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Original Research

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

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ABSTRACT

Background: *Low birth weight (LBW) remains a major contributor to neonatal morbidity and mortality globally. LBW remains an important maternal–neonatal health problem, particularly in high-risk referral settings. This study examined maternal and obstetric factors independently associated with LBW.*

Methods: *A retrospective case-control study used medical records of 270 mothers who delivered in 2025. Participants were selected by purposive sampling based on eligibility and record completeness, comprising 135 LBW cases and 135 controls. Eligible records included singleton deliveries without congenital anomalies; incomplete records and severe non-obstetric comorbidities were excluded. Maternal age, gestational age, birth spacing, parity, and documented preeclampsia were analyzed using chi-square tests and multivariable logistic regression. Variables with $p < 0.25$ entered the multivariable model.*

Results: *Preterm birth was strongly associated with LBW (AOR = 35.16, 95% CI: 16.92–73.09; $p < 0.001$), as was documented preeclampsia (AOR = 4.37, 95% CI: 1.94–9.80; $p < 0.001$). Maternal age and parity were not independently associated after adjustment, and birth spacing was not significant.*

Conclusion: *Preterm birth and documented preeclampsia showed the strongest adjusted associations with LBW. These findings support strengthened antenatal risk screening, preterm-birth surveillance, and timely referral, while providing context-specific evidence from a high-risk referral population.*

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INTRODUCTION

Particularly in low- and middle-income nations, low birth weight (LBW) continues to be a significant cause of infant illness and death (WHO, 2022). Defined as a birth weight of less than 2.500 grams regardless of gestational age, LBW reflects fetal growth and maternal health during pregnancy (UNICEF, 2024). Global estimates indicate that approximately 19.8 million liveborn infants, or 14.7% of all live births, had LBW in 2020,

with nearly three-quarters occurring in Southern Asia and sub-Saharan Africa (Okwaraji et al., 2024). LBW is a heterogeneous outcome influenced by maternal characteristics, reproductive history, pregnancy complications, placental function, and healthcare context (Arabzadeh et al., 2024; Lawn et al., 2023). Its persistent global burden underscores the importance of identifying clinically relevant maternal factors that may be amenable to prevention or early management across different populations and healthcare settings (Arabzadeh et al., 2024; Lawn et al., 2023; Okwaraji et al., 2024).

Indonesia continues to be one of Southeast Asia's nations with the highest LBW burden, and a prevalence ranging from 6.9% to 30% that variation in associated maternal, reproductive, socioeconomic, and contextual factors across the population. Analysis of the 2017 Indonesian Demographic and Health Survey identified birth interval, pregnancy complications, educational attainment, household wealth, marital status, and place of residence as factors associated with LBW, demonstrating that LBW in Indonesia is influenced by multiple maternal and socioeconomic characteristics (Wulandari et al., 2022; yumni, 2022). More recently, analysis of the 2021 Indonesian National Socio-Economic Survey involving 4,711,455 women demonstrated geographic variation in the distribution of LBW and identified maternal, reproductive, nutritional, behavioral, and residential characteristics associated with LBW (Ekoriano et al., 2025).

When combined, these results suggest that different Indonesian populations may have different profiles and relative contributions of LBW-related characteristics. Such variation may reflect differences in population characteristics, socioeconomic conditions, healthcare access, exposure distributions, and analytical approaches. However, these national population-based findings may not fully represent women receiving care in referral hospitals, where pregnancies are selectively referred because of greater clinical complexity and obstetric complications. Evidence from referral-hospital studies in other settings similarly suggests that the distribution of maternal and obstetric risk factors may differ according to the level and complexity of care provided (Afaya et al., 2021; Kargbo et al., 2021).

Current epidemiological literature identifies several maternal determinants that significantly contribute to LBW, including maternal age, gestational age, parity, birth spacing, anemia, and hypertensive disorders of pregnancy, particularly preeclampsia (Mitrogiannis et al., 2023; Syahda et al., 2024). Previous international and Indonesian evidence indicates that LBW is multifactorial and involves both distal maternal or reproductive characteristics and more proximal obstetric conditions. Maternal age has been associated with LBW and preterm birth, although the magnitude of this association may change after accounting for parity and other maternal characteristics, suggesting that maternal age may function partly as a distal risk marker rather than an isolated proximal determinant (Aradhya et al., 2023).

