KESANS: International Journal of Health and Science
2808-7178 / 2808-7380
http://kesans.rifainstitute.com/index.php/kesans/index

Determinants of Stunting among Children Aged 24–59 Months: The Role of Maternal and Infant Factors in Muara Papalik Subdistrict, Indonesia

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Article Information
Submitted: **20 April 2026**
Accepted: **01 May 2026**
Publish: **04 May 2026**

Keyword: Stunting; Low Birth Weight; Maternal Factors; Exclusive Breastfeeding; Antenatal Care; Child Nutrition;

Abstract
Introduction*: Stunting remains a major public health problem, particularly in developing countries, including Indonesia. Despite a declining trend, its prevalence at the local level is still relatively high, indicating the presence of specific risk factors related to maternal and child conditions.* ***Objective****: This study aimed to identify maternal and infant factors associated with stunting among children aged 24–59 months in Muara Papalik Subdistrict, Tanjung Jabung Barat Regency.* ***Method****: A quantitative cross-sectional study was conducted among mothers with children aged 24–59 months. Data were collected through structured interviews and anthropometric measurements. Variables included antenatal care, maternal nutritional status, anemia during pregnancy, birth weight, exclusive breastfeeding, and early initiation of breastfeeding. Data were analyzed using univariate, bivariate, and multivariate logistic regression.* ***Results and Discussion****: Maternal and infant factors were significantly associated with stunting. Low birth weight, lack of exclusive breastfeeding, and poor maternal nutritional status were identified as key determinants. Birth weight was the most dominant factor influencing stunting.* ***Conclusion****: Stunting is influenced by combined maternal and infant factors, with birth weight as the strongest determinant. Improving maternal nutrition and promoting optimal infant feeding practices are essential to reduce stunting prevalence.*

How to Cite **Ayu Oktavia Amelia Sari, Ummi Kalsum, Asparian, Willia Novita Eka Rini, Amelia Dwi Fitri, Muldiasman/Determinants of Stunting among Children Aged 24–59 Months: The Role of Maternal and Infant Factors in Muara Papalik Subdistrict, Indonesia/Vol. 5, No. 7, 2026**
DOI https://doi.org/10.54543/kesans.v5i7.630
e-ISSN/p-ISSN **2808-7178 / 2808-7380**
Published by **CV. Rifainstitut/KESANS: International Journal of Health and Science**

Introduction

Stunting remains a major public health problem globally, particularly in low- and middle-income countries (Setiyawati, Ardhiyanti, Hamid, Muliarta, & Raihanah, 2024); (Putra & Sadiyyah, 2023); (Rahman et al., 2023). It reflects chronic undernutrition that occurs during the most critical periods of growth and development in early life (Dewi et al., 2023); (Muslihin, Loita, Fauziah, Rahmadani, & Masturoh, 2025). According to joint estimates by the World Health Organization, UNICEF, and the World Bank, approximately 148 million children under five years of age were stunted worldwide in 2022, indicating that stunting continues to be a significant global health burden (UNICEF et al., 2023). Stunting not only affects physical growth but also has long-term consequences on cognitive development, educational achievement, and economic productivity (Maharani & Wulandari, 2025); (Felix, Oktaviani, & Zulbirri, 2026); (Dahlia, Pratama, & Julianti, 2025)

In Indonesia, although the prevalence of stunting has declined over the past decade, it remains a pressing public health issue. National data show a decrease from 37.2% in 2013 to 19.8% in 2024; however, this figure still exceeds the national target of reducing stunting to below 14% (Ministry of Health Republic of Indonesia, 2024). Furthermore, disparities persist across regions, with some areas exhibiting higher prevalence rates than the national average. In Jambi Province, the prevalence of stunting was reported at 13.5% in 2023, which is lower than the national average but still indicates the need for continued intervention (Ministry of Health Republic of Indonesia, 2023).

At the district level, Tanjung Jabung Barat Regency continues to report cases of stunting, particularly in Muara Papalik Subdistrict, where the prevalence reached 22.3%. This figure is considerably higher than the provincial average, suggesting the presence of specific local determinants that contribute to the persistence of stunting. Such variations highlight the importance of context-specific studies to better understand the underlying factors influencing child growth outcomes at the community level. Previous studies have identified that stunting is influenced by multiple determinants, including maternal and child-related factors. Maternal factors such as antenatal care utilization, nutritional status during pregnancy, and anemia have been associated with adverse birth outcomes and impaired child growth (Herna & Hidayani, 2022); (Doy, Ngura, & Ita, 2021); (Nirmalasari, 2020). Similarly, child-related factors such as low birth weight, lack of exclusive breastfeeding, and suboptimal early feeding practices have been consistently linked to an increased risk of stunting (Sitompul & Simbolon, 2025); (Norlita & Hasanah, 2024); (Ramdika, Fajar, Flora, & Rosyada, 2025). However, most existing studies tend to examine these factors separately, and limited research has explored the combined effect of maternal and infant factors simultaneously, particularly at the sub-district level.

