


RESEARCH

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Factors Influencing the Incidence of Low Birth Weight: An Analytical Observational Study

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ABSTRACT

Introduction: Low birth weight (LBW) serves as an indicator of neonatal mortality, morbidity, and disability, and it also impacts long-term health outcomes. LBW remains the leading cause of neonatal death in Indonesia. This study aimed to identify factors contributing to LBW incidence at a hospital in Central Jakarta from April to October 2025. **Methods:** This analytical observational study used a case-control design and medical record data. The independent variables included maternal age, nutritional status, blood pressure, and hemoglobin level, while the dependent variable was infant birth weight. A total of 246 participants were selected using consecutive sampling. Data were analyzed using Fisher's Exact test; *p*-values < 0.05 were considered statistically significant. **Results:** A significant association was found between maternal blood pressure and the incidence of LBW [OR: 15.250 (2.650–87.7499), $p = 0.001$]. No significant association was observed for other factors, including maternal age, nutritional status, and hemoglobin level ($p > 0.05$). **Conclusion:** Maternal blood pressure contributes to LBW.

Keywords: Blood pressure, hemoglobin level, low birth weight, nutritional status.

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INTRODUCTION

Low birth weight (LBW) is a major health problem worldwide since it has various adverse effects that affect later life.[1] LBW is an important determinant of mortality, morbidity, and disability in the neonatal, infant, and childhood periods and has a long-term effect on health status in adulthood.[2] LBW is the leading cause of neonatal mortality worldwide, particularly in developing countries.[3] In 2020, there were 19.8 million live births, of which an estimated 14.7% were LBW. The prevalence of LBW in developing countries reached 16.5%, twice as high as in developed countries. Indonesia is a developing country with the third-highest prevalence of LBW in the world (11.1%), after India (27.6%) and South Africa (13.2%).[4] In Southeast Asia, the incidence of LBW is estimated at 12.3%. Meanwhile, in Indonesia, the prevalence of LBW rose from 11.32% in 2019 to 11.37% in 2020 and increased further to 12.27% in 2021. In 2019, LBW was recorded as the leading cause of neonatal mortality in Indonesia, with 7,150 cases, accounting for approximately 35.5% of all neonatal deaths.[5]

Infant birth weight is the first weight recorded after birth, ideally measured within the first few hours after birth, before postnatal weight loss occurs.[6,7] Birth weight is classified as low birth weight (LBW) when < 2,500 g, normal birth weight (NBW) when ≥ 2,500–3,999 g, and high birth weight (HBW) when ≥ 4,000 g.[6,8] According to the World Health Organization (WHO), LBW is defined as a birth weight of less than 2,500 g (up to and including 2,499 g). Low birth weight refers to an absolute weight of < 2,500 g, regardless of gestational age. LBW is further categorized into very low birth weight (VLBW; < 1,500 g) and extremely low birth weight (ELBW; < 1,000 g).[6,7] Infant birth weight based on gestational age is divided into three categories according to the Lubchenco growth curve: small for gestational age (SGA), with a birth weight below the 10th percentile; appropriate for gestational age (AGA), with a birth weight between the 10th and 90th percentiles; and large for gestational age (LGA), with a birth weight above the 90th percentile for the gestational age.[9,10]

The main factors contributing to LBW include preterm birth (before 37 weeks of gestation) and fetal growth restriction. Factors contributing to these two conditions include poor maternal nutritional status, infections during pregnancy, chronic maternal diseases (such as high blood pressure), unhealthy lifestyles (smoking, alcohol consumption), and the mother being too young or too old. These factors contribute to LBW by impairing fetal growth and intrauterine development.[11–13]

A study by Arabzadeh, *et al*., identified several maternal factors associated with an increased risk of LBW, including drug use (such as cocaine), infertility, smoking, periodontal disease, depression, anemia, caffeine consumption, physically demanding work, underweight, alcohol consumption, hypertension, and hypothyroidism. Conversely, antenatal care visits protect against LBW.[11] This study aims to identify the factors contributing to the incidence of LBW during pregnancy at a hospital in Central Jakarta from April to October 2025.

