

Impact of Pregnancy Anemia and Low Birth Weight on Toddler Stunting

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ABSTRACT

Stunting is a long-term nutritional disorder among children under five that negatively affects physical growth, cognitive performance, and overall human resource quality in later life. Maternal health during pregnancy plays a critical role in the occurrence of stunting, with maternal anemia and low birth weight (LBW) identified as major contributing factors. This study aimed to examine the association between maternal anemia during pregnancy and LBW with stunting among children aged under five in the working area of Metro City. This study employed an observational-analytical design with a cross-sectional approach. The subjects consisted of mothers and children aged 24–59 months who met the specified inclusion criteria. A total of 60 respondents were selected using total sampling and purposive sampling techniques. Data were analysed using univariate and bivariate analyses, with the chi-square test to assess the relationships between variables. The findings demonstrated a statistically significant association between a history of maternal anemia during pregnancy and stunting ($p = 0.012$). Likewise, LBW was significantly associated with stunting ($p = 0.004$). Children born with LBW and those whose mothers experienced anemia during pregnancy were found to have a higher likelihood of developing stunting compared to children without such risk factors. In summary, maternal anemia during pregnancy and LBW are significantly associated with stunting among children under five. Therefore, stunting prevention strategies should prioritize strengthening antenatal care services, enhancing early detection and management of maternal anemia, and implementing adequate nutritional interventions for pregnant women to reduce the risk of LBW and subsequent stunting.



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INTRODUCTION

A child's height below the norm for their age, as determined by the height-for-age (H/A) index, is the defining characteristic of stunting, a chronic nutritional issue. This disorder not only causes growth failure but also has lasting effects such as impaired cognitive development, weaker immune responses, higher susceptibility to chronic degenerative illnesses later in life, and decreased human resource quality. Stunting is recognized by the World Health Organization (WHO) as one of the most pressing public health issues worldwide, especially in poor countries. According to WHO data, the prevalence of stunting in children under five worldwide increased from 22.3% in 2022 to 22.9% in 2023 and 23.2% in 2024, suggesting that approximately one-quarter of children under five experienced stunting (World Health Organization, 2025).

The national prevalence has remained above the WHO-recommended limit according to the Indonesian Nutrition Status Survey. According to data, 24.4% of children were stunted in 2021, decreased to 21.6% in 2022, then decreased slightly to 21.5% in 2023, and then decreased to 19.8% in 2024 (Ministry of Health Republic Indonesia, 2025). Despite this progress, Lampung Province still has high rates of stunting, necessitating stronger preventative and promotional actions. At the primary healthcare level, including the working area of Banjar Sari Public Health Centre, North Metro, stunting remains a top public health priority requiring comprehensive prevention efforts from the prenatal period through early childhood (Ministry of Health Republic Indonesia, 2024).

According to the Indonesian Health Survey (SKI) in 2023, the national prevalence of anemia among pregnant women was 27.7%. According to data from the Lampung Provincial Health Office (2023) and the Metro City Health Profile (2023), maternal anemia rates in Metro City and Lampung Province were about the same at 6.46% and 6.47%, respectively, in the same year. These numbers suggest that anemia remains a major dietary concern for pregnant women.

Stunting has a variety of causes, including inadequate nutrition during pregnancy, repeated illnesses, environmental sanitation issues, and poor maternal health. Low birth weight (LBW) and anemia during pregnancy are two of the most significant maternal risk factors. The blood's ability to deliver oxygen to the placenta and the foetus is diminished by maternal anemia, resulting in stunted foetal growth and development. As a result, infants born with LBW are more likely to have this illness. Because impacted babies begin life with low nutritional reserves and decreased adaptive capacity, making it challenging for them to catch up on growth without early and optimal interventions, LBW is identified as a key predictor of stunting (Abdullah & Kerti, 2024).