This gap indicates the need for a comprehensive analysis that integrates both maternal and infant determinants to better understand their contribution to stunting. Therefore, this study aims to analyze the association between maternal and infant factors and identify the most dominant determinants of stunting among children aged 24–59 months in Muara Papalik Subdistrict, Tanjung Jabung Barat Regency.

Method

This study employed a quantitative analytical observational design with a cross-sectional approach to examine the association between maternal and infant factors and stunting among children aged 24–59 months. The study was conducted in Muara Papalik

Subdistrict, Tanjung Jabung Barat Regency, Indonesia. The study population consisted of 539 children aged 24–59 months and their mothers. The sample size was determined using the Lemeshow formula for cross-sectional studies with a finite population, resulting in a minimum sample of 225 respondents. A total of 225 mother–child pairs were selected using probability sampling with a simple random sampling technique and proportional allocation across villages.

Inclusion criteria were children aged 24–59 months living with their biological mothers and residing in the study area. Exclusion criteria included children with congenital abnormalities, chronic diseases affecting growth, or incomplete maternal and child health records. Data were collected through structured interviews using validated questionnaires, anthropometric measurements, and document review from maternal and child health records. Stunting status was determined based on height-for-age Z-scores according to WHO Child Growth Standards.

Independent variables included maternal factors (antenatal care visits, maternal nutritional status measured by mid-upper arm circumference, and anemia during pregnancy) and infant factors (birth weight, exclusive breastfeeding, and early initiation of breastfeeding). The dependent variable was stunting status. Data analysis was performed in three stages: univariate analysis to describe variable distribution, bivariate analysis using the Chi-square test to assess associations, and multivariate analysis using binary logistic regression to identify dominant factors. Odds ratios with 95% confidence intervals were calculated. Due to the presence of extreme data distribution in several variables, potential issues such as perfect separation in logistic regression were considered. Therefore, multivariate findings were interpreted cautiously, incorporating both statistical results and epidemiological reasoning.

Result and Discussion

1. Result

Characteristics of Respondents

A total of 225 mother–child pairs were included in this study. Most mothers were aged 20–35 years (73%), had secondary education (SMA: 33%), and were not formally employed (24%). The majority of households had more than four family members (64%). Among children, 53.3% were male, and the age distribution was relatively balanced. Most children were born with normal birth weight (64.4%), although a considerable proportion had low birth weight (35.6%).

Table 1
Characteristics of Respondents

Variable	n	%
Maternal age		
<20 years	15	7
20–35 years	165	73
>35 years	45	20
Education		
Primary–Junior High	115	51
Senior High School	75	33
Higher Education	35	16
Occupation		
Not working	55	24
Informal sector	130	58
Formal sector	40	18
Child sex		
Male	120	53.3
Female	105	46.7

Prevalence of Stunting and Variable Distribution

The prevalence of stunting among children aged 24–59 months was 40.0%. Several maternal and infant risk factors were identified, including inadequate antenatal care (46.2%), maternal undernutrition (40.0%), anemia (40.0%), low birth weight (36.0%), non-exclusive breastfeeding (52.4%), and absence of early initiation of breastfeeding (60.0%).

Table 2
Distribution of Study Variables

Variable	n	%
Stunting		
Yes	90	40
No	135	60
ANC		
Not adequate	104	46.2
Adequate	121	53.8
Maternal MUAC		
Undernutrition	90	40
Normal	135	60
Anemia		
Yes	90	40
No	135	60
Birth weight	81	36
Low		
Normal	144	64
Exclusive breastfeeding	118	52.4
No		
Yes	107	47.6
Early breastfeeding initiation	135	60
No		
Yes	90	40

Bivariate Analysis

Bivariate analysis showed that all maternal and infant factors were significantly associated with stunting ($p < 0.05$). Children with low birth weight had a markedly higher risk of stunting (OR = 16.0; 95% CI: 8.5–30.1). Similarly, children who did not receive exclusive breastfeeding were 5.7 times more likely to be stunted.

Maternal factors such as inadequate antenatal care, maternal undernutrition, and anemia also showed significant associations. However, some variables demonstrated extreme distributions, indicating very strong associations.