Parity and birth spacing represent important components of reproductive history. In particular, a meta-analysis of 41 studies found that a short interpregnancy interval of less than six months was associated with increased odds of preterm birth, LBW, and small-for-gestational-age birth, supporting pathways linking reproductive spacing to both gestational duration and fetal growth (Wang et al., 2022). Pregnancy complications may act more proximally. Preeclampsia is biologically linked to placental dysfunction and impaired uteroplacental perfusion, which can restrict fetal growth and may also necessitate early delivery, thereby providing pathways from maternal complications to LBW (Marasciulo et al., 2021; Sławek-Szmyt et al., 2022). In addition, evidence from health-facility-based case-control studies demonstrates that preterm birth and pregnancy

comorbidity remain important factors associated with LBW after multivariable adjustment (Anil et al., 2020).

According to the research results of Syahda (2024), the factors associated with LBW are maternal age, gestational age, pregnancy spacing, parity, and preeclampsia. Ageless than 20 years of reproductive organs are not yet fully functional in addition there is also competition for nutrition for mothers who are still in the development stage with the fetus. This will result in increasing premature births, LBW, and congenital defects (Syahda et al., 2024; Ting et al., 2024). Based on the study, there was a significant relationship between gestational age and the incidence of LBW in Cilacap Regional Hospital (gestational age p-value = <0.001) with an OR value = 20.213 at CI = (6.332-64.522), then the pregnancy spacing where the majority of maternal pregnancy spacing ≤ 24 months or first child was 30 people (53.6%) and the minority > 24 months was 26 people (46.4%) (Silaban et al., 2024).

While some studies highlight gestational age as the dominant factor, others emphasize maternal age or parity. These inconsistencies point to a critical knowledge gap regarding how maternal determinants interact within different healthcare system contexts. Evidence from other countries further suggests that referral-hospital populations may generate different risk profiles because referral facilities selectively receive women with more clinically complex pregnancies and obstetric complications. For example, studies conducted in five referral hospitals in Sierra Leone and in a secondary referral hospital in Ghana identified distinct combinations of maternal and obstetric factors associated with LBW within referral-care populations (Afaya et al., 2021; Kargbo et al., 2021).

In referral hospitals, where patient populations are defined by referral pathways and the treatment of clinically complex maternal and newborn disorders, population-based estimates may not accurately represent women getting care. However, they do offer significant evidence at the national level. It is crucial to look at LBW in the context of clinical care since recent multicenter and national referral-hospital studies in Indonesia show the significant burden of LBW and extreme preterm within hospital-based referral populations (Haksari et al., 2025; Marsubrin et al., 2025a).

Therefore, this study aimed to determine the maternal factors which were associated with LBW among mothers who delivered in a referral-hospital setting in Bukittinggi. The selected variables were specified as a priori on the basis of their established biological plausibility and placement within a conceptual framework. Maternal age, parity, birth spacing, preeclampsia and gestational age were the selected variables. The novelty of this study lies in providing context-specific evidence on the relative contribution of these selected maternal factors within a referral-hospital population.

By evaluating these factors simultaneously within an explicit conceptual framework, this study seeks to identify which factors retain an independent association with LBW in this clinical context. The central research question guiding this investigation is: Which maternal factors independently predict the occurrence of low birth weight in this hospital population. The study hypothesizes that gestational age and preeclampsia are the strongest predictors of LBW, consistent with global epidemiological patterns. The findings of this research are expected to inform targeted antenatal interventions, strengthen early-risk screening protocols, and contribute new empirical evidence to the broader scientific discourse on maternal–fetal health determinants.

