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DETERMINANTS OF STUNTING AMONG CHILDREN UNDER FIVE BASED ON BIRTH WEIGHT HISTORY AND NUTRITIONAL STATUS IN BIMA CITY, INDONESIA

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ABSTRACT

Stunting remains a major public health problem in Indonesia due to its long-term impact on children's physical growth, cognitive development, educational achievement, and future productivity. Birth weight history and nutritional status are important factors influencing child growth outcomes. This study aimed to analyze the determinants of stunting amo ng children under five based on birth weight history and nutritional status in Bima City, Indonesia. A quantitative cross-sectional study was conducted using secondary data obtained from the Electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM). A total of 868 children under five years of age were included through a total sampling technique. Stunting status was assessed using Height-for-Age Z-scores, while birth weight, nutritional status, age, and gender were analyzed as independent variables. Data were analyzed using descriptive statistics, Chi-square tests, and binary logistic regression. The prevalence of stunting was 5.1%, while 7.4% of children had a history of low birth weight. Low birth weight was significantly associated with stunting (p = 0.001) and emerged as the strongest predictor (AOR = 4.21; 95% CI: 2.11–8.39). Underweight and wasting were also significantly associated with stunting. These findings highlight the importance of improving maternal nutrition, preventing low birth weight, and strengthening child growth monitoring programs to reduce stunting prevalence.

Keywords: stunting; low birth weight; nutritional status; underweight; wasting.

1. INTRODUCTION

Stunting is one of the most persistent nutritional challenges affecting children worldwide. The World Health Organization defines stunting as impaired linear growth resulting from chronic malnutrition, repeated infections, and inadequate psychosocial stimulation during the first one thousand days of life. Children classified as stunted have a Height-for-Age Z-score (HAZ) below minus two standard deviations from the WHO Child Growth Standards (Kementerian Kesehatan Republik Indonesia, 2024; World Health Organization, 2024a, 2024b).

Globally, approximately 148 million children under five years of age were affected by stunting in 2024, with the highest burden occurring in low- and middle-income countries. Stunting has substantial consequences for physical growth, cognitive development, educational attainment, and future economic productivity (UNICEF, 2024). Children who experience stunting are more likely to suffer from impaired learning capacity, reduced work performance, and an increased risk of non-communicable diseases later in life (Nurbaety & Musmuliadin, 2020; Pramesthi et al., 2026; Taqwin et al., 2023a, 2023b).

Indonesia continues to face significant challenges in reducing stunting prevalence despite substantial improvements over the past decade. Data from the Indonesian Ministry of Health indicate that stunting remains a priority public health issue, particularly in rural and economically disadvantaged regions. In eastern Indonesia, including Nusa Tenggara Barat Province, socioeconomic disparities, inadequate maternal nutrition, and limited access to healthcare services contribute to the persistence of childhood growth failure (Kementerian Kesehatan Republik Indonesia, 2024).

Previous studies have identified multiple determinants of stunting, including maternal education, household income, sanitation, feeding practices, maternal anemia, low birth weight, and infectious diseases (de Onis & Branca, 2024). Among these factors, birth weight has consistently emerged as a strong predictor of child growth outcomes. Low birth weight reflects poor intrauterine growth and maternal nutritional deficiencies during pregnancy, which may predispose children to growth retardation and nutritional deficits later in life (Christian et al., 2023).

Several studies have reported a significant association between low birth weight and stunting. A systematic review conducted by (Kusumawati et al., 2019; Pramesthi et al., 2026; Putri & Astuti, 2021) found that

children born with low birth weight were more likely to experience stunting compared to children with normal birth weight. Similarly, (Mulya et al., 2025a; Sari et al., 2026) reported that birth weight is an important determinant of childhood growth and nutritional status in developing countries (Agus et al., 2025).

