SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Hanamasagar *et al*., 2025
doi: 10.21276/SSR-IIJLS.2025.11.4.47

Original Article

open access

Maternal Risk Factors Associated with Low-Birth-Weight: A Case-Control Study

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Received: 12 Feb 2025/ Revised: 24 Apr 2025/ Accepted: 17 Jun 2025

ABSTRACT

Background: Low birth weight (LBW), defined as birth weight below 2,500 g, remains a major public health concern due to its association with chronic illnesses, growth retardation, and neonatal morbidity. Maternal characteristics significantly influence fetal growth and birth weight outcomes.

Methods: A hospital-based case–control study was conducted at Shanti Multispecialty Hospital, Bagalkot, Karnataka, including 200 mothers of LBW babies (cases) and 200 mothers of normal birth weight babies (controls), selected through convenience sampling. Data were obtained via structured interviews and clinical record reviews. Binary logistic regression was performed to determine associations between maternal factors and LBW.

Results: Several maternal factors were significantly associated with LBW: infertility treatment (OR=4.86, 95% CI: 2.19–10.78, p<0.001), history of hypertension (OR=2.86, 95% CI: 1.18–6.97, p=0.021), stress during pregnancy (OR=1.79, 95% CI: 1.21–2.66, p=0.004), previous LBW history (OR=2.95, 95% CI: 1.75–4.99, p<0.001), antenatal hemorrhage (OR=2.99, 95% CI: 1.65–5.46, p<0.001), insufficient sleep during pregnancy (OR=2.61, 95% CI: 1.69–4.02, p<0.001), and gestational hypertension (OR=2.26, 95% CI: 1.50–3.41, p<0.001). Joint family status was protective against LBW (OR=0.63, 95% CI: 0.43–0.94, p=0.022).

Conclusion: The study identified key modifiable maternal factors associated with LBW in Bagalkot. Strengthening antenatal care, addressing hypertension and stress, ensuring adequate rest, and providing targeted interventions for high-risk mothers could substantially reduce LBW prevalence. Early identification and management of these factors should be integrated into maternal health programs.

Key-words: Low birth weight, Maternal risk factors, Case-control study, Antenatal care, Convenient sampling

INTRODUCTION

Pregnancy is the most delicate period of every woman's life. The birth of a child is always filled with happiness and expectations in a family, but sometimes the same situation can be full of challenges, pain, and struggle.

How to cite this article
Hanamasagar PI, Nimbargi R, Dhandargi UN, Patil SS. Maternal Risk Factors Associated with Low-Birth-Weight: A Case-Control Study. SSR Inst Int J Life Sci., 2025; 11(4): 8117-8125.

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If the child is born with any abnormality or does not possess all the normal physiological or physical characteristics. The burden of Child mortality has been a consistent challenge to healthcare services in India.[1,2]

Among many indicators of good health at the time of birth, the baby's weight is considered one of the prime indicators of the baby's future health. In many developing countries, low birth weight remains a major Concern for meeting maternal and child health care demands. WHO has defined low birth weight as birth weight less than 2500 g. According to some of the research studies, mortality among low-birth-weight

doi: 10.21276/SSR-IIJLS.2025.11.4.47

babies is 20 times higher than that of babies with normal birth weight. According to a study conducted in India, it was noted that among live-born children, around 6% of children have a birth weight of less than 1500 grams.[3-6] India reports a high level of prevalence of low birth weight as compared to many other developing countries. The prevalence of low birth rate in India is around 18 to 19%. Moreover, the prevalence is higher in rural areas compared to urban areas. A study in Karnataka reported that the prevalence of low birth weight is around 13 to 14%. According to the National Family Health Survey in Karnataka, the prevalence of low birth weight is around 16%. According to the WHO, the area is still struggling to overcome the prevalence of low birth weight in 2025. Low birth weight can be prevented with appropriate control of maternal factors amid Environmental or genetic challenges. Maternal health must be a prime concern during pregnancy. Factors such as nutrition, immunisation, exercise, and the absence of physiological disorders can play a crucial role in newborn health. Many maternal factors like age of marriage, age at menarche, Treatment for Infertility, bad habits, gestational diabetes, pre-eclampsia, Eclampsia, etc. They play a crucial role in controlling the birth weight of the child. To minimise the risk of low birth weight, it is essential to identify the maternal factors that contribute to it. So that they can be controlled at the earliest and prevent their effect on fetus.[7-13]