MATERIALS AND METHOD

Study Design and Setting

This study employed an analytical observational design using a retrospective case–control approach to examine maternal factors associated with LBW. A case–control design was selected because it allows the distribution of antecedent maternal and obstetric characteristics to be compared between mothers who delivered LBW infants (cases) and those who delivered non-LBW infants (controls), with associations expressed as odds ratios. The retrospective approach was appropriate because exposure and covariate information was obtained from previously recorded maternal and obstetric medical records (Celentano et al., 2024; Flanagan et al., 2024). The research was conducted at Dr. Achmad Mochtar Hospital, a provincial referral hospital in Bukittinggi that serves patients from multiple districts with varying levels of obstetric risk.

Population and Sample

The study used maternal and neonatal medical records from a provincial referral hospital in West Sumatra serving multiple surrounding districts with heterogeneous obstetric risk profiles. The source population comprised all mothers who delivered at the hospital between January and December 2025. Cases were mothers who delivered singleton infants weighing <2.500 grams, while controls delivered singleton infants weighing ≥2.500 grams during the same period. All eligible LBW cases were included using total sampling, yielding 135 cases. Controls were selected from the same hospital-based source population using purposive sampling based on the availability of complete medical-record information for all predefined study variables. A total of 135 controls were selected, resulting in a 1:1 case-to-control ratio and 270 participants overall. No individual matching was performed between cases and controls.

Eligible participants had singleton deliveries, infants without documented congenital anomalies, and complete maternal and obstetric records containing all study variables. Records with incomplete information on any predefined variable or severe non-obstetric maternal comorbidities considered capable of independently influencing birth weight were excluded. Selection bias was minimized by including all eligible cases during the predefined study period and selecting controls from the same population source and period using the same eligibility criteria; however, residual selection bias could not be completely excluded because controls were purposively selected based on record completeness.

The 1:1 case-control ratio was used, and because all eligible cases were included, the final case number was determined by the available eligible population. An unmatched case-control sample-size assessment, assuming an expected OR of 3.15, control exposure prevalence of 13.3%, $\alpha = 0.05$, 80% power, and a 1:1 ratio, yielded a minimum of approximately 74 cases and 74 controls; therefore, the final sample of 135 cases and 135 controls exceeded the estimated minimum requirement (Simbolon et al., 2025). Controls were selected from the same source population as the cases and met the predefined eligibility criteria.

Research Variables and Measurements

The primary variables analyzed included maternal age, gestational age, birth spacing, parity, and preeclampsia status. Maternal age was categorized into ≤20 years, and >20 years old. Gestational age was classified as preterm (<37 weeks) or term (≥37 weeks). Birth spacing was grouped into ≤24 months and >24 months. Parity was

categorized as primiparous, or multiparous. Preeclampsia was classified according to the documented clinical diagnosis recorded in the maternal medical record. Because this was a retrospective study based on secondary clinical records, the investigators did not independently re-adjudicate each preeclampsia diagnosis using additional diagnostic measurements or an external diagnostic guideline. Therefore, the study relied on the clinical diagnosis documented in the medical records as the source of exposure classification.

Data were retrospectively extracted from maternal and neonatal medical records using a structured data-abstraction sheet developed according to the predefined operational definitions. The abstraction form included fields for maternal demographic and obstetric characteristics, gestational age, pregnancy spacing, parity, documented preeclampsia, and infant birth weight. Data quality was ensured through a standardized data-abstraction procedure using a structured extraction form based on the predefined operational definitions. Two trained reviewers independently extracted the relevant maternal and neonatal information from the medical records. Any discrepancies identified during data extraction were resolved by rechecking the original medical records and reaching consensus before the analytical dataset was finalized.

Statistical Analysis

Data were processed through coding, cleaning, editing, and verification prior to analysis. Descriptive statistics were used to summarize maternal characteristics. Bivariate analysis using chi-square tests was performed to assess associations between maternal factors and LBW. Variables with p-values <0.25 were included in multivariable logistic regression to identify independent predictors. Odds ratios (ORs) with 95% confidence intervals (CIs) were used to express the degree of relationship and statistical significance was determined using a two-sided p-value <0.05. Standard statistical software was used to conduct statistical analysis.

