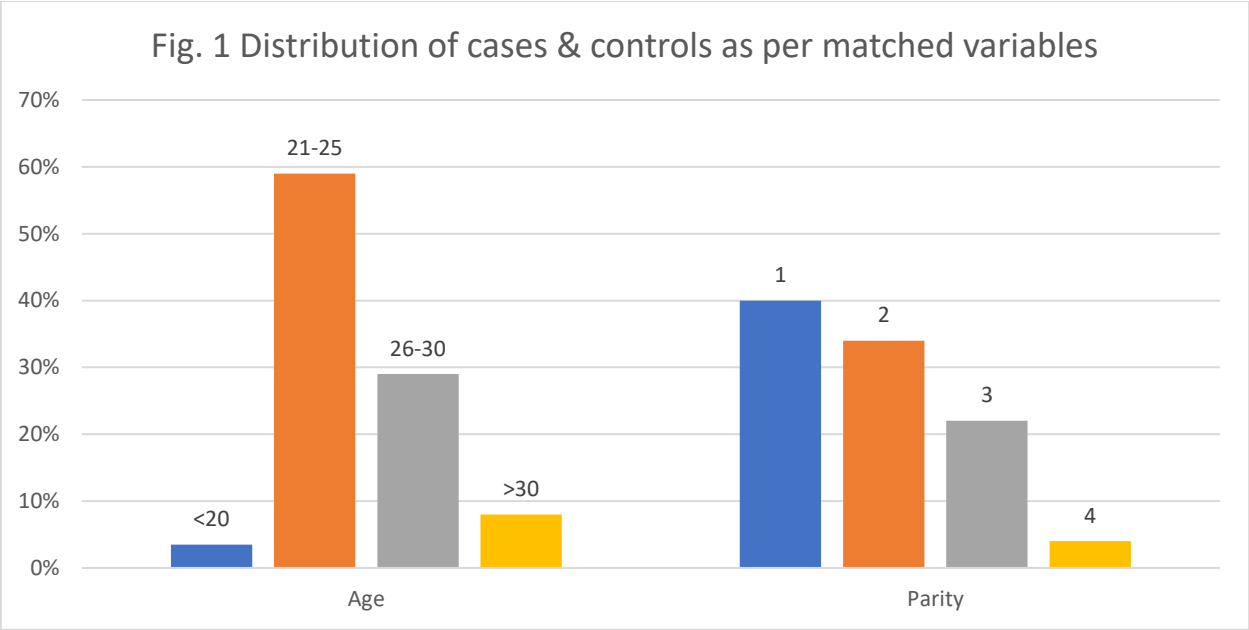

Figure 1 shows the distribution of cases and controls as per the matched variables. The mean age of mothers was 25.27 ± 3.45 years. The majority of pairs' mothers, 104(59.4%), were in the age group of 21-25 years, while 51(29.1%) were in the 26-30 years age group, 14(8%) were in the>30 years age group, and 6(3.4%) were < 20 years of age. Out of total 70(40%) pairs of mothers were primipara, while 60(34.3%) were second para, 39(22.3%) were third para and 6(3.4%) were fourth para.