Iron deficiency caused by insufficient food intake, poor adherence to iron supplementation, and infections during pregnancy is still the main cause of anemia during pregnancy, which is one of the most common nutritional illnesses. In addition to higher maternal morbidity and obstetric complications, the negative consequences also include stunted fetal growth. Prior research has revealed that mothers with moderate to severe anemia have a much greater risk of giving birth to LBW babies, which increases the child's risk of stunting in early life (Achadi, 2021). A child's low birth weight is a key marker of the mother's and the infant's health. Compared to newborns who weigh 2,500 grams or more, infants born with a lower birth weight are more prone to stunted growth, delayed motor and cognitive development, and repeated sickness. These babies are more likely to experience stunting during the toddler years if they lack sufficient dietary help and regular growth monitoring (Rahman et al., 2023).

Data at the local level remain scarce, despite prior studies demonstrating links between maternal anemia, low birth weight, and stunted growth. This data is critical for developing context-tailored interventions. Instances of maternal anemia and low birth weight continue to be seen among pregnant women and newborns in the operational zone of the Banjar Sari Public Health Centre, North Metro. However, there is no organized documentation of the connection between these factors and the prevalence of stunting in children under the age of five. This gap hinders the creation of focused prevention and control measures that meet the community's real needs. This research aims to investigate the link between a prior history of maternal anemia during pregnancy, LBW, and stunting among children under the age of five in the working area of the Banjar Sari Public Health Centre, North Metro. It is anticipated that the data will provide evidence to support improvements in antenatal care, child growth monitoring initiatives, and integrated nutritional interventions at the primary healthcare level (Abdulkadir, 2024).

METHOD

This study using a cross-sectional methodology, an observational analytic design. The study sought to determine the link between a history of maternal anemia during pregnancy, the incidence of low birth weight (LBW), and stunting in children under the age of five. At a single moment in time, the independent and dependent variables were evaluated concurrently. The research population consisted of 60 moms with children aged 24–59 months who lived in the working area of the Banjar Sari Public Health Centre, North Metro, and who satisfied the predefined inclusion and exclusion criteria. Participants were chosen at random using a stratified method. On 10 March, 2025, the Research Ethics Committee of Poltekkes Tanjung Karang formally gave ethical permission for this study under approval number 038/KEPK-TJK/III/2025.

RESULTS

Based on Table 1, among the 60 respondents, 43.3% of mothers had a history of anemia during pregnancy, while 56.7% did not experience anemia during pregnancy; 30.0% of mothers had infants with a history of low birth weight, whereas 70.0% did not have a history of LBW.

Table 1. Proportion of maternal anemia history and Low Birth Weight (LBW) with stunted toddlers

| Variable | Category | n | % |
|---|---------------------------|----|------|
| History of maternal Anemia during pregnancy | Anemia (Hb < 11 g/dL) | 26 | 43.3 |
| | Non-anemia (Hb ≥ 11 g/dL) | 34 | 56.7 |
| Low Birth Weight (LBW) | LBW (< 2,500 grams) | 18 | 30.0 |
| | Non-LBW (≥ 2,500 grams) | 42 | 70.0 |

Based on Table 2, 43.3% of the 60 mothers surveyed had a history of anemia during pregnancy. The chi-square test showed a significant association between a history of anemia during pregnancy and the incidence of stunting ($p=0.012$), with an OR of 2.41 (95%CI: 1.231–10.350), indicating that toddlers born to mothers who experienced anemia during pregnancy were 2.41 times more likely to experience stunting than children born to mothers who did not experience anemia.

Table 2. The relationship between a history of anemia during pregnancy and the incidence of stunting in toddlers

| History of Anemia | Stunted | | Not Stunted | | Total | | p-value | OR (95% CI) |
|----------------------|---------|------|-------------|------|-------|------|---------|---------------------|
| | n | % | n | % | n | % | | |
| History of Anemia | 15 | 57.5 | 11 | 42.3 | 26 | 43.3 | 0.012 | 2.41 (1.231–10.350) |
| No History of Anemia | 7 | 20.6 | 27 | 79.4 | 34 | 56.7 | | |
| Total | 22 | 100 | 38 | 100 | 60 | 100 | | |

Based on Table 3, 46.6% of the 60 respondents had previously given birth to low-birth-weight babies, while 53.4% had no history of LBW. The chi-square study revealed a statistically significant correlation between LBW history and stunting in children ($p=0.004$). The odds ratio was 5.26 (95% CI: 1.68–16.44), which means that kids born with a history of LBW had a 5.26-fold higher chance of experiencing stunting than those born with normal birth weight.