Before interpretation of the multivariable logistic regression estimates, multicollinearity among the independent variables was assessed using tolerance and variance inflation factor (VIF) statistics. VIF values <5 and tolerance values >0.20 were considered to indicate no substantial multicollinearity among the predictors. This assessment was performed to evaluate whether excessive correlation among the independent variables could adversely affect the stability and interpretability of the regression estimates.

Ethical Considerations

The institutional ethics committee granted ethical permission for this investigation prior to the start of data collection. Every technique adhered to the ethical guidelines for human subject research, which include data security, anonymity, and confidentiality. Because the study used secondary data from medical records without direct patient involvement, informed consent was waived in accordance with institutional guidelines. Data were stored securely and analyzed in aggregated form to ensure respondent privacy. Ethical approval was obtained from the Ethics Committee of Fort De Kock University under approval number 018/KEPK-UFDK/I/2026, dated 28 Januari 2026.

RESULTS

A total of 270 mothers were included in the analysis, comprising 135 LBW cases and 135 controls. Among cases, 97 (71.1%) of mothers were aged ≤20 years, compared

with 75 (55.5%) among controls. Preterm delivery was substantially more common among cases than controls (120 or 88.9% vs. 21 or 15.6%). Birth-spacing distributions were relatively similar between the two groups. Multiparity was more common among cases than controls (108 or 80.0% vs. 90 or 66.7%), whereas primiparity was more common among controls. Documented preeclampsia was substantially more frequent among cases than controls (71 or 52.6% vs. 18 or 13.3%).

Table 1. Maternal Characteristics of Respondents (n = 270)

Variabel	Category	LBW (n=135)		Non LBW (n=135)		Total	
		n	%	n	%	n	%
Maternal Age	≤20 years	97	71.1	75	55.5	171	63.3
	>20 years	39	28.9	60	44.4	99	36.7
Gestational Age	Preterm	120	88.9	21	15.6	141	52.2
	Term	15	11.1	114	84.4	129	47.8
Birth Spacing	≤2 years	88	65.2	80	59.3	168	62.2
	>2 years	47	34.8	55	40.7	102	37.8
Parity	Primipara	27	20.0	45	33.3	72	26.7
	Multipara	108	80.0	90	66.7	198	73.3
Preeclampsia	No	64	47.4	117	86.7	181	67.0
	Yes	71	52.6	18	13.3	89	33.0

Bivariate Analysis

Bivariate analysis showed significant associations between LBW and maternal age, gestational age, parity, and preeclampsia, whereas birth spacing was not significantly associated with LBW. Preterm birth showed the strongest crude association with LBW (OR = 43.43; 95% CI: 21.34–88.37), while preeclampsia was also strongly associated with higher odds of LBW (OR = 7.21; 95% CI: 3.96–13.14). Primiparity was associated with lower odds of LBW compared with multiparity (OR = 0.50; 95% CI: 0.29–0.87).

Table 2. Bivariate Analysis of Maternal Factors and LBW (n = 270)

Variable	Comparison	OR	95% CI	p-value*
Maternal age	≤20 vs. >20 years	**1.97**	1.19–3.26	**0.008**
Gestational age	Preterm vs. term	**43.43**	21.34–88.37	**<0.001**
Birth spacing	≤24 vs. >24 months	**1.29**	0.79–2.11	0.315
Parity	Primiparous vs. Multiparous	**0.50**	0.29–0.87	**0.013**
Preeclampsia	Yes vs. No	**7.21**	3.96–13.14	**<0.001**

*Chi-square tests

Multivariable Logistic Regression Analysis

Variables with $p < 0.25$ in the bivariate analysis—maternal age, gestational age, parity, and pre-eclampsia—were included in the multivariable model. The final logistic regression model demonstrated that gestational age and pre-eclampsia were the only independent predictors of LBW.