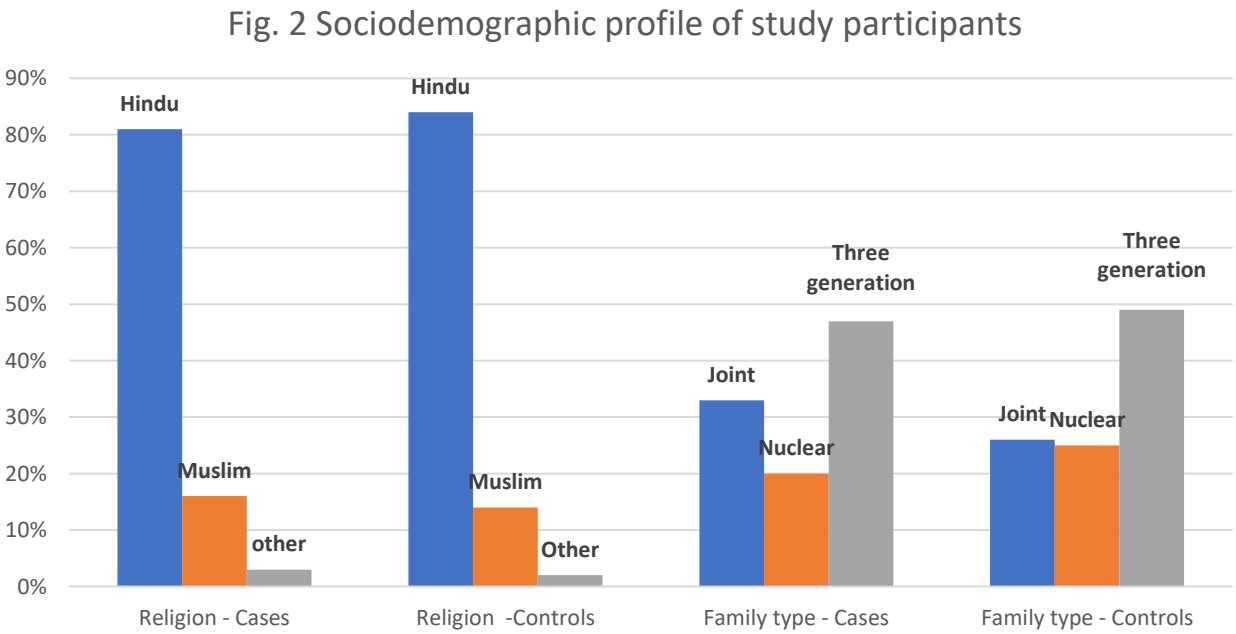

Figure 2 shows that, of the total, the majority of study participants were Hindu (around 80%), followed by Muslims and others in both cases and controls. The major portion of both cases and controls belongs to the three-generation family type (Around 50%), followed by joint and nuclear families.

Table 1: Association between Sociodemographic variables and LBW (N=350)

Variable	Case (%)	Control (%)	OR	95% CI	P value
Residence					
Rural	110(62.9)	82(46.9)	1.92	1.25 - 2.94	0.001
Urban	65(37.1)	93(53.1)	1		
Occupation					
Housewife	88(50.3)	115(65.7)	1		
Labourer	68(38.9)	36(20.6)	2.47	1.51 - 4.03	0.0001

Service (Govt./Private)	19(10.9)	24(13.7)	1.03	0.53 - 2.01	0.46
Education					
Illiterate	18(10.29)	18(10.29)	0.6	0.24 - 1.49	0.14
Primary	62(35.43)	54(30.86)	0.69	0.33 - 1.43	0.16
Secondary	49(28.00)	33(18.86)	0.89	0.40 - 1.93	0.38
Higher secondary	21(12.00)	55(31.43)	0.23	0.10 - 0.51	0.0002
Graduate & above	25(14.29)	15(8.57)	1		
Socioeconomic Class (Modified Prasad)					
Class - 1	2(1.1)	5(2.9)	1		
Class - 2	26(14.9)	34(19.4)	1.91	0.34 - 0.65	0.23
Class - 3	88(50.3)	99(56.6)	2.22	0.42 - 1.74	0.17
Class - 4	54(30.9)	36(20.6)	3.75	0.69 - 0.39	0.06
Class - 5	5(2.9)	1(0.6)	12.50	0.84 - 86.3	0.03

Table 1 shows the association between socio-demographic variables of study participants and LBW. Of the total, the majority of study participants in both cases (62.9%) and controls (46.9%) resided in rural areas. Rural residence was found to be significantly associated with LBW (OR = 1.92; 95% CI: 1.25–2.94; p = 0.001). Regarding occupation, housewives constituted the majority in both cases (50.3%) and controls (65.7%). Labourers had a significantly higher likelihood of the outcome (OR = 2.47; 95% CI: 1.51–4.03; p = 0.0001). However, individuals engaged in government or private service did not show a statistically significant association (OR = 1.03; 95% CI: 0.53–2.01; p = 0.46).

In terms of educational status, no statistically significant association was observed for illiterate, primary, or secondary education levels when compared to graduates and above. However, participants with higher secondary education demonstrated significantly lower odds of the outcome (OR = 0.23; 95% CI: 0.10–0.51; p = 0.0002), indicating a protective effect. Analysis of socioeconomic status using the Modified Prasad classification revealed no statistically significant association for Classes II, III, and IV, although participants belonging to Class V exhibited (OR = 12.50; 95% CI: 0.84–186.3; p = 0.03) a statistically significant association.