Table 3. The relationship between Low Birth Weight (LBW) during pregnancy and the incidence of stunting in toddlers

| LBW History | Stunted | | Not stunted | | Total | | p-value | OR (95% CI) |
|-------------|---------|------|-------------|------|-------|------|---------|-------------------|
| | n | % | n | % | n | % | | |
| LBW | 13 | 72.2 | 5 | 27.8 | 28 | 46.6 | 0.004 | 5.26 (1.68–16.44) |
| No LBW | 9 | 21.4 | 33 | 78.6 | 32 | 53.4 | | |
| Total | 22 | 100 | 38 | 100 | 60 | 100 | | |

DISCUSSION

Proportion of maternal anemia history with stunted children

These findings demonstrate that about half of the pregnant women in the working area of the Banjar Sari Public Health Center had anemia, emphasizing that maternal anemia continues to be a significant health problem that needs to be addressed as a priority. The study found that 43.3% of pregnant women in the study setting had maternal anemia, suggesting that the condition continues to be prevalent. Maternal anemia can raise the possibility of pregnancy and labor problems, such as stunted fetal development and the birth of low birth weight (LBW) babies, both of which can increase the risk of stunting in early childhood (Ma'rupah, 2024).

Anemia is a collection of symptoms caused by various factors. Besides iron deficiency, other possible underlying causes of anemia include premature destruction of red blood cells

(hemolysis), chronic blood loss or bleeding, suboptimal red blood cell production, malnutrition, such as impaired absorption of protein and iron by the intestines, and impaired red blood cell formation by the bone marrow (Yuliawati et al., 2025). The comparatively high prevalence of anemia among pregnant women implies that it remains a significant maternal health concern in the research region. According to national statistics, more than 40% of Indonesian pregnant women suffer from anemia, which is the WHO's public health limit. This high incidence could be explained by several contributing factors, including inadequate intake of iron-rich foods, poor adherence to iron-folic acid (IFA) supplementation, and persistent nausea and vomiting during pregnancy, which may impair nutrient absorption. Moreover, socioeconomic hardships and limited maternal education may also limit access to adequate nutrition during pregnancy (Kirthan & Somannavar, 2024).

Pregnancy-related anemia has a direct negative impact on both maternal and fetal outcomes. Lowered hemoglobin levels impair oxygen transfer to the placenta and maternal tissues, which might impair healthy fetal development. This increases the chance of low birth weight (LBW) and intrauterine growth restriction (IUGR). Infants born with LBW frequently have little nutritional reserves, making them more vulnerable to postnatal developmental issues and, in the end, stunting (Tendean, 2025). According to this study's results, maternal anemia is a significant factor in LBW and child growth retardation, which is consistent with prior research. When compared to pregnant women with normal hemoglobin levels, those with hemoglobin levels under 11 g/dL are more likely to give birth to LBW babies. Iron deficiency during the first thousand days of life, from conception until the age of two, is a significant factor in restricting linear growth and overall development (Nwadike, 2018).

The widespread prevalence of maternal anemia among respondents highlights the pressing need to improve maternal health interventions. Regular hemoglobin checks during pregnancy, better antenatal treatment, and improved education to encourage adherence to iron and folic acid supplementation are all critical measures. Furthermore, to raise awareness of the importance of adequate and balanced nutrition during pregnancy, family- and community-based preventive and promotional initiatives should be strengthened (Aruan, 2025). Preventing anemia in pregnant women is a crucial step in preventing stunting. This can be achieved through various interventions, such as regular pregnancy monitoring and regular iron supplementation.