Table 3. Multivariable Logistic Regression for Maternal Determinants of LBW

Variable	AOR	95% CI	p-value
Maternal Age	1.62	0.85–3.08	0.140
Gestational Age	35.16	16.92–73.09	<0.001
Parity	1.32	0.69–2.55	0.398
Preeclampsia	4.37	1.94–9.80	<0.001

AOR = adjusted odds ratio; CI = confidence interval

In the final multivariable model, gestational age and preeclampsia remained independently associated with LBW. Preterm birth was associated with substantially higher odds of LBW compared with term birth (AOR = 35.16; 95% CI: 16.92–73.09; $p < 0.001$). Mothers with documented preeclampsia had 4.37-fold higher adjusted odds of LBW compared with mothers without preeclampsia (95% CI: 1.94–9.80; $p < 0.001$).

Multicollinearity Diagnostics

Table 4. Multicollinearity Diagnostics for Candidate Predictors

Candidate predictor	Tolerance	VIF
Maternal age	0.976	1.025
Gestational age	0.836	1.196
Parity	0.980	1.020
Preeclampsia	0.861	1.162

Multicollinearity diagnostics demonstrated no evidence of problematic multicollinearity among the candidate predictors. Tolerance values ranged from 0.836 to 0.980 and VIF values from 1.020 to 1.196, indicating acceptable levels of collinearity among the predictors. Multicollinearity diagnostics demonstrated no evidence of problematic multicollinearity among the candidate predictors. Tolerance values ranged from 0.836 to 0.980 and VIF values from 1.020 to 1.196, indicating acceptable levels of collinearity among the predictors. Therefore, all candidate predictors were considered suitable for inclusion in the subsequent multivariable analysis.

DISCUSSION

This study found that preterm birth and preeclampsia were independently associated with LBW in the referral-hospital population studied. Preterm birth showed the strongest adjusted association with LBW, while preeclampsia was also independently associated with higher odds of LBW. Maternal age and parity showed associations in the bivariate analyses but did not remain independently associated after adjustment, whereas birth spacing was not statistically associated with LBW. These findings indicate that, among the maternal and obstetric factors evaluated in this study, proximal obstetric conditions, particularly gestational duration and preeclampsia were more strongly associated with LBW than the selected background reproductive characteristics. This pattern is broadly consistent with previous facility-based case-control evidence in which preterm birth remained associated with LBW after multivariable adjustment, although the magnitude of association in the present study was considerably larger (Anil et al., 2020).

The strong association between preterm birth and LBW is biologically plausible because gestational duration directly determines the time available for fetal growth, tissue maturation, and accumulation of fat and other energy reserves. Previous health-facility-based case-control research has similarly identified preterm birth as an independent factor associated with LBW, although with a substantially smaller effect estimate than that observed in the present study (Anil et al., 2020). The magnitude of the association in this study should therefore be interpreted cautiously rather than regarded as a universal size effect. One explanation is the close biological relationship between gestational duration and birth weight itself: LBW is defined by a birth weight below 2.500 g irrespective of gestational age, while preterm infants have had less time for intrauterine growth.

In addition, the present study was conducted in a referral-hospital population in which pregnancies with greater clinical complexity may be disproportionately represented. Consequently, the distribution of preterm births and other obstetric complications may differ from that observed in population-based samples. Residual confounding by factors that were not measured in the present study, including maternal nutritional status, anemia, body mass index, chronic disease, and fetal growth restriction, may also have contributed to the magnitude of the observed estimate. Thus, the AOR of 35.16 should be understood as a context-specific adjusted association within the variables and population included in this study, rather than evidence of a universal 35-fold causal effect (Mitrogiannis et al., 2023).