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METHODS

This was an analytical observational study with a retrospective cross-sectional design using medical records. Data were collected at a hospital in Central Jakarta from April 1 to October 27, 2025. The study population was all the mothers who delivered at that hospital between April and October 2025. Inclusion criteria included mothers who gave birth between April and October 2025 and had complete medical records, including age, nutritional status, blood pressure, and hemoglobin levels. The exclusion criteria included mothers with twins and infants with intrauterine fetal death (IUFD).

Data were obtained from medical records. Sampling was conducted using consecutive sampling, which involved collecting medical records of all participants who met the inclusion and exclusion criteria during a specific time period. The total population consisted of 254 individuals; 8 were excluded due to twin births and IUFD, resulting in a total of 246 participants in this study. The research instrument consisted of medical records containing data on maternal age, nutritional status, maternal blood pressure, maternal hemoglobin levels, maternal chronic diseases, and fetal congenital anomalies. The independent variables are maternal age, nutritional status, blood pressure, and hemoglobin level, and the dependent variable is the birth weight of the baby. **Table 1** presents the study's operational definitions.

The data were analyzed using SPSS for univariate and bivariate analyses. Univariate analysis determined the frequency distribution of each variable. Bivariate analysis examined the relationship between independent and dependent variables using the chi-square test. Chi-square test was considered statistically significant at *p*-value ≤ 0.05. Fisher's exact test was applied if the data did not meet the requirements of the chi-square test. Odds ratio was calculated from 2 × 2 contingency tables.

RESULTS

Descriptive analysis showed that of the 246 participants, 211 (85.8%) were aged 18–35 years, 35 (14.2%) were older than 35 years, and none were younger than 18 years. The most common nutritional status was BMI > 25, observed in 124 participants (50.4%). Twenty-nine (11.8%) participants had high blood pressure (≥ 140/90 mmHg), and 71 (28.9%) had low hemoglobin levels (< 11 g/dL) **(Table 2).**

The average age was 30 years, with the youngest participant at 18 years and the oldest at 45 years. Based on BMI measurements, the sample's average BMI was 25.70 kg/m^2, with a minimum of 15.60 kg/m^2 and a maximum of 51.00 kg/m^2. The sample's average blood pressure was 121/79 mmHg, with a maximum of 201/130 mm Hg. The average hemoglobin level was 11.46 g/dL, and the lowest was 8.1 g/dL **(Table 3).**

Table 1. Operational definitions.

No.	Variable	Operational Definitions	Category	Scale
1.	Infant birth weight	A baby's weight immediately after birth.	1: Low birth weight (LBW): < 2,500 gram 2: Normal birth weight (NBW): ≥ 2.500–3.999 gram 3: High birth weight (HBW): ≥ 4,000 gram	Ordinal
2.	Maternal age	Calculated in years as recorded in medical records.	1: < 18 years 2: 18–35 years 3: > 35 years	Ordinal
3.	BMI (kg/m^2)	An anthropometric index derived from the ratio of body weight (kg) and height (m). The weight used is the pre-pregnancy weight.	1: BMI < 18,5 kg/m^2 2: BMI 18,5–25 kg/m^2 3: BMI > 25 kg/m^2	Ordinal
4.	Blood pressure	Systolic blood pressure (SBP) and diastolic blood pressure (DBP) in mmHg. The blood pressure values used are those measured at the beginning of the hospital visit, before any medical intervention.	1: ≥ 140/90 mmHg 2: < 140/90 mmHg	Ordinal
5.	Hemoglobin level	Peripheral blood hemoglobin concentration (g/dL) in antenatal blood tests.	1: ≥ 11 g/dL 2: < 11 g/dL	Ordinal
6.	Chronic medical condition of the mother	Chronic medical conditions of the mother before or during pregnancy that may affect the development of the fetus.	Listing the types of medical conditions identified.	Nominal
7.	Congenital fetal defects	Structural or functional abnormalities in infants that develop during the embryonic period and can affect the infant's growth, organ function, or viability.	Listing the categories of specified abnormalities.	Nominal

Abbreviations: BMI: Body mass index; HIV: Human immunodeficiency virus.