MATERIALS AND METHODS

Study Design- The study was conducted using a non-matched case–control research design. The cases were mothers who had delivered a baby with a birth weight <2,500 g, whereas the controls were mothers who had delivered a baby with a birth weight ≥2,500 g. Both groups were selected from Shanti Multispecialty Hospital, Bagalkot.

Study Area- The study was conducted in Shanti Multispecialty Hospital, Bagalkot, Karnataka, India — a 100-bedded multispecialty hospital with a 30-bed NICU. Cases were mothers whose babies (birth weight <2,500 g) were admitted to the NICU; controls were selected from the pediatric OPD.

Population and Sample- Study participants were mothers delivering LBW (low birth weight) babies. According to NFHS-5 data, the crude birth rate of Karnataka and Bagalkot is 16.5 per 1,000 population, and the prevalence of LBW is 16.5%. The study included two groups: (1) case group-200 mothers of infants with birth weight <2,500 g, and (2) control group-200 mothers of infants with birth weight ≥2,500 g.

Inclusion Criteria- Cases: Mothers of infants with birth weight <2,500 g, available for data collection, and who provided consent.
Controls: Mothers of infants with birth weight ≥2,500 g, available for data collection, and who provided consent.

Exclusion Criteria- Mothers who were physically or mentally unfit to provide data were excluded from both groups.

Sample Size Estimation- Based on NFHS-5 prevalence of LBW in India (16.5%) and using the formula $N=4PQ/I^2$, where P is prevalence, Q=100–p, and I is the allowable error (20% of p), the calculated sample size was 355. Considering possible missing or incomplete data, the final sample size was fixed at 400 (200 cases and 200 controls).

Sampling Technique- Convenience sampling was used. Permission was obtained from the Medical Superintendent, and eligible mothers were approached. A list of admitted LBW babies was prepared, and their mothers were enrolled after informed consent until 200 cases were reached. Simultaneously, 200 controls were enrolled from the pediatric OPD. Data collection was conducted from 04 March 2025 to 10 March 2025.

Source of Data- Birth weight data were obtained from hospital records. Baseline and maternal factors were collected from both cases and controls using interviews and review of clinical records.

Data Collection Instruments:

Baseline Proforma- Structured proforma to collect maternal age, education, socioeconomic status, occupation, place of residence, and family income.

Structured Questionnaire- Collected data on maternal risk factors, including type of delivery, gestational hypertension, previous history of abortion, gestational diabetes, pre-eclampsia/eclampsia, etc.

doi: 10.21276/SSR-IIJLS.2025.11.4.47

Open-ended questions were used for numerical data (e.g., age, weight, income), and closed-ended questions for categorical data. Both tools were developed in English, translated into Kannada by a language expert, validated by subject experts, and tested for reliability using test–retest (r=1.0).

Data Collection Procedure- For literate participants, questionnaires were self-administered; for illiterate participants, trained interviewers read out questions and recorded responses. Face-to-face interviews were used for clarification and completeness. Data collection occurred from 9 AM to 5 PM during the study period.

Statistical Analysis- Data were entered into Microsoft Excel, cleaned, and analyzed using SPSS version 20. Baseline factors were compared between cases and controls using frequency and percentage distributions, chi-square test, and Fisher's exact test. Binary logistic regression was applied to calculate crude and adjusted odds ratios with 95% confidence intervals. A p-value <0.05 was considered statistically significant.

Ethical Approval- Ethical clearance was obtained from the Institutional Ethics Committee, BES Bagalkot College of Nursing, Bagalkot (BES-IEC-2024-25-12, dated 25 December 2024), by the Declaration of Helsinki.