The independent association between documented preeclampsia and LBW is also biologically plausible and consistent with evidence from Indonesia. A recent Indonesian meta-analysis reported a significant association between preeclampsia and LBW, including a pooled OR of 3.15 (95% CI: 1.76–5.64) among case-control studies (Simbolon et al., 2025). Previous studies in Indonesia reported similar associations (Isnaini et al., 2021; Syahda et al., 2024). The relationship can be understood through the central role of placental dysfunction in preeclampsia and fetal growth impairment. Abnormal placentation and inadequate remodeling of the uterine spiral arteries can result in impaired uteroplacental perfusion, placental ischemia, and angiogenic imbalance. These processes may reduce the capacity of the placenta to support adequate oxygen and nutrient transfer to the fetus, thereby contributing to fetal growth restriction and lower birth weight (Brouwers et al., 2024; Burute & Parvin, 2026; Dimitriadis et al., 2023).

Importantly, preeclampsia may be linked to LBW through more than one pathway. Placental insufficiency may directly impair fetal growth, while maternal or fetal compromise associated with severe placental dysfunction may result in medically indicated early delivery and consequently shorter gestational duration. Recent evidence conceptualizes preeclampsia, fetal growth restriction, and preterm birth as partly overlapping manifestations of placental dysfunction rather than completely independent conditions (Burute & Parvin, 2026). Prospective placental-bed evidence further demonstrated substantially more frequent impaired spiral artery remodeling and vascular lesions among pregnancies complicated by preeclampsia and/or fetal growth restriction than among healthy controls (Brouwers et al., 2024).

Maternal age and parity were associated with LBW in the bivariate analyses but did not retain statistical significance in the final multivariable model. This attenuation suggests that their observed crude associations may partly reflect differences in other maternal or obstetric characteristics rather than independent associations within the final model. This interpretation is consistent with Indonesian population-based evidence showing that LBW is influenced by a combination of maternal, reproductive,

socioeconomic, and healthcare-related characteristics rather than by a single maternal characteristic (Ekoriano et al., 2025; Wulandari et al., 2022).

Importantly, the present findings should not be interpreted as demonstrating that maternal age or parity has no relationship with LBW. Rather, these variables did not retain independent statistical associations after adjustment for the other factors included in this study. This finding suggests that their effects may be mediated through more proximal obstetric conditions such as preterm birth and preeclampsia. Younger maternal age has been associated with biological immaturity, nutritional competition, and increased susceptibility to pregnancy complications, while higher parity may reflect cumulative reproductive stress (Anil et al., 2020b).

Birth spacing was not significantly associated with LBW in the present analysis. This finding does not necessarily contradict broader evidence because the exposure in this study was categorized simply as ≤24 versus >24 months. A recent systematic review and dose–response meta-analysis involving 129 studies and more than 46.8 million pregnancies found that the strongest associations with adverse birth outcomes occurred at extreme interpregnancy intervals, particularly intervals shorter than 6 months or 60 months or longer, rather than across a simple dichotomous classification (Ni et al., 2023). Although short interpregnancy intervals (<24 months) are often associated with maternal nutrient depletion and increased risk of adverse pregnancy outcomes, the lack of association here may reflect effective antenatal care practices at the study site, including nutrition counseling and routine monitoring. This aligns with studies indicating that improved maternal care can mitigate the risks associated with suboptimal spacing (Fagundes Pasini et al., 2025; Mamari et al., 2025).

The referral-hospital setting is important when interpreting the magnitude and generalizability of these findings. Referral hospitals do not necessarily represent the underlying population of pregnant women because patients are selectively referred according to clinical needs, complications, and the availability of specialist services. Consequently, the exposure distribution and severity of obstetric conditions in a referral hospital may differ from those observed in population-based studies. Indonesian multicenter research conducted in hospital settings has demonstrated the substantial burden of LBW and its associated neonatal complications across hospital populations (Haksari et al., 2025), while research at Indonesia's national referral hospital has specifically focused on extremely preterm and extremely LBW infants requiring intensive neonatal management (Marsubrin et al., 2025a).