Table 2. Frequency distribution of risk factors for LBW.

Sample Characteristics	Frequency	Percentage (%)
Maternal Age		
< 18 years	0	0
18–35 years	211	85.8
> 35 years	35	14.2
Maternal Nutritional Status		
BMI < 18,5 kg/m^2	5	2
BMI 18,5–25 kg/m^2	117	47.6
BMI > 25 kg/m^2	124	50.4
Maternal Blood Pressure		
≥ 140/90 mmHg	29	11.8
< 140/90 mmHg	217	88.2
Maternal Hemoglobin Levels		
≥ 11 g/dL	175	71.1
< 11 g/dL	71	28.9
Maternal Chronic Diseases		
Type 2 diabetes	4	1.62
β-Thalassemia minor	11	4.47
Hyperthyroidism	2	0.81
Asthma	4	1.62
HIV	1	0.41
Epilepsy	2	0.81
Uterine myoma	10	4.06
Tuberculosis colli	1	0.41
Sinus node dysfunction	1	0.41
Congenital Fetal Defects		
Esophageal atresia	1	0.41

Abbreviations: BMI: Body mass index; HIV: Human immunodeficiency virus.

The results showed that maternal blood pressure was a significant risk factor for LBW infants [OR: 15.250 (2.650–87.7499), p = 0.001], whereas nutritional status, maternal age, and maternal hemoglobin levels were not significantly associated (p > 0.05). In this study, 6 mothers with BP ≥ 140/90 mmHg had LBW infants. The risk of LBW was 15.250 times higher in mothers with blood pressure ≥ 140/90 mmHg compared to mothers with blood pressure < 140/90 mmHg **(Table 4).**

DISCUSSION

Maternal age can affect pregnancy outcomes. High maternal age is defined as < 20 years or > 35 years. Biological immaturity of young age (< 20 years) at pregnancy has been associated with increased risk of LBW, preterm birth, and perinatal mortality. Advanced maternal age (≥ 35 years) is associated with a higher risk of obstetric complications such as preeclampsia, gestational diabetes, fetal chromosomal abnormalities (such as Down syndrome), cesarean delivery, and intrauterine fetal death. The risk increases more sharply in the 40-year age group and above.[14] The results of this study showed no significant association between maternal age and the incidence of low birth weight (p-value = 0.065). These results are consistent with other studies that showed no significant association between maternal age and the incidence of LBW (p-value = 0.31).[4] Another study found a significant association between age and the occurrence of LBW (p-value < 0.001), especially in mothers aged < 20 years or > 35 years.[15] The difference in the results may be due to the previous study[4] only studying some maternal factors. At the same time, the incidence of LBW is affected by various factors, such as fetal, placental, and environmental factors.[4] Besides, other external factors, including occupational activities and economic status, as well as internal factors such as age, interval between pregnancies, parity, antenatal care, nutritional status, medical history, and pregnancy complications, also contribute to the occurrence of LBW.[4]

Nutritional status before and during pregnancy plays a crucial role in obstetric and perinatal outcomes. A study by Monnet, *et al*., showed that in women with a body mass index (BMI) < 18.5 kg/m^2, insufficient pregnancy weight gain (< 12.5 kg) is associated with an increased risk of LBW, anemia, premature rupture of membranes (PROM), and intrauterine growth restriction (IUGR), as well as a shorter gestational age at delivery; therefore, monitoring nutrition and weight gain during pregnancy is crucial for preventing obstetric complications.[16] Meanwhile, a study by Zhang, *et al*., showed that pre-pregnancy obesity (BMI ≥ 30 kg/m^2) is associated with an increased risk of complications such as gestational diabetes mellitus, gestational hypertension, preeclampsia, cesarean section, labor induction, and postpartum hemorrhage.[17] Both studies indicate that maternal undernutrition and overnutrition significantly affect the health of the mother and fetus. This study found no significant association between nutritional status, as measured by BMI and the incidence of LBW (p = 0.222; p > 0.05). These findings are consistent with previous research indicating no significant association between nutritional status based on BMI and the incidence of LBW (p = 0.265).[3] The differences in these results may be due to confounding factors such as weight gain during pregnancy, socioeconomic status, and differences in population characteristics.[18]