RESULTS

Most mothers in both LBW and normal birth weight groups were homemakers (73.8% vs. 79.0%), followed by those who were employed (17.9% vs. 17.5%), daily wage earners (5.9% vs. 3.0%), and engaged in business (2.5% vs. 0.5%). Most mothers in both groups resided in urban areas (54.0% in LBW vs. 49.5% in the normal group), while 46.0% and 50.5% respectively, belonged to rural areas. Regarding educational status, the largest proportion in both groups had attained secondary education (40.1% in LBW vs. 35.5% in the normal group), followed by degree or above (46.0% vs. 51.5%), primary education (10.4% vs. 11.0%), and no formal education (3.5% vs. 2.0%). Dietary habits showed that a mixed diet was more common among LBW mothers (70.3%) compared to normal birth weight mothers (62.5%), whereas a vegetarian diet was reported by 29.7% and 37.5% respectively. None of the socio-demographic variables showed a statistically significant association with LBW (p>0.05) (Table 1).

Table 1: Description of socio-demographic factors

Variable	Category	LBW		Normal		Total		χ^2	p- value
		F	%	F	%	F	%		
Maternal occupation	Business	4	2.5	1	0.5	5	1.5	5	0.25
	Daily wages	11	5.9	6	3.0	17	4.5		
	Employed	36	17.9	35	17.5	71	13.5		
	Home maker	149	73.8	158	79.0	307	76.4		
Residence	Rural	92	46.0	101	50.5	193	48.3	0.8	0.37
	Urban	108	54.0	99	49.5	207	51.7		
Maternal Education	Degree or above	92	46	103	51.5	195	48.8	2	0.57
	No formal education	7	3.5	4	2	11	2.7		
	Primary education	20	10.4	22	11	42	10		
	Secondary education	81	40.1	71	35.5	152	37.8		
Diet	Mixed	141	70.3	125	62.5	266	72.4		
	Vegetarian	59	29.7	75	37.5	134	33.6	2.96	0.28

LBW: Low birth weight, F: Frequency, %: percentage, χ^2: Chi-square value

doi: 10.21276/SSR-IIJLS.2025.11.4.47

A higher proportion of LBW mothers reported receiving treatment during pregnancy (74.8%) compared to controls (86.5%), showing a statistically significant association (p=0.003). Infertility treatment was reported by 16.8% of LBW mothers versus 4.0% of controls, while 7.4% of LBW mothers underwent IVF treatment compared to 2.0% of controls; both showed strong associations with LBW (p<0.05). A history of hypertension was more common among LBW mothers (9.4%) than controls (3.5%) (p=0.021). Stress during pregnancy was reported by 56.9% of LBW mothers compared to 42.5% of controls (p=0.004). Previous history of LBW was reported by 28.7% of cases versus 12.0% of controls (p=0.001). Insufficient sleep during pregnancy was more frequent in the LBW group (43.1%) compared to controls (22.5%) (p=0.012). Antenatal hemorrhage occurred in 21.9% of LBW mothers compared to 8.5% of controls (p=0.012). Gestational hypertension was also significantly more prevalent among LBW mothers (48%) compared to controls (29.0%) (p=0.001). No statistically significant association was found for skipped meals during pregnancy, strenuous work, treatment for anaemia, or use of over-the-counter drugs (Table 2).

