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Research Article

# THE ASSOCIATION BETWEEN MATERNAL FACTORS AND THE INCIDENCE OF LOW BIRTH WEIGHT IN WEST SUMATRA PROVINCE: AN ANALYSIS OF THE 2024 INDONESIAN NUTRITIONAL STATUS SURVEY DATA

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**ABSTRACT**

**Background:**
Low Birth Weight is a major cause of infant mortality and serves as a key indicator for assessing a country's health status. This study aims to analyze the relationship between maternal factors and the incidence of Low Birth Weight in West Sumatra through an analysis of the 2024 Indonesian Nutritional Status Survey data.
**Methods:** The study was conducted from August 2025 to March 2026 using a cross-sectional study design. A total sampling method was applied, resulting in a sample size of 5,834 infants. The analysis included univariate, bivariate, and multivariate analysis.
**Results:** The prevalence of LBW in West Sumatra was 7.2%. Bivariate analysis revealed that hypertension (p=0.0001), intrauterine growth restriction (p=0.0001), and preeclampsia (p=0.0001) were significantly associated with LBW. In contrast, anemia, parity, excessive gestational weight gain, and ANC visits did not show significant relationships. Multivariate analysis identified intrauterine growth restriction as the most dominant risk factor (AOR=18.616), followed by preeclampsia (AOR=3.164) and hypertension (AOR=2.477).
**Conclusion:** Intrauterine growth restriction, preeclampsia, and hypertension are the primary determinants of LBW incidence in West Sumatra. Strengthening the quality of medical risk screening and intensive fetal growth monitoring within antenatal care (ANC) services is urgently required as a preventive measure.

**Keywords**: *Low Birth Weight, Maternal Factors, SSGI 2024, West Sumatra*

## INTRODUCTION

Low Birth Weight is a condition where a baby is born with a body weight of less than 2,500 grams, which is measured immediately after the baby is born without considering the gestational age. A baby's weight at birth is determined by the nutritional intake obtained by the pregnant mother and is an indicator of growth and development from childhood to adulthood. (1)

UNICEF/WHO data shows the global prevalence was 14.6% in 2016 and increased to 14.7% in 2020, with the highest figure in lower middle income countries. (1,2) Riskesdas 2018 and SKI 2023 data recorded a prevalence of 6.2%, while SSGI 2021–2022 was 6.6% and 6.5% in 2024. (3–7)

At the provincial level, West Sumatra shows an alarming increasing trend, from 4.6% (Riskesdas 2018) to 6.4% (SSGI 2024), placing it as one of the provinces with the highest prevalence in Sumatra.(3–7) This condition is in line with the high level of under-five nutrition problems such as underweight, stunting and wasting, both nationally and in West Sumatra, which are partly rooted in the history of LBW. (4,7,8) Apart from having an impact on growth and development, child development, LBW also contributes to neonatal mortality, with an increase in the number of neonatal deaths in recent years and LBW as one of the main causes. (9,10)

Conceptually, the incidence of LBW is related to the interaction of maternal, placental and fetal factors that influence the supply of oxygen and nutrients during pregnancy, as explained in Brodsky & Christou's theory of intrauterine growth restriction (IUGR). (11)

This study uses representative 2024 SSGI data at the provincial level for toddlers aged 0–32 months. In West Sumatra, the high number of nutritional problems and LBW emphasizes the importance of analysis that aims to determine the relationship between maternal factors and the incidence of LBW as a basis for formulating more targeted policies and interventions. (6.18).

## MATERIAL AND METHODS

This research is a quantitative study using a cross sectional study design. The population in this study were all toddlers who were recorded during the 2024 Indonesian Nutrition Status Survey data collection period in West Sumatra Province. From the total population, 5,834 samples were taken using the total sampling technique and adjusted to the inclusion and exclusion criteria for this study.

The inclusion criteria for this study were toddlers whose birth weight was recorded in the survey and came from West Sumatra, while the exclusion criteria for this study were toddlers who were born before the ANC K6 policy was established and toddlers with incomplete data on the variables studied. The research instrument used was secondary data from the 2024 Indonesian Nutrition Status Survey (SSGI) as the data source. Data analysis was conducted using bivariate analysis with the chi-square test. Data analysis was conducted using univariate, bivariate analysis (chi square test) and multivariate analysis (logistic regression test).