Table 3. Distribution of sample data based on risk factors for LBW.

Variable	Mean	±SD	Median	Min-Max
Maternal Age	30.37	4.42	30.00	18–45
Maternal Nutritional Status (BMI)	25.70	5.16	25.20	15.60–51.00
Maternal Blood Pressure				
Systolic	121.14	16.36	118.00	93–201
Diastolic	79.61	11.50	78.00	56–130
Maternal Hemoglobin Levels	11.46	1.22	11.50	8.1–14.90

Abbreviations: BMI: Body mass index; SD: Standard deviation.

Hypertensive disorders of pregnancy (HDP) is a group of conditions that includes chronic hypertension, gestational hypertension, preeclampsia/eclampsia, and preeclampsia occurring in women with chronic hypertension. A diagnosis is established when blood pressure is ≥ 140/90 mmHg on two separate measurements taken at least four hours apart; in preeclampsia, this is accompanied by proteinuria ≥ 300 mg/24 hours or signs of organ dysfunction such as elevated creatinine, thrombocytopenia, liver dysfunction, pulmonary edema, or neurological symptoms. In contrast, seizures in the presence of these conditions characterize eclampsia.[19,20] Pathophysiologically, HDP results from a failure of spiral artery remodeling, which reduces uteroplacental perfusion and leads to an imbalance in angiogenic factors, specifically, an increase in antiangiogenic factors (sFlt-1, soluble endoglin) and a decrease in proangiogenic factors (PlGF, VEGF), resulting in systemic endothelial dysfunction, vasoconstriction, and glomerular damage.[19,20] This condition can manifest as an earlier and more severe form of "placental preeclampsia" due to placental ischemia, or as a later-onset "maternal preeclampsia" dominated by maternal vascular dysfunction.[19,20] This study found a significant association between maternal blood pressure and the incidence of LBW (p = 0.001; $p < 0.05$). These results are consistent with previous studies showing a significant association between hypertension and the incidence of LBW, $p < 0.001$ ($p < 0.05$).[21]

Meta-analysis by Getaneh, *et al.*, showed that mothers with pregnancy-induced hypertension (PIH) are 3.89 times more likely to give birth to a LBW infant.[22] This is because of incomplete trophoblast invasion into the spiral arteries that supply blood to the placenta in PIH. This suboptimal invasion process reduces in uteroplacental blood flow and, therefore, the supply of oxygen

Table 4. Analysis of factors affecting LBW on infant birth weight.

Variable	Category								Odds Ratio (95% CI)	*p*
	LBW		NBW		HBW		Total			
	f	%	f	%	f	%	f	%		
Maternal Age										
< 18 years	0	0	0	0	0	0	0	0	0.687 (0.077–6.121)	0.065
18–35 years	5	2	182	74	24	9.8	211	85.8		
> 35 years	1	0.4	25	10.2	9	3.7	35	14.2		
Total	**6**	**2.4**	**207**	**84.1**	**33**	13.4	246	100		
Maternal Nutritional Status										
BMI < 18,5 kg/m^2	0	0	5	2	0	0	5	2	0.187 (0.021–1.628)	0.222
BMI 18,5–25 kg/m^2	5	2	100	40.7	12	4.9	117	47.6		
BMI > 25 kg/m^2	1	0.4	102	41.5	21	8.5	124	50.4		
Total	**6**	2.4	207	84.1	33	13.4	246	100		
Maternal Blood Pressure										
≥ 140/90 mmHg	4	1.6	24	9.8	1	0.4	29	11.8	15.250 (2.650–87.749)	0.001*
< 140/90 mmHg	2	0.8	183	74.4	32	13	217	88.2		
Total	**6**	**2.4**	**207**	**84.1**	**33**	**13.4**	**246**	100		
Maternal Hemoglobin Levels										
≥ 11 g/dL	3	1.2	148	60.2	24	9.8	175	71.1	0.399 (0.078–2.032)	0.496
< 11 g/dL	3	1.2	59	24	9	3.7	71	28.9		
Total	**6**	**2.4**	**207**	**84.1**	**33**	**13.4**	**246**	100		