Table 2: Description of factors associated with low birth weight

Factor	Category	LBW		Normal		Total		χ^2	p-value
		F	%	F	%	F	%		
Treatment during pregnancy	No	50	25.2	27	13.5	77	19.4	8	.003*
	Yes	150	74.8	173	86.5	323	80.6		
Treatment for Infertility	No	167	83.2	192	96.0	359	89.6	17	.00*
	Yes	33	16.8	8	4.0	41	10.4		
IVF treatment	No	186	92.6	196	98.0	382	95.3	6.57	.010*
	Yes	14	7.4	4	2.0	18	4.7		
History of Hypertension	No	182	90.6	193	96.5	375	93.5	5.79	.01*
	Yes	18	9.4	7	3.5	25	6.5		
History of stress during pregnancy	No	86	43.1	115	57.5	201	50.2	8.37	.004*
	Yes	114	56.9	85	42.5	199	49.8		
History of LBW	No	143	71.3	176	88.0	319	79.6	17.28	.01*
	Yes	57	28.7	24	12.0	82	20.4		
Insufficient sleep during pregnancy	No	114	56.9	155	77.5	269	67.2	15.23	0.01*
	yes	86	43.1	45	22.5	131	32.8		
Skipped meals during pregnancy	No	176	87.6	175	87.5	351	87.6	2.11	0.81*
	Yes	24	12.4	25	12.5	49	12.4		
History of antennal hemorrhage	No	157	78.1	183	91.5	340	84.5	13.42	0.01*
	Yes	43	21.9	17	8.5	60	15.5		
Gestational hypertension	No	105	52	142	71	247	61.4	14.13	0.001*
	Yes	95	48	58	29	155	38.6		
Strenuous work during pregnancy	No	157	77.7	162	81.0	319	79.4	.65	.41
	Yes	45	22.3	38	19.0	83	20.6		
Treatment for Anaemia during pregnancy	No	64	31.7	52	26.0	116	28.9	1.58	.20
	Yes	138	68.3	148	74.0	286	71.1		
Over count drugs pregnancy	No	191	94.6	185	92.5	376	93.5	.70	.40
	Yes	11	5.4	15	7.5	26	6.5		

doi: 10.21276/SSR-IIJLS.2025.11.4.47

Multivariate analysis identified several maternal characteristics as significant independent predictors of LBW. Mothers who received infertility treatment had nearly five times higher odds of delivering an LBW baby compared to those without such a history (AOR=4.92, 95% CI: 2.65–9.68, p<0.001). Similarly, mothers who underwent IVF treatment had almost four times higher odds (AOR=3.78, 95% CI: 1.19–12.45, p=0.025). A history of hypertension during pregnancy increased the odds of LBW by 2.59 times (95% CI: 1.02–6.57, p=0.04), while those reporting stress during pregnancy had 1.85 times higher odds (95% CI: 1.21–2.66, p=0.003).

Previous history of delivering an LBW infant was a strong risk factor, with affected mothers being more than three times as likely to deliver another LBW baby (AOR=3.06, 95% CI: 1.83–5.02, p<0.001). Antenatal hemorrhage during pregnancy was also strongly associated (AOR=2.90, 95% CI: 1.46–5.48, p=0.001). Mothers who reported insufficient sleep during pregnancy had 2.72 times higher odds (95% CI: 1.76–4.35, p<0.001). Gestational hypertension was another significant factor, increasing the odds of LBW by 2.24 times (95% CI: 1.69–3.14, p<0.001).

In contrast, belonging to a joint family was found to be protective, reducing the odds of LBW by 45% (AOR=0.55, 95% CI: 0.36–0.84, p=0.006). Other factors, including maternal education level, occupation, strenuous work during pregnancy, treatment for anaemia, skipped meals, over-the-counter drug use, and dietary pattern, did not show statistically significant independent associations with LBW after adjustment in the model (Table 3).