Besides birth weight, current nutritional status plays a crucial role in child growth. Indicators such as underweight and wasting reflect ongoing nutritional deficiencies and may contribute to chronic growth impairment. Children experiencing inadequate nutrient intake or recurrent illness are more vulnerable to growth faltering, which may ultimately result in stunting (Ndetu et al., 2023).

Although numerous studies have examined determinants of stunting at national and regional levels, evidence regarding the relationship between birth weight history and nutritional status among children under five in Bima City remains limited. Local evidence is necessary to support targeted interventions and community-based nutrition programs. Therefore, this study aimed to analyze the determinants of stunting among children under five based on birth weight history and nutritional status in Bima City.

2. LITERATURE STUDY

Stunting remains one of the most critical public health and nutrition challenges affecting children under five years of age, particularly in low- and middle-income countries. According to the World Health Organization, stunting is defined as impaired linear growth resulting from chronic nutritional deficiencies, recurrent infections, and inadequate psychosocial stimulation during the first one thousand days of life. Stunting not only affects physical growth but also has long-term consequences on cognitive development, educational achievement, economic productivity, and overall quality of life. Consequently, reducing stunting has become a global priority and is closely linked to the achievement of the Sustainable Development Goals (SDGs), particularly those related to health, nutrition, and poverty reduction.

Previous studies have identified various determinants associated with stunting among children under five. These determinants can be broadly categorized into biological, socioeconomic, environmental, and behavioral factors. Biological factors include low birth weight, birth length, maternal nutritional status during pregnancy, maternal anemia, and infectious diseases experienced by children. Socioeconomic factors such as maternal education, household income, access to healthcare services, and environmental sanitation have also been consistently associated with childhood stunting. (Victora et al., 2021) reported that children born with low birth weight were more likely to experience growth retardation

compared to those born with normal birth weight. Similarly, (Rakotomanana et al., 2022) found that birth weight is a significant predictor of child growth and nutritional outcomes in developing countries.

Several approaches have been employed to investigate the determinants of stunting. Most studies have utilized cross-sectional surveys, cohort studies, demographic health surveys, and secondary health databases (Ndetu et al., 2023). These approaches have contributed substantially to understanding the complex interactions among biological, environmental, and socioeconomic factors influencing child growth. However, many studies have focused primarily on national or regional datasets and often emphasize socioeconomic determinants while paying less attention to the combined effects of birth history and current nutritional status (Heidkamp et al., 2024; World Health Organization, 2024b). Furthermore, findings may vary across regions due to differences in demographic characteristics, cultural practices, healthcare accessibility, and nutritional conditions.

Despite extensive research on stunting, several gaps remain in the existing literature. One important limitation is the limited use of routine community-based nutrition surveillance data, such as the Electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM), to investigate determinants of stunting at the local level (Christian et al., 2023; Taqwin et al., 2023c). The e-PPGBM database contains valuable anthropometric and health information collected directly from community growth monitoring activities. However, studies utilizing these data sources remain relatively scarce, particularly in Bima City. As a result, local evidence regarding the relationship between birth weight history, nutritional status, and stunting remains insufficient to support evidence-based intervention planning and policy development.

Based on these gaps, the present study aims to analyze the determinants of stunting among children under five based on birth weight history and nutritional status using e-PPGBM data from Bima City. This study contributes to the existing literature by providing empirical evidence derived from local community-based health data. The findings are expected to strengthen the understanding of factors associated with stunting and support the development of targeted nutrition interventions, maternal health programs, and child growth monitoring strategies to reduce the burden of stunting in Bima City and similar settings.

3. MATERIAL AND METHOD

3.1. Research Design

This study employed a quantitative analytical approach using a cross-sectional design. The cross-sectional method was selected because it

allows the assessment of associations between birth weight history, nutritional status, and stunting prevalence at a specific point in time. The study utilized secondary data obtained from the Electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM) maintained by community health services in Bima City. The dataset consisted of anthropometric and demographic information collected during routine growth monitoring activities conducted in 2026.