Table 3
Bivariate Analysis of Factors Associated with Stunting

Variable	Category	OR	95% CI	p-value
Birth weight	Low vs Normal	16	8.500–30.119	0.000
ANC	Not adequate vs Adequate	2.500	2.055–3.041	0.000
Exclusive breastfeeding	No vs Yes	5.757	3.198–10.363	0.000
Maternal MUAC	Undernutrition vs Normal	–	–	0.000
Anemia	Yes vs No	–	–	0.000
Early initiation	No vs Yes	–	–	0.000

Multivariate Analysis

Multivariate analysis using logistic regression showed that all variables were significantly associated with stunting ($p < 0.05$). The model demonstrated good fit based on the Hosmer–Lemeshow test.

However, extreme data distribution resulted in perfect separation, limiting the estimation of adjusted odds ratios. Despite this limitation, birth weight, maternal nutritional status, anemia, and infant feeding practices were identified as key determinants.

Table 4
Multivariate Analysis Results

Variable	p-value	Interpretation
ANC	0.000	Significant
Maternal MUAC	0.000	Significant
Anemia	0.000	Significant
Birth weight	0.000	Significant
Exclusive breastfeeding	0.000	Significant
Early initiation	0.000	Significant

2. Discussion

Main Findings

This study found that both maternal and infant factors were significantly associated with stunting among children aged 24–59 months. The prevalence of stunting (40.0%) indicates that stunting remains a serious public health problem in the study area. Key determinants identified include low birth weight, inadequate antenatal care, maternal undernutrition, anemia during pregnancy, lack of exclusive breastfeeding, and absence of early initiation of breastfeeding.

Birth Weight and Stunting

Low birth weight (LBW) was identified as the strongest predictor of stunting in this study, with children who had a history of LBW being 16 times more likely to experience stunting (OR = 16.000; 95% CI: 8.500–30.119). This finding indicates a very strong association and highlights the critical role of prenatal factors in determining child growth outcomes. From a theoretical perspective, LBW reflects intrauterine growth restriction resulting from inadequate maternal nutrition and health during pregnancy. According to the *Developmental Origins of Health and Disease (DOHaD)* theory, adverse conditions during fetal development can lead to permanent structural and metabolic changes that affect growth and increase the risk of chronic undernutrition, including stunting (Barker, 2004). Infants born with LBW generally have reduced body reserves, immature organ function, and impaired metabolic adaptation, which limit their ability to achieve optimal catch-up growth. Biologically, LBW infants are more susceptible to infections due to immature immune systems. Recurrent infections can lead to poor nutrient absorption and increased metabolic demands, ultimately contributing to growth faltering and stunting (Black et al., 2013). In addition, LBW is associated with suboptimal linear growth velocity, especially during the first 1,000 days of life, which is a critical window for growth and development (Gunardi, 2021).

The findings of this study are consistent with previous research. Dewey and Begum (2011) reported that LBW is a major risk factor for stunting due to its long-term impact on physical growth. In Indonesia, Aryastami et al. (2017) also identified LBW as the most dominant determinant of stunting among children aged 12–23 months. More recent studies further support this relationship. For example, Tahir (2025) found a significant association between LBW history and stunting incidence in toddlers, indicating that LBW remains a persistent risk factor in various settings. Similarly, Batu (2022) reported that LBW, along with exclusive breastfeeding practices, significantly influenced stunting among children aged 24–59 months. Additional evidence from local and regional studies also supports these findings. Nashita (2023) demonstrated that birth weight is closely related to early child growth, while Hidayah (2023) showed that gestational age and maternal conditions contribute significantly to LBW occurrence, which subsequently affects child growth outcomes. These findings emphasize that LBW is not an isolated factor but is closely linked to maternal health and pregnancy conditions.

Compared to previous studies, the magnitude of association found in this study (OR = 16.0) appears higher. This may be explained by the accumulation of multiple risk factors in the study population, such as maternal undernutrition, anemia during pregnancy, and suboptimal infant feeding practices. These interacting factors may amplify the effect of LBW on child growth, leading to a stronger observed association. Overall, these findings confirm that LBW serves as both a biological marker of intrauterine growth restriction and a key entry point in the pathway leading to stunting. Therefore, interventions should prioritize improving maternal nutrition, strengthening antenatal care services, and preventing anemia during pregnancy to reduce the incidence of LBW and its long-term impact on child growth.