## RESULTS

**Table 1. Descriptive analysis of Low Birth Weight cases**

| Variabel | f | % |
|---|---|---|
| Kejadian BBLR | | |
| Ya | 17.622 | 7,2 |
| Tidak | 226.362 | 93 |
| Total | 243.984 | 100 |

Table 1. explains that out of a total of 243,984 toddlers in West Sumatra, there were still 17,622 (7.2%) toddlers who experienced LBW

| Variable | f | % | f BBLR | % |
|---|---|---|---|---|
| **Hypertension** | | | | |
| Yes | 18.698 | 7,7 | 3.248,47 | 17,37 |
| No | 225.285 | 92 | 14.373,51 | 6,38 |
| **Anemia** | | | | |
| Yes | 35.789 | 15 | 2.935,75 | 8,2 |
| No | 208.195 | 85 | 14.686,22 | 7,05 |
| **Intrauterine growth restriction** | | | | |
| Yes | 1.396 | 0,6 | 818,84 | 58,64 |
| No | 242.587 | 99 | 16.803,13 | 6,93 |
| **Preeclampsia** | | | | |
| Yes | 5.332 | 2,2 | 1.415,71 | 26,55 |
| No | 238.651 | 98 | 16.206,26 | 6,79 |
| **Excessive weight gain during pregnancy** | | | | |
| Yes | 4.417 | 1,8 | 561,95 | 12,72 |
| No | 239.566 | 98 | 17.060 | 7,12 |
| **Parity** | | | | |
| Risky | 77.195 | 32 | 6.650,22 | 8,61 |
| Not risky | 166.788 | 68 | 10.971,75 | 6,58 |
| **ANC visits** | | | | |
| Incomplete | 162.079 | 66 | 11.620,84 | 7,17 |
| Complete | 81.905 | 34 | 6.001,13 | 7,33 |
| **Total** | **243.984** | **100** | **17.622** | **7,2** |

Table 2 explains that although the majority of pregnant women in West Sumatra Province do not have risk factors during pregnancy, the incidence of LBW is still a public health problem. Based on the results of univariate analysis, it was explained that the proportion of LBW incidents was higher in the group of mothers who had a history of risk factors such as hypertension, anemia, stunted fetal growth, preeclampsia, excessive weight gain during pregnancy, and parity. Meanwhile, for ANC visits, the proportion of LBW was almost the same between mothers who had a complete ANC visit history and mothers who had an incomplete ANC visit history.

**Table 3. Association between maternal factors and low birth weight**

| Variables | LBW | | | | Total | | POR (95% CI) | *p-value* |
|---|---|---|---|---|---|---|---|---|
| | Yes | | No | | | | | |
| | f | % | f | % | f | % | | |
| **Hypertension** | | | | | | | | |
| Yes | 3.248,47 | 17,37 | 15.449,83 | 82,63 | 18.698 | 100 | 3,085 | 0,0001 |
| No | 14.373,51 | 6,38 | 210.911,74 | 93,62 | 225.285 | 100 | (2,009-4,738) | |
| **Anemia** | | | | | | | | |
| Yes | 2.935,75 | 8,2 | 32.853,21 | 91,8 | 35.789 | 100 | 1,177 | 0,4673 |
| No | 14.686,22 | 7,05 | 193.508,35 | 92,95 | 208.195 | 100 | (0,757- 1,83) | |
| **Intrauterine growth restriction** | | | | | | | | |
| Yes | 818,84 | 58,64 | 577,54 | 41,36 | 1.396 | 100 | 19,051 | 0,0001 |
| No | 16.803,13 | 6,93 | 225.784 | 93,07 | 242.587 | 100 | (6,952-52,206) | |
| **Preeclampsia** | | | | | | | | |
| Yes | 1.415,71 | 26,55 | 3.916,54 | 73,45 | 5.332 | 100 | 4,961 | 0,0001 |
| No | 16.206,26 | 6,79 | 222.445 | 93,21 | 238.651 | 100 | (2,635-9,342) | |
| **Excessive weight gain during pregnancy** | | | | | | | | |
| Yes | 561,95 | 12,72 | 3.855,26 | 87,28 | 4.417 | 100 | 1,901 | 0,1918 |
| No | 17.060 | 7,12 | 222.506,3 | 92,88 | 239.566 | 100 | (0,713-5,072) | |
| **Parity** | | | | | | | | |
| Risky | 6.650,22 | 8,61 | 70.544,96 | 91,39 | 77.195 | 100 | 1,339 | 0,0635 |
| Not risky | 10.971,75 | 6,58 | 155.816,6 | 93,42 | 166.788 | 100 | (0,983-1,824) | |
| **ANC visits** | | | | | | | | |
| Incomplete | 11.620,84 | 7,17 | 150.458 | 92,83 | 162.079 | 100 | 0,977 | 0,8806 |
| Complete | 6.001,13 | 7,33 | 75.903,48 | 92,67 | 81.905 | 100 | (0,72-1,326) | |