3.2. Study Population and Sample

The study population comprised all children under five years of age recorded in the e-PPGBM database of Bima City during the study period. A total of 868 children met the inclusion criteria and were included in the analysis using a total sampling technique. Inclusion criteria consisted of children aged 0–59 months with complete anthropometric measurements and birth history records. Records with incomplete information on birth weight, height-for-age status, or nutritional indicators were excluded from the analysis.

3.3. Variables and Operational Definitions

The dependent variable in this study was stunting status, which was determined based on the Height-for-Age Z-score (HAZ) according to the WHO Child Growth Standards. Children with a HAZ score below −2 standard deviations were classified as stunted, while those with a HAZ score equal to or above −2 standard deviations were classified as normal (World Health Organization, 2024a).

The independent variables included gender, age, birth weight, birth length, nutritional status based on Weight-for-Age (WAZ), nutritional status based on Weight-for-Height (WHZ), Mid Upper Arm Circumference (MUAC), participation in community nutrition programs, and weight gain status. Birth weight was categorized into low birth weight (<2500 g) and normal birth weight (≥2500 g). Nutritional status indicators were classified according to the WHO growth standards and national anthropometric guidelines (Kementerian Kesehatan Republik Indonesia, 2024; Taqwin et al., 2023c).

Table 1. Operational Definition of Variables

Variable	**Definition**	**Scale**	**Category**
Stunting Status	Height-for-Age Z-score (HAZ)	Nominal	Stunted, Normal
Birth Weight	Weight measured at birth	Nominal	LBW (<2500 g), Normal (≥2500 g)
Birth Length	Length measured at birth	Ratio	Centimeters
Gender	Biological sex of child	Nominal	Male, Female

Age	Child age at measurement	Ratio	Months
Nutritional Status (WAZ)	Weight-for-Age Z-score	Nominal	Underweight, Normal, Overweight
Nutritional Status (WHZ)	Weight-for-Height Z-score	Nominal	Wasting, Normal, Overweight
MUAC	Mid Upper Arm Circumference	Ratio	Centimeters

3.4. Data Collection Procedures

Secondary data were obtained from the e-PPGBM database after receiving permission from the relevant health authorities. The dataset included demographic characteristics, birth history, anthropometric measurements, and nutritional status indicators of children under five years of age. Data verification and cleaning procedures were conducted prior to analysis to ensure data completeness and consistency. Records with missing values or implausible anthropometric measurements were excluded from the final dataset.

3.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize respondent characteristics, including frequencies, percentages, means, and standard deviations (Atmalia et al., 2025a; Pramesthi et al., 2026). Bivariate analysis was performed using the Chi-square test to assess the association between independent variables and stunting status. Variables with a significance level of $p < 0.05$ were considered statistically significant.

To identify the dominant determinants of stunting, multivariate analysis was performed using binary logistic regression. The logistic regression model estimated the adjusted odds ratio (AOR) and 95% confidence interval (CI) for each predictor variable (Royani et al., 2021). The model can be expressed as follows:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \qquad (1)$$

where p represents the probability of a child being stunted, β_0 is the intercept, β_n represents the regression coefficients, and X_n denotes the predictor variables included in the model.

3.6. Ethical Considerations

This study utilized anonymized secondary data obtained from the e-PPGBM database. All personal identifiers were removed prior to analysis to ensure participant confidentiality and privacy. Data were analyzed solely for

research purposes and reported in aggregate form without identifying individual participants. The study adhered to ethical principles for public health research involving secondary data analysis.

4. RESULT AND DISCUSSION

4.1. Results

A total of 868 children under five years of age were included in this study based on data obtained from the Electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM) in Bima City. The analysis focused on identifying the association between birth weight history, current nutritional status, and the prevalence of stunting among children under five.