Several potentially important maternal determinants of LBW were not available for inclusion in the present model, including maternal nutritional status, body mass index, anemia, smoking exposure, socioeconomic status, educational attainment, antenatal-care utilization, and chronic maternal disease. These variables may be relevant because contemporary evidence demonstrates associations between maternal nutritional status and adverse birth outcomes, while insufficient gestational weight gain has been associated with higher odds of LBW and preterm birth (Goldstein et al., 2025; Hunter et al., 2023). Similarly, an updated global systematic review found that low maternal hemoglobin was associated with higher odds of LBW, preterm birth, and preeclampsia (Young et al., 2023), and a meta-analysis of 55 cohort studies found that maternal smoking during pregnancy was associated with LBW (Di et al., 2022). These factors may therefore represent residual confounders of the observed associations. Because they were not consistently available in the retrospective medical records used for this study, their potential influence cannot be excluded.

The retrospective medical-record design also limits causal interpretation. Although gestational age and documented preeclampsia have clear biological plausibility in relation to LBW, this study estimates associations within a retrospectively selected case-control population and cannot establish causal effects. In addition, reliance on existing clinical documentation may introduce documentation or information bias if diagnoses or maternal characteristics were incompletely or inconsistently recorded. The purposive selection of records based on data completeness may further introduce selection bias and restrict representativeness. Accordingly, the findings should be interpreted as adjusted associations within the studied referral-hospital population, rather than definitive causal effects applicable to all pregnant women.

Despite these limitations, this study provides important insights into the determinants of LBW within a high-risk referral hospital context. By highlighting the dominant role of gestational age and preeclampsia, the findings contribute to a more context-specific understanding of LBW and support the development of targeted clinical and public health interventions aimed at reducing adverse birth outcomes in similar healthcare settings. From a clinical and public health perspective, these findings underscore the importance of strengthening early detection and management of preterm labor and hypertensive disorders of pregnancy within referral systems. Enhancing antenatal surveillance, improving risk stratification, and ensuring timely referral and intervention may substantially reduce LBW incidence in high-risk populations. In addition, strengthening health system components—such as referral coordination, continuity of care, and early complication management—may further improve maternal and neonatal outcomes (UNICEF, 2024b; WHO, 2022).

The findings have implications for both maternity and pediatric or neonatal nursing practice. In maternity care, the strong associations observed for preterm birth and documented preeclampsia support the importance of systematic antenatal surveillance, early recognition of hypertensive disorders, assessment of preterm-birth risk, and timely escalation or referral when maternal or fetal compromise is suspected. In neonatal and pediatric nursing, identification of pregnancies at high risk for preterm or LBW delivery can facilitate anticipatory preparation for thermal management, respiratory support, feeding difficulties, infection prevention, family education, and continuity of care. Evidence from an Indonesian national referral hospital indicates that structured, checklist-driven management can improve outcomes among extremely preterm and extremely LBW infants, underscoring the importance of standardized multidisciplinary preparation and early neonatal care (Marsubrin et al., 2025).

Referral-hospital maternal care should strengthen early and repeated screening for preeclampsia, systematic surveillance of women at risk of preterm birth, and timely escalation of abnormal maternal or fetal findings. Clear referral criteria, communication between referring and receiving facilities, and continuity of maternal and fetal information should be strengthened. High-risk pregnancies should receive individualized antenatal surveillance, counselling, birth-preparedness planning, and coordinated multidisciplinary care. Maternity nurses should contribute to early recognition and escalation of pre-eclampsia and preterm-birth risk, while pediatric and neonatal nurses should support anticipatory preparation and coordinated care for infants at risk of prematurity or LBW. These recommendations should be evaluated in future prospective and multicentre studies incorporating additional maternal, nutritional, socioeconomic, behavioral, and fetal-growth factors.

CONCLUSION

In this retrospective case-control study, preterm birth and documented preeclampsia were independently associated with higher odds of LBW in a referral-hospital population. Preterm birth showed the strongest adjusted association, while documented preeclampsia was also independently associated with LBW. Maternal age and parity were not independently associated after adjustment, and birth spacing was not statistically associated with LBW. This study contributes context-specific evidence on the relative contribution of selected maternal and obstetric factors to LBW in a high-risk referral-hospital population. Early identification of high-risk pregnancies enables standardized multidisciplinary preparation and early neonatal care to improve outcomes for preterm and LBW infants.

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