Based on the results of the analysis in Table 3, there are three maternal factors that have a significant relationship with the incidence of LBW in West Sumatra Province (p-value = 0.0001), namely a history of hypertension, Fetal Growth Restriction (FGR), and preeclampsia. Mothers with a history of hypertension during pregnancy have a 3 times greater risk of giving birth to a LBW baby (OR = 3.085; CI 95% = 2.009–

4.738). In addition, mothers with IUGR also showed the most extreme risk level, which was 19 times higher than mothers without a history of IUGR (OR = 19.051; CI 95% = 6.952–52.206). Furthermore, mothers who experienced preeclampsia during pregnancy also had a 4.9 times higher risk of giving birth to low birth weight babies (OR = 4.961; 95% CI = 2.635–9.342).

On the other hand, although the proportion of LBW cases descriptively appeared to be higher in the group of mothers with a history of anemia, excessive weight gain, and risky parity, the statistical test results showed that these three factors were not significantly associated with LBW cases (p-values of 0.4673, 0.1918, and 0.0635, respectively). A similar condition was also found in the ANC visit variable, where the proportion of LBW cases was found to be almost balanced between mothers with complete and incomplete visits, thus statistically showing no significant relationship (p-value = 0.8806).

**Table 4. Full model of multivariate analysis**

| Variable | *p-value* | AOR | CI 95% | |
|---|---|---|---|---|
| | | | *Lower* | *Upper* |
| Preeclampsia | 0,0003 | 3,060 | 1,678 | 5,578 |
| Hypertension | 0,00001 | 2,477 | 1,611 | 3,809 |
| Intrauterine growth restriction | 0,00001 | 18,471 | 6,393 | 53,370 |
| Parity | 0,0623 | 1,338 | 0,985 | 1,817 |
| Excessive weight gain during pregnancy | 0,7766 | 1,141 | 0,458 | 2,844 |

The statistical test results in Table 4. The initial Full Model shows the complete model for the first multivariate analysis. Variables with p-values > 0.05 were removed one by one, starting with the largest. Excessive weight gain during pregnancy was the first variable to be removed, leaving the variables of preeclampsia, hypertension, fetal growth restriction, and parity.

**Table 5. The second model of multivariate analysis**

| Variables | *p-value* | AOR | CI 95% | |
|---|---|---|---|---|
| | | | *Lower* | *Upper* |
| Preeclampsia | 0,0003 | 3,089 | 1,680 | 5,681 |
| Hypertension | 0,00001 | 2,505 | 1,631 | 3,848 |
| Intrauterine growth restriction | 0,00001 | 18,414 | 6,351 | 53,388 |
| Parity | 0,0653 | 1,334 | 0,982 | 1,812 |

The statistical test results in Table 5 show that in the second stage of multivariate analysis, after removing the variable of weight gain during pregnancy, the variables of preeclampsia (p-value 0.0003), hypertension (p-value 0.00001), and fetal growth restriction (p-value 0.00001) remained significantly associated with LBW, while the parity variable showed a non-significant statistical test result (p-value 0.0653).

**Table 6. The third model of multivariate analysis**

| Variabel | *p-value* | AOR | CI 95% | |
|---|---|---|---|---|
| | | | *Lower* | *Upper* |
| Preeclampsia | 0,0003 | 3,164 | 1,709 | 5,855 |
| Hypertension | 0,00001 | 2,477 | 1,612 | 3,806 |
| Intrauterine growth restriction | 0,00001 | 18,616 | 6,162 | 56,237 |

Based on Table 6, preeclampsia has a significant effect on the incidence of LBW (p-value = 0.0003). Based on these analysis results, it can be seen that mothers with a history of preeclampsia are approximately three times more likely to give birth to a

baby with LBW compared to mothers who do not have a history of preeclampsia (OR = 3.164).

The results of the analysis also show that hypertension has a significant effect on LBW (p-value = 0.00001). Mothers with a history of hypertension during pregnancy are approximately 2.5 times more likely to give birth to a baby with LBW than mothers without hypertension during pregnancy (OR = 2.477).