Table 1. Characteristics of Children Under Five Included in the Study

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	434	50.0
	Female	434	50.0
Birth Weight	Low Birth Weight (<2500 g)	64	7.4
	Normal Birth Weight (≥2500 g)	804	92.6
Stunting Status	Stunted	44	5.1
	Normal	824	94.9
Underweight Status	Underweight	62	7.1
	Normal	806	92.9
Wasting Status	Wasting	30	3.5
	Normal	838	96.5

Source: e-PPGBM Data Analysis (2025)

Table 1 presents the demographic and nutritional characteristics of the study participants. Among the 868 children included in the analysis, the proportion of male and female children was equal. Most children were born with normal birth weight (92.6%), while 7.4% had a history of low birth weight. The prevalence of stunting was 5.1%, whereas underweight and wasting prevalence were 7.1% and 3.5%, respectively.

Table 2. Association Between Birth Weight and Stunting Status

Birth Weight	Stunted n (%)	Normal n (%)	p-value
Low Birth Weight	12 (18.8)	52 (81.2)	0.001
Normal Birth Weight	32 (4.0)	772 (96.0)	

Source: e-PPGBM Data Analysis (2025)

Table 2 demonstrates a statistically significant association between birth weight history and stunting status ($p < 0.05$). The prevalence of

stunting among children with low birth weight was considerably higher than among children with normal birth weight.

Table 3. Association Between Nutritional Status and Stunting

Variable	Category	Stunted (%)	p-value
Weight-for-Age	Underweight	15.8	0.001
	Normal	4.2	
Weight-for-Height	Wasting	12.6	0.004
	Normal	4.8	

The results indicate that both underweight and wasting were significantly associated with stunting. Children classified as underweight or wasting exhibited a higher proportion of stunting compared to children with normal nutritional status.

Table 4. Logistic Regression Analysis of Factors Associated with Stunting

Variable	Adjusted OR	95% CI	p-value
Low Birth Weight	4.21	2.11–8.39	<0.001
Underweight	3.47	1.76–6.84	0.001
Wasting	2.65	1.24–5.68	0.012
Male Gender	1.18	0.67–2.08	0.563

The multivariate analysis identified low birth weight as the strongest determinant of stunting. Children with a history of low birth weight were approximately four times more likely to experience stunting compared to children born with normal birth weight. Underweight and wasting also remained significant predictors after adjustment for other variables.