Abbreviations: LBW: Low birth weight; NBW: Normal birth weight; HBW: High birth weight; f: frequency; BMI: Body mass index; *statistically significant.




and nutrients to the fetus. This leads to intrauterine growth restriction (IUGR), small-for-gestational-age (SGA) infants, and preterm birth, with LBW as the result.[22]

Anemia in pregnancy (AIP) is a substantial global health problem.[23] Iron deficiency is the leading cause, affecting more than 50% of pregnant women worldwide. WHO defined AIP,[23] as Hb < 11 g/dL in the first trimester or < 10.5 g/dL in the second trimester and classified it as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), or severe (< 7.0 g/dL). The prevalence is especially high in low-income countries with limited access to healthcare services. Knowledge, awareness, socioeconomic status, treatment adherence, and dietary habits are the main determinants.[23] This study showed no statistically significant association between maternal hemoglobin levels and the incidence of LBW (p-value = 0.496). However, the prevalence of anemia during pregnancy (Hb < 11 g/dL) in this study was quite high at 28.9%. Other studies have shown that anemic mothers have a higher risk of their infants being LBW ($p = 0.001 < 0.05$).[24] The management of anemia in the study hospital has become more comprehensive, including ferritin testing in the first trimester of pregnancy, and if the ferritin level is < 35 µg/dL, iron sucrose infusions are administered during prenatal check-ups. This has resulted in improved outcomes, including a decrease in the incidence of anemia during pregnancy and a reduction in the incidence of LBW associated with anemia during pregnancy. Internal data show that the incidence of LBW among mothers with iron deficiency anemia has reduced from 35% in 2021 to 1.2% of the total 28.9% of anemic mothers during April–October 2025.

Limitation

This study did not assess several potential LBW risk factors mentioned in the introduction, such as maternal infections and unhealthy lifestyle behaviors (smoking and alcohol consumption), which may have contributed to residual confounding.

CONCLUSION

This study shows that blood pressure contributes to the incidence of LBW. Other factors, including maternal age, maternal hemoglobin levels, and maternal nutritional status, were not significantly associated with the occurrence of low birth weight (LBW). Maintaining stable blood pressure during pregnancy and preventing the onset of pregnancy-induced hypertension often presents its own challenges. Early detection and improved prenatal care for high-risk women, including education on healthy living such as a good diet, exercise, and adequate rest, may reduce the incidence of LBW.

DECLARATIONS

Ethics Statement

Ethical approval was not required for this study because it involved the secondary analysis of publicly available, fully anonymized data. No identifiable personal information was accessed, and no direct contact with human participants occurred. The study was conducted in accordance with applicable ethical principles.

Consent for Publication

Not applicable. This study used publicly available, fully anonymized data and did not involve direct interaction with human participants or access to personally identifiable information.

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Author Contribution

BS: Data curation, data analysis, article writing. TUI: Study conception, data gathering, article writing. All authors reviewed and approved the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

Declaration on the Use of Artificial Intelligence (AI)

Generative AI (ChatGPT by OpenAI) and Grammarly were used to assist with English translation, grammar correction, and sentence refinement; they were not used to generate study data. All authors reviewed and approved the final manuscript and accept full responsibility for its content.

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