Proportion of Low Birth Weight (LBW) history with stunted

This discovery, which represents a rather high proportion and points to ongoing difficulties in enhancing maternal health and nutritional status throughout pregnancy, demonstrates that over one-third of the children in the research area were born with LBW. LBW reflects insufficient fetal development during the intrauterine period. Poor maternal nutritional status, anemia during pregnancy, short interpregnancy intervals, maternal infections, high-risk maternal age (20 or 35 years), and inadequate quality of antenatal care (ANC) are just a few of the variables that may contribute to this condition. A chronic energy shortage in pregnant women is also a major factor in raising the risk of LBW (Susanti et al., 2025).

According to several health surveys, the national average for LBW ranges from around 6% to 10%, whereas this study found a prevalence of 30.0%. The high prevalence of LBW may point to local conditions, such as lower socioeconomic status, inadequate access to maternal and child health care, and poor adherence to iron-folic acid pill usage. Furthermore, a lack of maternal understanding of the significance of routine pregnancy monitoring and risk management may also contribute to the high rate of LBW. Due to the failure of certain moms to attend the prescribed minimum of six ANC visits throughout their pregnancy, the diagnosis and treatment of diseases such as anemia, persistent energy deficiency, or fetal growth restriction may be delayed (Lubis et al., 2025). Low birth weight (LBW) has consistently been identified as a risk factor contributing to stunting, particularly in children 0-11 months of age. Research shows that toddlers with a history of low birth weight (LBW) have approximately a fivefold higher risk of stunting than toddlers with normal birth weight.

LBW has effects that last throughout childhood and adulthood, not just in the neonatal phase. Due to their low energy reserves and compromised metabolism and immune system, low birth weight infants are more prone to micronutrient deficiencies, recurrent illnesses, and growth problems. These circumstances greatly increase the likelihood of stunting in early childhood. Consequently, the high rate of LBW is a major factor in the persistent stunting issue in the research region. These results highlight the importance of LBW prevention as a key intervention in stunting reduction initiatives. Strategies that should continue to be optimized by Banjar Sari Public Health Center include enhancing maternal nutritional screening (including body weight, mid-upper arm circumference (MUAC), and hemoglobin levels), increasing the quality of integrated ANC services, reinforcing instruction on appropriate maternal nutrition, and ensuring adherence to the use of at least 90 iron folic acid pills throughout pregnancy. Additionally, cross-sectoral strategies that address environmental sanitation and socioeconomic circumstances are needed as supplementary interventions to lower LBW rates (Yuliatwati, 2025).

With a recorded proportion of 30.0% in this research, maternal and child health issues continue to be significant and need immediate attention with all-encompassing intervention measures. Preventing LBW from pregnancy onwards is a key investment in enhancing human resource quality and breaking the intergenerational cycle of malnutrition in the working area of Banjar Sari Public Health Center, North Metro. Stunting prevention needs to be carried out early, especially during the first 1000 days of life, by addressing risk factors for LBW and ensuring adequate nutrition.

Association between maternal anemia during pregnancy and stunting among children under five

According to the findings of this research, which was carried out in the workspace of the Banjar Sari Public Health Centre in North Metro, a sizable number of mothers (43.3%) had anemia during pregnancy, while 36.7% of children under the age of five were stunted. A statistically significant association between maternal anemia and stunting incidence was confirmed in bivariate analysis ($p = 0.012$). The estimated odds ratio (OR = 2.41; 95% CI: 1.231–10.350) suggested that children whose mothers had anemia during pregnancy were about 2.4 times more likely to be stunted than those whose mothers had normal haemoglobin levels. This relationship was deemed statistically significant because the confidence interval did not include the value of one.