Table 3: Maternal factors associated with low birth weight

Maternal Characteristic	Category	COD (CI 95%)	p-value	AOD (CI 95%)	p-value
Maternal education	Primary education	1.26 (0.83 – 1.96)	.280	1.551(.96- 2.51)	.074
	Secondary education	.65 (0.12 – 1.15)	.509	.787(.18-3.48)	.752
	Degree or above	1.19 (0.63 – 1.84)	.606	1.291(.64-2.62)	.479
	No formal education	1	-	1	-
Birth order	1	1.04 (0.56 – 1.72)	.995	.926 (.19-4.45)	.923
	2	.98 (0.42 – 1.46)	.986	.870 (.18-4.195)	.862
	3	.79 (0.33 – 1.82)	.762	.635 (.12-3.27)	.587
	4	1	-	1	-
Maternal occupation	Daily wages	.18 (0.03 – 0.26)	.130	.164 (0.18-1.48)	.107
	Business	.47 (0.04 – 0.82)	.143	.470 (.146-1.51)	.204
	Govt. employee	.84 (0.31 – 1.28)	.564	.859(.46 -1.61)	.636
	Home maker	1	-	1	-
Residence	Urban	1.19 (0.74 – .46)	.371	1.336(.86-2.08)	1.336
	Rural	1	-	1	-
Number of family members	Less than 5 members	.63 (0.21 – 1.35)	.022*	.549(.36-.84)	.006*
	5 members and more	1	-	1	-
Treatment of infertility	Yes	4.85 (2.13 – 8.42)	.0001*	4.92 (2.65 – 9.68)	.0001*
	No	1	-	1	-
Treatment during	Yes	1.46 (.773-.276)	.003*	.387	.001*

doi: 10.21276/SSR-IIJLS.2025.11.4.47

pregnancy	No	1	-	1	-
IVF treatment	Yes	3.93 (1.28-12.06)	.01*	3.78 (1.19-12.45)	0.025*
	No	1	-	1	-
History of hypertension	Yes	2.86 (1.176-6.970)	.021*	2.592	0.045*
	No	1	-	1	-
History of stress during pregnancy	Yes	1.79 (1.21 -2.66)	.004*	1.85 (1.21 -2.66)	.003*
History of LBW	Yes	2.95 (1.749-4.989)	.0001*	3.06 (1.83-5.02)	.0001*
	No	1	-	1	-
Craving during pregnancy	Yes	.830 (.535 – 1.02)	0.40	.835 (0.52 -1.14)	0.43
	No	1	-	1	-
Diet	Vegetarian	0.70 (.467-1.075)	0.10	0.68	0.08
	Mixed	1	-	1	-
History of antenatal haemorrhage	Yes	2.99 (1.647-5.456)	.0001*	2.90 (1.46 -5.48)	0.001*
	No	1	-	1	-
Strenuous work during pregnancy	Yes	1.22 (.75-1.98)	0.41	1.23 (.72-1.87)	0.41
	No	1	-	1	-
Treatment for Anaemia in pregnancy	Yes	.75 (.491-1.168)	0.20	.76 (.51-1.28)	0.22
	No	1	-	1	-
over the counter drugs pregnancy	Yes	0.71 (.318-1.587)	0.40	0.62 (0.17 – 1.49	0.29
Insufficient sleep during pregnancy	Yes	2.61 (1.69- 4.02)	.0001*	2.72 (1.76- 4.35)	.0001*
	No	1	-	1	-
Skipped meals frequently during pregnancy	Yes	0.98 (.547-1.788)	0.97	.92 (.49-1.69)	0.81
	No	1	-	1	-
History of Gestational hypertension	Yes	2.26 (1.498-3.41)	0.0001*	2.23 (1.69-3.14)	.0001*
	No	1	-	1	-

**Significant, α=0.05, COD: Crude odds ratio, AOD: Adjusted odds ratio*

DISCUSSION

This hospital-based case–control study examined maternal risk factors associated with low birth weight (LBW) in Bagalkot. Cases consisted of mothers who delivered LBW infants (<2,500 g), while controls were mothers of normal birth weight infants (≥2,500 g). The analysis revealed several maternal characteristics significantly linked with LBW, consistent with previous research conducted in different geographical contexts. In the present study, a notable proportion of LBW mothers belonged to joint families, did not use contraceptives, received treatment for anaemia during pregnancy, and experienced stress during pregnancy. Many also had a previous history of delivering an LBW infant, reported cravings during pregnancy, or suffered from gestational hypertension. These findings agree with earlier studies, which similarly identified such factors as key contributors to poor birth outcomes.