In addition to preeclampsia and hypertension, the final model table also shows that fetal growth restriction significantly affects the incidence of LBW (p-value = 0.00001). Based on the analysis results, mothers diagnosed with intrauterine growth restriction during pregnancy are approximately 18.6 times more likely to give birth to a baby with LBW compared to mothers who were not diagnosed with intrauterine growth restriction during pregnancy (OR = 18.616), meaning that the IUGR variable is the most dominant variable affecting the occurrence of LBW

## DISCUSSION

The main findings of this study indicate that the incidence of Low Birth Weight (LBW) in West Sumatra Province is largely determined by clinical pathophysiological disorders during pregnancy, with Intrauterine Growth Restriction (IUGR) as the most dominant determinant, followed by preeclampsia and maternal hypertension. These results confirm that proximal medical factors that disrupt placental function have a much stronger influence than maternal behavioral factors or macroscopic nutritional status, such as weight gain and parity, which did not show a significant relationship in this population.

IUGR emerged as the strongest risk factor with an adjusted odds ratio (AOR) of 18.6, meaning that mothers with IUGR have a nearly 19-fold greater chance of delivering a LBW infant. Scientifically, IUGR represents the failure of the fetus to achieve optimal growth potential due to multifactorial disruptions in oxygen and nutrient supply. (11,12) This is consistent with the study by Shreyas Arya et al., which identified intrauterine growth restriction as the primary determinant of birth weight. This relationship is proximal; This means that direct disruption of fetal development in utero is more important in determining the final birth weight outcome than more distal maternal factors. (13)

In line with IUGR, preeclampsia and hypertension have also been shown to significantly increase the risk of low birth weight by 3.16 and 2.48 times, respectively. The underlying biological mechanisms are endothelial dysfunction and narrowing of the spiral blood vessels supplying the placenta, leading to chronic fetal hypoxia. These findings reinforce global epidemiological evidence, such as studies by Liu et al. and Li et al., which consistently place maternal vascular disorders as important determinants of low birth weight. The significance of these results suggests that in West Sumatra, low birth weight is not simply a matter of nutritional intake, but rather a matter of the integrity of vascular and placental function during pregnancy. (14,15)

Contrary to previous literature, the variables anemia, excessive weight gain, parity, and antenatal care visits did not show a statistically significant association in this study. In the case of anemia, the insignificant association is likely due to the similar proportion distribution between the LBW and non-LBW groups in the sample, as well

as the possibility that routine iron supplementation interventions may modify the impact of anemia on the fetus. This contrasts with the findings of Habib et al., who found a significant association, but this difference may be explained by variations in the definitions of anemia severity used. (16)

Regarding weight gain and parity, these results suggest that pathological mechanisms of pregnancy (such as IUGR and preeclampsia) significantly influence birth outcomes compared to the mother's overall physical status. Although a Japanese study by Uchinuma demonstrated a crucial role in weight gain, and a study by Girotra et al. showed that primiparous women were more likely to deliver low birth weight infants in this population, vascular disorders appear to mask the effects of macroscopic nutrition and the number of births. (17,18) Similarly, with regard to antenatal care visits, although a study by Chakreyavanich et al. reported that mothers who attended fewer than five antenatal care visits had a higher risk of giving birth to low birth weight babies compared to mothers with adequate antenatal care visits. However, the results of this study indicate that the frequency of visits alone is not sufficient to prevent low birth weight babies if it is not accompanied by improvements in the quality of clinical screening, such as early detection of hypertension and fetal growth monitoring via ultrasound. (19)

This study provides a scientific basis for LBW prevention strategies in West Sumatra to shift from simply monitoring maternal weight to strengthening a more comprehensive medical risk screening system. However, interpretation of these results must take into account the limitations of using secondary SSGI data, where clinical variables such as Hb levels and weight are only available as categorical data without detailed numerical values.

## CONCLUSION

This study concludes that the incidence of low birth weight (LBW) in West Sumatra Province is strongly influenced by pathophysiological maternal clinical factors, with fetal growth restriction (IUGR) as the most dominant determinant, followed by preeclampsia and hypertension. These findings advance the field of maternal and child health by providing a scientific basis for shifting interventions from routine monitoring to comprehensive management of high-risk pregnancies. The primary application of these findings is the need to strengthen early detection through standardized blood pressure screening and increase access to ultrasound examinations for accurate fetal growth monitoring at the primary care level. Policy expansion should also include improving the competence of health workers in handling high-risk cases and optimizing the rapid referral system.

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