Anemia in pregnancy remains a national problem, reflecting the socioeconomic well-being of the community and its significant impact on the quality of human resources. Some pregnant women suffer from anemia, which is not harmful. However, anemia increases the risk of neonatal disease and death, as well as maternal morbidity. These results support theoretical explanations that emphasize the impact of maternal anemia on foetal development. Lower haemoglobin levels can cause foetal hypoxia, leading to intrauterine growth restriction (IUGR) by reducing the oxygen and nutrient supply to the placenta. Low birth weight and insufficient neonatal nutritional reserves are more likely to occur due to this disease, which, in turn, impairs linear growth in early childhood (Lubis et al., 2025).

Additionally, the research emphasizes the significance of low birth weight (LBW) as a key indicator of stunting. Despite being examined as a distinct variable, LBW had a strong relationship with stunting ($p = 0.004$), with most children who had a history of LBW being categorized as stunted. Babies born with LBW often have an underdeveloped metabolic system, a less than ideal physiological state, and increased nutritional needs to catch up on their growth. These children are more likely to experience growth retardation during the toddler phase if they do not have adequate food intake and regular growth monitoring (Rahmawati, 2025).

Anemia in pregnant women is a classic problem that seems to persist and is difficult to eliminate. Anemia is a condition in which a woman has a haemoglobin level of less than 11 g% in the first and third trimesters, and less than 10.5% in the second trimester. This condition is caused by iron deficiency or sudden bleeding, and the two are often causally related. This study's findings support earlier research that identified maternal anemia and LBW as key factors contributing to stunting. Previous research has shown that anemic pregnant women are between two and six times more likely than non-anemic moms to have LBW babies and to have children who eventually have delayed growth. Additionally, children born with low birth weight are far more likely to

experience prolonged growth problems than those born with normal birth weight (Hidayanti & Abbas, 2025).

The prevalence of maternal anemia found in this study emphasizes the need to strengthen maternal health treatments from the beginning of pregnancy. Major strategies include enhancing prenatal care services, conducting frequent haemoglobin screening, increasing adherence to iron-folic acid supplementation programs, and educating pregnant women about balanced nutrition. To promote optimal catch-up development in babies with low birth weight (LBW), specific nutritional interventions should be implemented through routine growth monitoring, appropriate complementary feeding practices, and infection prevention strategies (Susanti et al., 2025).

Overall, this study emphasizes that successful stunting prevention must begin during pregnancy, focusing primarily on managing maternal anemia and reducing the incidence of low birth weight. A comprehensive, integrated strategy involving healthcare practitioners, families, and cross-sector stakeholders at the primary healthcare level is necessary to reduce stunting prevalence in the working area of Banjar Sari Public Health Centre, North Metro. The study of Lubis et al. (2025), titled "Association of Maternal Anemia, Economic Status, and Feeding Practices with Stunting among Children at Public Health Centre, North Lombok Regency," supported these findings, finding a strong correlation between maternal anemia and stunting ($p = 0.002$). The reported prevalence ratio of 2.33 (95% CI: 1.343–4.070) indicates that children born to mothers with a history of anemia were more than twice as likely to experience stunting as those born to non-anemic mothers. Similarly, a study by Yuliawati et al. (2024) titled "Analysis of Stunting Determinants in the Working Area of Yosomulyo Public Health Centre, Metro City" also demonstrated a significant association between maternal anemia and stunting ($p = 0.005$), further corroborating the present study's results.

Association between Low Birth Weight (LBW) and stunting among children under five

The research, conducted at the Banjar Sari Public Health Centre in North Metro, found that a significant proportion of moms (43.3%) suffered from anemia during pregnancy. In comparison, 36.7% of children under the age of five were stunted. Bivariate analysis confirmed a statistically significant association between maternal anemia history and stunting prevalence ($p = 0.012$). The estimated odds ratio (OR = 2.41; 95% CI: 1.231–10.350) indicated that children whose mothers had anemia during pregnancy were around 2.4 times more likely to be stunted than children whose mothers had healthy haemoglobin levels. Because the confidence interval did not include the value of one, this connection was determined to be statistically significant.