In a case–control study conducted in rural Kurdistan, Moradi et al. reported that 2.2% of mothers had undergone in vitro fertilisation (IVF) treatment and that a majority were homemakers, suggesting socio-economic and reproductive history as potential determinants [15]. Rizvi *et al*. in their study from Karachi, observed that 67.1% of mothers had received daily iron

doi: 10.21276/SSR-IIJLS.2025.11.4.47

supplementation during pregnancy, reflecting the emphasis on nutritional interventions in antenatal care [16]. Stylianou-Riga et al., studying maternal socioeconomic factors in Cyprus, reported that 32.3% of mothers had education up to the secondary level, a figure comparable to the 40.5% observed among LBW mothers in the present study [17]. Mekie *et al.* in Ethiopia, found that 44% of mothers resided in urban areas, 64.9% were housewives, and 90.1% received iron supplementation, closely matching the demographic and antenatal care profiles in our study population [18].

The LBW group in this study was characterised by a high proportion of homemakers, urban residents, and women who delivered by lower-segment caesarean section. Additionally, infertility treatment, history of abortion, exposure to second-hand smoke, and belonging to the Hindu religion were frequently reported. Similar patterns have been documented by Baye *et al*., who noted that more than one-third of mothers had completed secondary education and nearly half were housewives [19]. Among control mothers, a higher prevalence of joint family living, lower incidence of infertility treatment, and fewer reports of hypertension or stress during pregnancy were evident. These patterns align with the findings of Devaguru *et al*., who reported a substantial proportion of Hindu mothers in their study [20], and Domple *et al.,* who identified urban residence and Hindu religion as prevalent among their participants [21]. Acharya *et al.* in a rural Nepalese study, also noted that insufficient sleep during pregnancy was a crucial maternal factor linked to LBW [22].

In the present analysis, several maternal factors emerged as significant predictors of LBW. Belonging to a joint family was found to be protective, potentially due to increased social and emotional support, reduced workload, and improved nutritional intake. In contrast, infertility treatment, history of hypertension, stress during pregnancy, previous LBW delivery, antenatal haemorrhage, insufficient sleep, and gestational hypertension were associated with increased odds of LBW. These findings are consistent with previous studies. Moradi et al. demonstrated a similar association between infertility treatment and LBW [15], while Stylianou-Riga *et al.* confirmed the strong link between LBW and stress during pregnancy [24]. Domple *et al*. observed that joint family living reduced the likelihood of LBW, whereas a history of LBW delivery significantly increased recurrence risk [21]. Acharya *et al.* corroborated the relationship between LBW and insufficient sleep during pregnancy [25].

The consistency of these findings across diverse populations highlights the universal role of maternal health and psychosocial conditions in determining birth weight. Stress, hypertension, sleep deprivation, and infertility treatment—particularly IVF—are known to impair fetal growth through physiological and obstetric pathways. At the same time, joint family living may provide protective social and emotional support. Antenatal care should prioritise early screening for hypertension, stress management, adequate rest, and focused care for women with a history of or previous LBW deliveries. Strengthening family and community support, alongside culturally sensitive health education, can help reduce LBW prevalence and improve neonatal outcomes.

CONCLUSIONS

The present study explored maternal risk factors associated with low birth weight (LBW) and differentiated the factors responsible for its occurrence. Identifying these risk factors enables antenatal mothers to be made aware of them well in advance, allowing timely interventions to prevent LBW and its associated complications. The findings highlight the significant association of maternal factors such as stress, hypertension, and insufficient sleep with the birth of LBW infants. Controlling these factors can substantially improve birth weight and overall neonatal health. The study further recommends conducting additional research to develop effective strategies for managing these risk factors, thereby enhancing the chances of optimal birth weight at delivery.

ACKNOWLEDGMENTS

The authors thank Dr. R.T. Patil, Chairman, Bagalkot Education Society; Dr. Sunil Patil, Pediatric Intensivist, Shanti Hospital; Mrs. Sunanda Patil, Vice Chairman, Bagalkot Education Society; and Mr. Hanamanthagouda L. Patil, Administrator, BES Nursing College, for their support.

FUNDS

The study is funded by Rajiv Gandhi University of Health Sciences, Bangalore.

doi: 10.21276/SSR-IIJLS.2025.11.4.47

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