Maternal Factors (ANC, Nutritional Status, and Anemia)

Maternal factors, including antenatal care (ANC), maternal nutritional status, and anemia during pregnancy, were found to be significantly associated with stunting in this study ($p < 0.05$). These findings highlight the crucial role of maternal health during

pregnancy in determining child growth outcomes. Antenatal care (ANC) plays a fundamental role in monitoring maternal and fetal health. Mothers who did not receive adequate ANC were more likely to have children with stunting. This is consistent with previous studies indicating that inadequate ANC limits early detection and management of pregnancy-related complications, including nutritional deficiencies and anemia (Aryawati, 2025; Putri, 2023). ANC services provide opportunities for nutritional counseling, supplementation, and early risk identification, all of which are essential for optimal fetal growth (Kementerian Kesehatan Republik Indonesia, 2020).

From a theoretical perspective, ANC is part of preventive health behavior that influences maternal and child health outcomes. According to behavioral health models, access to and utilization of health services significantly affect health status (Ridwan, 2020). Mothers who regularly attend ANC are more likely to receive appropriate interventions, such as iron supplementation and dietary guidance, which contribute to improved pregnancy outcomes. Maternal nutritional status, measured by mid-upper arm circumference (MUAC), was also significantly associated with stunting. Mothers with undernutrition (chronic energy deficiency) are more likely to experience restricted fetal growth, resulting in low birth weight and subsequent stunting (Adriati, 2022). Nutritional deficiencies during pregnancy reduce the availability of essential nutrients required for fetal development, affecting both birth outcomes and long-term growth trajectories.

Recent studies support this finding. Suryaningsih (2025) found that poor maternal nutritional status was significantly associated with stunting among children under five. Similarly, Nasution (2022) reported that maternal undernutrition is a major determinant of child malnutrition, particularly in low-resource settings. These findings emphasize the importance of ensuring adequate maternal nutrition during pregnancy. Anemia during pregnancy was also identified as a significant factor associated with stunting. Anemia reduces the oxygen-carrying capacity of the blood, leading to inadequate oxygen supply to the fetus and impaired growth (Agustin, 2024). This condition can result in intrauterine growth restriction and low birth weight, which are strongly linked to stunting. Evidence from recent studies further supports this relationship. Nasir (2024) reported that anemia in pregnancy is associated with adverse birth outcomes, including low birth weight and impaired fetal growth. Similarly, Salsabila (2025) found that maternal anemia significantly increased the risk of poor child nutritional status. Overall, these findings indicate that maternal factors are interrelated and collectively influence child growth outcomes. Inadequate ANC, poor maternal nutritional status, and anemia during pregnancy may interact and contribute to suboptimal fetal development, which subsequently increases the risk of stunting. Therefore, improving maternal health through strengthened ANC services, nutritional interventions, and anemia prevention programs is essential for reducing stunting prevalence.

Infant Feeding Practices (Exclusive Breastfeeding and Early Initiation)

Infant feeding practices, particularly exclusive breastfeeding and early initiation of breastfeeding, were found to be significantly associated with stunting in this study ($p < 0.05$). Children who did not receive exclusive breastfeeding were more likely to experience stunting compared to those who were exclusively breastfed. From a biological perspective, exclusive breastfeeding provides complete and optimal nutrition required for infant growth during the first six months of life. Breast milk contains essential macronutrients, micronutrients, antibodies, and bioactive components that support

immune function and protect against infections (Wahdiyati, 2023). Infants who are not exclusively breastfed are more vulnerable to infections such as diarrhea and respiratory diseases, which can impair nutrient absorption and increase the risk of growth faltering.

In addition, exclusive breastfeeding plays a critical role in ensuring adequate nutrient intake during the first 1,000 days of life, a period that determines long-term growth and development (Gunardi, 2021). Failure to provide exclusive breastfeeding may result in early introduction of complementary foods that are often nutritionally inadequate and increase exposure to pathogens (Kocagozoglu, 2024). The findings of this study are consistent with previous research. Sampe (2020) reported a significant relationship between exclusive breastfeeding and stunting among children under five. Similarly, Helyaning (2023) found that mothers who did not practice exclusive breastfeeding were more likely to have children with poor nutritional status. More recent studies also support these findings. Afifah (2025) demonstrated that exclusive breastfeeding and early breastfeeding practices significantly influence child growth and development outcomes. Early initiation of breastfeeding (IMD) was also significantly associated with stunting in this study. IMD facilitates early skin-to-skin contact and allows infants to receive colostrum, which is rich in antibodies and essential nutrients. Colostrum plays a crucial role in strengthening the infant's immune system and supporting early growth (Matahari, 2023).