Table -2: Association between Maternal determinants and LBW (N=350)

Variable	Case (%)	Control (%)	OR	95% CI	P value
Maternal height (cm)					
≤ 140	18(10.3)	16(9.1)	1.14	0.56 - 2.31	0.36
> 140	157(89.7)	159(90.9)	1		
BMI (Kg/m2)					
< 18.5	85(48.6)	45(25.7)	1.94	1.2 - 3.15	0.003
18.5-22.9	73(41.7)	75(42.9)	1		
≥ 23	17(9.7)	55(31.4)	0.32	0.17 - 0.6	0.0001
Weight gain during pregnancy (Kg)					
5 to 8	111(63.4)	37(21.1)	5.82	3.51 - 9.64	0.0001
9 to 11	50(28.6)	97(55.4)	1		
>11	014(8)	41(23.4)	0.66	0.33 - 1.33	0.12
Current Pregnancy-Related Health Problem					
Yes	57(32.6)	22(12.6)	3.36	1.94 - 5.81	0.0001
No	118(67.4)	153(87.4)	1		
H/O Tobacco chewing					
Yes	11(6.3)	6(3.4)	1.89	0.68 - 5.23	0.11
No	164(93.7)	169(96.6)	1		
Interpregnancy interval*(N=210)					
< 3 years	85(48.6)	60(34.3)	3.19	1.71 - 5.94	0.0001
≥ 3 years	20(11.4)	45(25.7)	1		
Previous H/O LSCS/ Instrumental delivery*(N=210)					
Yes	55(31.4)	48(27.4)	1.31	0.76 - 2.25	0.17
No	50(28.6)	57(32.6)	1		
Previous H/O LBW*(N=210)					
Yes	38(21.7)	28(16)	1.56	0.87 - 2.81	0.07
No	67(38.3)	77(44)	1		

*For Interpregnancy interval, Previous H/O LBW and Previous H/O LSCS/ Instrumental delivery N = 210

Table 2 depicts the association of maternal determinants with LBW among cases and controls. Short stature (Maternal height ≤140 cm) was slightly higher among cases (10.3%) than controls (9.1%); however, the association was not statistically significant (OR=1.14, 95% CI: 0.56–2.31, p=0.36). Nearly half of the cases (48.6%) had BMI <18.5 kg/m² compared to 25.7% of controls. Underweight mothers were significantly associated with LBW (OR=1.94, 95% CI: 1.2–3.15, p=0.003), whereas mothers with BMI ≥23 kg/m² showed significantly lower risk (OR=0.32, 95% CI: 0.17–0.60, p=0.0001).

Low weight gain during pregnancy (5–8 kg) was observed in 63.4% of cases and was strongly associated with LBW (OR=5.82, 95% CI: 3.51–9.64, p=0.0001). Current pregnancy-related health problems were also significantly higher among cases (32.6%) than controls (12.6%) (OR=3.36, 95% CI: 1.94–5.81, p=0.0001). Interpregnancy interval <3 years was significantly associated with LBW (OR=3.19, 95% CI: 1.71–5.94, p=0.0001). Tobacco chewing, previous LSCS/instrumental delivery, and previous history of LBW showed higher odds among cases, but these associations were not statistically significant.

Table -3: Association between Antenatal care (ANC) services utilisation and LBW (N=350)

Variable	Case (%)	Control (%)	OR	95% CI	P value
Registration of pregnancy					
Early registration	104(59.4)	145(82.9)	1		
Late registration	68(38.9)	29(16.6)	3.27	1.98 - 5.4	0.0001
No	3(1.7)	1(0.6)	4.18	0.43 - 40.78	0.11
No. ANC visits attended					
< 4	82(46.9)	38(21.7)	3.26	2.04 - 5.21	0.0001
≥ 4	90(51.4)	136(77.7)	1		
No	3(1.7)	1(0.6)	4.53	0.46 - 44.27	0.01
TT injection taken					
Yes	172(98.3)	174(99.4)	1		
No	3(1.7)	1(0.6)	3.03	0.31 - 29.46	0.17
Consumption of IFA tablets					
<100	108(61.7)	36(20.6)	6.47	4 - 10.45	0.0001
≥ 100	64(36.6)	138(78.9)	1		
No	3(1.7)	1(0.6)	6.47	0.66 - 63.4	0.05
Consumption of calcium tablets					
<100	116(66.3)	62(35.4)	3.74	2.4 - 5.84	0.0001
≥ 100	56(32)	112(64)	1.00		
No	3(1.7)	1(0.6)	6.00	0.61 - 59	0.06
Deworming during pregnancy					
Yes	172(98.3)	174(99.4)	1		
No	3(1.7)	1(0.6)	3.03	0.31 - 29.46	0.17
Utilisation of take-home ration					
Yes	60(34.3)	95(54.3)	1		
No	115(65.7)	80(45.7)	2.28	1.48 - 3.5	0.0001
Hb during pregnancy (gm %)					
<7	23(13.1)	8(4.6)	7.19	2.85 - 18.11	0.0001
7-9.9	45(25.7)	28(16)	4.02	2.09 - 7.74	0.0001
10-10.9	81(46.3)	74(42.3)	2.74	1.57 - 4.76	0.0001
>11	26(14.9)	65(37.1)	1		