Low birth weight (LBW) in infants has been identified as a risk factor for stunting in Indonesia. Babies born with low birth weight (LBW) can experience digestive system problems because they are not yet fully functional, making it difficult for them to absorb food, and they can also experience electrolyte disturbances (Fransisca et al., 2023; Sholihah, 2023). These findings support theoretical models that prioritize the effects of maternal anemia on foetal development. Lower haemoglobin levels may cause foetal hypoxia, which in turn may lead to intrauterine growth restriction (IUGR) by limiting the amount of oxygen and nutrients delivered to the placenta. This condition increases the likelihood that a newborn will have low birth weight and inadequate nutritional reserves, which can then hinder linear growth in the early years of a child's life (Lubis et al., 2025).

Furthermore, the study highlights the importance of low birth weight (LBW) as a major predictor of stunting. Although LBW was studied as a separate variable, it was highly correlated with stunting ($p = 0.004$), and most children with an LBW history were found to be stunted. Infants born with LBW typically have higher nutritional requirements to make up for their growth, an underdeveloped metabolic system, and a less than perfect physiological condition. If these children do not receive enough food and regular growth monitoring, they are more prone to growth retardation throughout their toddler years (Rahmawati, 2025).

Earlier studies that found maternal anemia and low birth weight to be significant contributors to stunting are supported by the results of this work. Prior research has found that compared to non-anemic mothers, anemic pregnant women are two to six times more likely to give birth to LBW infants and raise children with delayed development. Furthermore, children

born with low birth weight are much more prone to have long-term developmental issues compared to children born with a healthy birth weight (Hidayanti & Abbas, 2025). The high rate of maternal anemia discovered in this research highlights the importance of improving maternal health care from the start of pregnancy. Key tactics include improving prenatal treatment services, conducting routine haemoglobin screenings, promoting compliance with iron-folic acid supplementation programs, and informing expectant mothers about a healthy diet. Specific dietary interventions should be implemented through routine growth monitoring, appropriate complementary feeding practices, and infection prevention strategies to promote optimal catch-up growth in babies with low birth weight (LBW) (Susanti et al., 2025).

In general, this study highlights that effective stunting prevention must begin during pregnancy, with particular emphasis on controlling maternal anemia and reducing the risk of low birth weight. Reducing stunting prevalence in the working area of the Banjar Sari Public Health Centre in North Metro requires a comprehensive, integrated plan that involves healthcare professionals, families, and stakeholders from various sectors at the primary healthcare level. The findings were supported by the study by Lubis et al. (2025), titled "Association of Maternal Anemia, Economic Status, and Feeding Practices with Stunting among Children at Public Health Centre, North Lombok Regency," which found a significant correlation between maternal anemia and stunting ($p = 0.002$). The reported prevalence ratio of 2.33 (95% CI: 1.343–4.070) suggests that children born to mothers with a history of anemia were more than twice as likely to experience stunting as those born to non-anemic mothers. In a related vein, the Analysis of Stunting Determinants in the Working Area of Yosomulyo Public Health Centre, Metro City, a study by Yuliawati et al. (2024), also found a statistically significant correlation between maternal anemia and stunting ($p = 0.005$), supporting the current research's findings.

CONCLUSION

There was a strong correlation between maternal anemia during pregnancy and the prevalence of stunting among children under the age of five. The study also found a statistically significant correlation between a history of low birth weight (LBW) and stunting. Compared to children without these risk factors, those born to mothers who had anemia during pregnancy, as well as those born with LBW, are far more likely to experience stunting, according to these findings. Health workers are encouraged to enhance their role in promoting maternal and child health and to further involve community health cadres in actively providing information and education on maternal nutrition during pregnancy and age-appropriate child nutrition. This effort is expected to prevent stunting starting from the pregnancy period, reduce the prevalence of stunting among children under five, and improve the overall health status of mothers and children.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

NF: Supervision (lead), validation (equal), and visualization (equal); **YA:** Writing original draft, visualization, conceptualization; **YY:** writing original draft, visualization, conceptualization, review, and editing;

Availability of data and materials

All data are available from all authors.

Competing interests

The authors declare no competing interests.

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