Furthermore, IMD contributes to the success of continued breastfeeding. Mothers who practice IMD are more likely to maintain exclusive breastfeeding, which in turn supports optimal child growth (Jaiba, 2024). Studies by Ofiktra (2024) and Wahyuningsih (2024) also found that early initiation of breastfeeding is associated with better nutritional outcomes and reduced risk of stunting. Compared to previous studies, the strong association observed in this study may be influenced by the combined effect of suboptimal feeding practices and other maternal risk factors, such as poor nutritional status and inadequate antenatal care. This indicates that infant feeding practices do not act independently but are part of a broader continuum of care that begins during pregnancy. Overall, these findings highlight that improving infant feeding practices is a key strategy in stunting prevention. Promoting exclusive breastfeeding and early initiation of breastfeeding should be prioritized through community-based interventions, maternal education, and strengthened health services to ensure optimal child growth and development.

Integrated Perspective (Maternal–Infant Interaction)

The findings of this study demonstrate that stunting is not caused by a single factor but results from the interaction between maternal and infant factors occurring across the continuum of care, from pregnancy to early childhood. This integrated perspective highlights that maternal health conditions during pregnancy directly influence birth outcomes, which subsequently affect infant feeding practices and child growth. Maternal factors such as inadequate antenatal care, poor nutritional status, and anemia during pregnancy contribute to suboptimal fetal development, often resulting in low birth weight. As demonstrated in this study, low birth weight was the most dominant predictor of stunting, indicating that the pathway to stunting begins early in the prenatal period. This aligns with the concept that the first 1,000 days of life—from conception to two years of age—are critical in determining long-term growth outcomes (Gunardi, 2021).

Following birth, infant feeding practices play a crucial role in either mitigating or exacerbating early growth deficits. Children who do not receive exclusive breastfeeding or early initiation of breastfeeding are more likely to experience infections and inadequate nutrient intake, further increasing the risk of stunting. This suggests that postnatal care practices can either buffer or amplify the effects of adverse prenatal conditions. These findings are consistent with the UNICEF conceptual framework, which explains that stunting is influenced by both immediate factors (inadequate dietary intake and disease) and underlying factors (maternal health, caregiving practices, and access to health services) (UNICEF, 2023). In this context, maternal and infant factors should not be viewed independently but as interconnected components within a broader system affecting child nutrition.

Evidence from recent studies also supports this integrated approach. Kalsum (2022) found that maternal factors, environmental conditions, and child-related factors collectively influence stunting outcomes. Similarly, Rahmi (2024) and Kobat (2025) reported that stunting is the result of multiple interacting determinants, including maternal health, infant feeding practices, and socioeconomic conditions. The stronger magnitude of association observed in this study suggests that these factors may interact synergistically rather than independently. For instance, maternal undernutrition and anemia may lead to low birth weight, which, when combined with inadequate breastfeeding practices, significantly increases the likelihood of stunting. This cumulative risk model explains why interventions targeting a single factor may be insufficient. Therefore, stunting prevention requires an integrated and multi-sectoral approach that addresses both maternal and infant factors simultaneously. Strengthening antenatal care, improving maternal nutrition, preventing anemia, and promoting optimal infant feeding practices should be implemented as part of a continuous care strategy to effectively reduce stunting prevalence.

Methodological Consideration

It is important to note that several variables in this study showed extreme distributions, resulting in perfect separation in the regression model. While this indicates very strong associations, it may limit the estimation of adjusted effects. Therefore, findings should be interpreted cautiously, considering both statistical results and epidemiological plausibility.

Implications for Public Health

These findings suggest that interventions to reduce stunting should adopt a comprehensive approach, focusing on maternal health during pregnancy and optimal infant feeding practices. Strengthening antenatal care services, improving maternal nutrition, preventing anemia, and promoting exclusive breastfeeding and early initiation are essential strategies for stunting prevention.

Conclusion

The prevalence of stunting among children aged 24–59 months in Muara Papalik Subdistrict was 40.0%, indicating that stunting remains a significant public health problem in the study area. This study demonstrated that both maternal and infant factors were significantly associated with stunting. Low birth weight emerged as the strongest determinant, with children having low birth weight being 16 times more likely to

experience stunting (OR = 16.000; 95% CI: 8.500–30.119). Additionally, children who did not receive exclusive breastfeeding had a higher risk of stunting (OR = 5.757; 95% CI: 3.198–10.363). Maternal factors, including inadequate antenatal care, poor maternal nutritional status, and anemia during pregnancy, were also significantly associated with stunting ($p < 0.05$). These findings indicate that stunting results from cumulative and interrelated risks occurring from the prenatal period through early childhood. Therefore, comprehensive and integrated interventions focusing on improving maternal health during pregnancy and promoting optimal infant feeding practices are essential to effectively reduce stunting prevalence.

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