Table 3 shows the association between Antenatal care (ANC) services utilisation and LBW. Late registration of pregnancy was more common among cases (38.9%) compared to controls (16.6%). Mothers with late registration had a significantly higher association with LBW (OR=3.27, 95% CI: 1.98–5.4, p=0.0001). Nearly half of the cases (46.9%) attended inadequate ANC visits, whereas the majority of controls (77.7%) attended four or more visits. Inadequate ANC visits were significantly associated with LBW (OR=3.26, 95% CI: 2.04–5.21, p=0.0001). TT immunisation status did not show a significant association with LBW.

Consumption of Inadequate IFA tablets was observed among 61.7% of cases and 20.6% of controls. Mothers consuming Inadequate IFA tablets had significantly higher odds of LBW babies (OR=6.47, 95% CI: 4–10.45, p=0.0001). Similarly, inadequate calcium tablet consumption (<100 tablets) was significantly higher among cases (66.3%) than controls (35.4%) (OR=3.74, 95% CI: 2.4–5.84, p=0.0001). Non-utilisation of take-home ration was more common among cases (65.7%) compared to controls (45.7%) and showed a significant association with LBW (OR=2.28, 95% CI: 1.48–3.5, p=0.0001). Severe Anemia (Hb <7 gm%) was present in 13.1% of cases and 4.6% of controls, showing the highest risk (OR=7.19,

95% CI: 2.85–18.11, p=0.0001). Moderate and mild Anemia were also significantly associated with increased odds of low birth weight compared to mothers with Hb >11 gm%.

DISCUSSION

Various studies across the world found that maternal age and parity were significantly associated with LBW. We have matched these two variables in our study, which coincides with the study from Nagpur, Maharashtra, by Nagargoje et al.[8] In our study, rural residence was found to be significantly associated with LBW (OR = 1.92; 95% CI: 1.25–2.94; p = 0.001), which is aligned with the findings of a study from central India by Nair et al. [9] and Nagpur, Maharashtra (OR=2.11 (CI: 1.58 -2.80) p= <0.00), Nagargoje et al.[8] Labourer had a significant association with LBW (OR = 2.47; 95% CI: 1.51–4.03; p = 0.0001) in the present study, which coincides with the study by Gohel et al.[7] (OR=3.57, CI=1.08-11.71) and a study from the Saurashtra region by Patel et al[10]

There was no significant association observed for illiterate, primary or secondary education levels. However, participants with higher secondary education demonstrated (OR = 0.23; 95% CI: 0.10–0.51; p = 0.0002) a protective effect. This is in contrast with the studies by Gohel et al.[7] and the study from the Saurashtra region, Patel et al.[10] Socioeconomic status revealed no significant association for Classes II, III, and IV, although participants belonging to Class V exhibited higher odds (OR = 12.50; 95% CI: 0.84–186.3; p = 0.03) and a significant association. These findings are aligned with the study by Gohel et al.[7] But in contrast with the study from the Saurashtra region, Patel et al[10]

Our study found that short stature was not statistically significant (OR=1.14, 95% CI: 0.56–2.31, p=0.36), which contradicts the findings of a study from Eastern Nepal by Bhaskar et al.[11] and Gujarat (OR=12.95 (CI: 1.66- 100.9), p=0.01)- Gohel et al.[7] Underweight mothers (BMI <18.5 kg/m²) were significantly associated with LBW (OR=1.94, 95% CI: 1.2–3.15, p=0.003). These findings were aligned with the findings of the study (OR=1.84 (CI: 1.14- 2.97), p=0.01), Gohel et al.[7]

Low weight gain during pregnancy was strongly associated with LBW (OR=5.82, 95% CI: 3.51–9.64, p=0.0001). These findings are in agreement with the studies from Rajasthan by Kabra M et al.[12] and Nanded, Maharashtra (OR= 38.107 (CI: 6.87- 211.07), p= < 0.001) by Domple et al.[13]

Current pregnancy-related health problems were also significantly associated with LBW (OR=3.36, 95% CI: 1.94–5.81, p=0.0001). These findings are aligned with studies like (OR=2.13 (CI- 1.07-4.24) p= 0.024) Pawar et al.[14] and a study from Eastern Nepal, Bhaskar et al.[11]

Low Interpregnancy interval was significantly associated with LBW (OR=3.19, 95% CI: 1.71–5.94, p=0.0001), which coincides with findings of the study from Assam (OR = 3.93; CI: 2.16- 7.13) by Borah et al. [15]

In our study, Tobacco chewing, previous LSCS/instrumental delivery, and previous history of low birth weight showed higher odds among cases, but these associations were not statistically significant. These findings are aligned with the study by Gohel et al. [7]. Mothers with late registration of pregnancy had significantly higher odds of delivering LBW babies (OR=3.27, 95% CI: 1.98–5.4, p=0.0001). Similar findings were observed by a study from Dahod, Gujarat, by Gohel et al. [7]

Inadequate ANC visits were found to be significantly associated with LBW (OR=3.26, 95% CI: 2.04–5.21, p=0.0001) in our study. This is consistent with the findings of Jayaraj et al.[16] and Gohel et al. [7]

Mothers consuming fewer IFA tablets had significantly higher odds of LBW babies (OR=6.47, 95% CI: 4–10.45, p=0.0001). These findings are aligned with a study from Nepal (AOR 3.2, CI: 1.7–5.7), K C et al. [17] But it contradicts the results of the study from Eastern Nepal by Bhaskar et al.[11]

Inadequate calcium tablet consumption was found to be significantly associated (OR=3.74, 95% CI: 2.4–5.84, p=0.0001) with LBW. This is consistent with the result of the study from Eastern Nepal by Bhaskar et al.[11]

Non-utilisation of take-home ration showed a significant association with LBW (OR=2.28, 95% CI: 1.48–3.5, p=0.0001). A similar result was observed by the study from Gujarat (OR= 2.18 (1.24-3.81), p= 0.006) by Gohel et al. [7] Our study founds Maternal Anemia was significantly associated with LBW. This result coincides with the studies by Pawar et al.[14] (OR= 2.36 (CI- 1.13-4.95)p= 0.020) , Borah et al. [15] (OR= 1.93(CI- 1.3-2.9)) and Girma et al[18] (AOR = 3.54, 95%CI, 1.468.61) from West Ethiopia.

CONCLUSION

This study highlighted that Women living in rural areas, of low socioeconomic class, labourers as occupation were the major sociodemographic factors that are mainly responsible for LBW and found to be significantly associated, while higher education level serves as the protective factor. The maternal factors such as short stature (Height <140 cm), undernutrition (BMI < 18.5 Kh/m2), Less weight gain during pregnancy (5 to 8 Kg), Less interpregnancy interval (<3 years) and current

pregnancy-related health problems were found to be significantly associated with LBW in the present study. Although there was no significant association found between LBW and Maternal Height, History of Tobacco chewing, Previous H/O LBW and Previous H/O LSCS/ Instrumental delivery. The late registration of pregnancy, inadequate ANC visits, inadequate consumption of IFA and calcium tablets, and not utilising the take-home ration and maternal Anemia in pregnancy were major ANC service utilisation factors associated with LBW found in our study. While taking TT injections and deworming tablets were not found to be associated with LBW.

Recommendation

Based on the study findings, improving the availability and accessibility of ANC services in rural areas through mobile clinics and community health workers can reduce the burden of LBW in the community. Develop community-based Health education programs and nutrition programs targeting pregnant women to address undernutrition. Future research is needed to identify specific barriers faced by women in rural areas and labourers regarding the utilisation of ANC services and nutrition, and also to identify the factors responsible for LBW.

Limitations

Being a single-centre study conducted by purposive sampling in one tertiary care hospital, the
Results may not be generalizable. The present study carries all the limitations of the case-control study, such as recall bias, etc.

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Nil.

Conflicts of interest

There are no conflicts of interest**.**

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