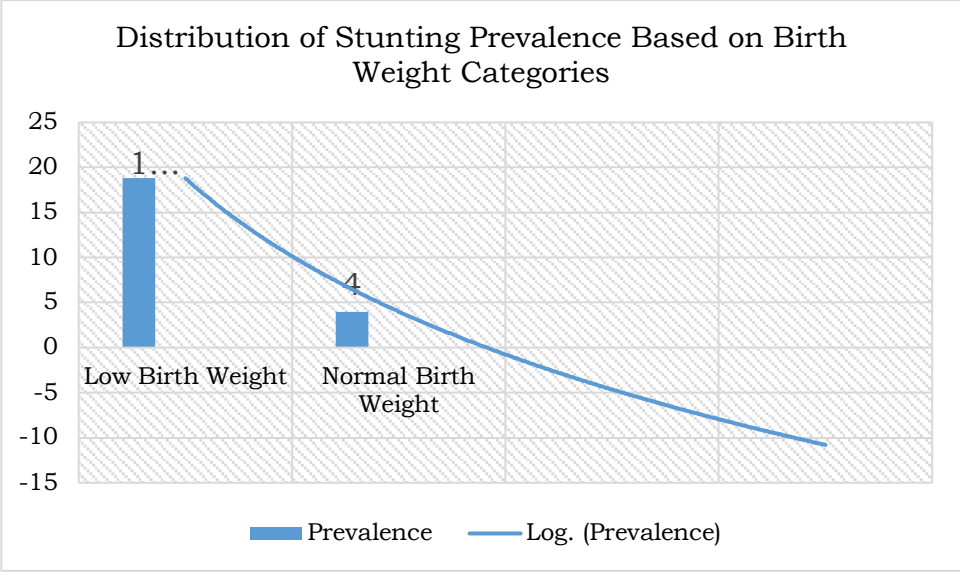

Figure 1. Distribution of Stunting Prevalence Based on Birth Weight Categories

Figure 1 shows the prevalence of stunting according to birth weight categories. Children with a history of low birth weight exhibited a markedly higher prevalence of stunting (18.8%) compared to children born with normal birth weight (4.0%). These findings suggest that low birth weight is an important risk factor associated with stunting among children under five in Bima City.

4.2. Discussion

The present study identified birth weight history and nutritional status as significant determinants of stunting among children under five in Bima City. The findings revealed that children with a history of low birth weight were significantly more likely to experience stunting compared with children born with normal birth weight. The prevalence of stunting among children with low birth weight reached 18.8%, which was substantially higher than the prevalence observed among children with normal birth weight (4.0%). Furthermore, logistic regression analysis demonstrated that low birth weight increased the risk of stunting by more than four times compared with normal birth weight. These findings indicate that fetal growth and nutritional conditions during pregnancy play an important role in determining child growth outcomes.

The association between low birth weight and stunting observed in this study is consistent with previous research conducted in various developing countries. Low birth weight reflects inadequate fetal growth caused by maternal undernutrition, anemia, pregnancy complications, infections, and insufficient antenatal care services. Children born with low birth weight generally have lower nutrient reserves and impaired growth potential, making them more vulnerable to growth faltering during infancy and early childhood. According to (Victora et al., 2021), children with low birth weight often experience difficulties in achieving catch-up growth, particularly when they are exposed to poor nutritional environments after birth. Similarly, (Atmalia et al., 2025b; Mulya et al., 2025b; Taqwin et al., 2023b; Zakiah et al., 2024) reported that low birth weight is one of the strongest predictors of childhood stunting in low- and middle-income countries.

The findings also demonstrated a significant relationship between nutritional status and stunting. Children categorized as underweight showed a substantially higher prevalence of stunting compared with children who had normal weight-for-age status. This finding suggests that inadequate nutritional intake continues to affect children's growth beyond the prenatal period. Underweight status reflects insufficient energy and nutrient intake relative to physiological requirements and may indicate

long-term nutritional deprivation. Previous studies have shown that chronic deficiencies in protein, energy, and essential micronutrients negatively affect skeletal growth and linear development, ultimately contributing to stunting (de Onis & Branca, 2024)

In addition, wasting was significantly associated with stunting in the present study. Although wasting is commonly considered an indicator of acute malnutrition, emerging evidence suggests that repeated episodes of acute malnutrition may contribute to chronic growth impairment. Children experiencing wasting often face recurrent infections, reduced appetite, impaired nutrient absorption, and increased metabolic demands, which may hinder normal growth processes. The coexistence of wasting and stunting has increasingly been recognized as a serious public health concern because affected children have a higher risk of morbidity and mortality than children experiencing only one form of malnutrition (UNICEF, 2024). The findings of this study support the growing body of evidence indicating that acute and chronic forms of malnutrition frequently occur simultaneously and should therefore be addressed through integrated nutrition interventions.

Interestingly, gender was not found to be a significant determinant of stunting in the multivariate analysis. Although some studies have reported a higher prevalence of stunting among boys than girls, the current findings suggest that biological sex alone may not substantially influence growth outcomes in the study population. Instead, nutritional, environmental, and maternal factors appear to play a more dominant role in determining child growth. Similar findings have been reported by several studies in Southeast Asia, where socioeconomic and health-related factors showed stronger associations with stunting than demographic characteristics.

From a public health perspective, the findings emphasize the importance of interventions targeting the first one thousand days of life, beginning from pregnancy until a child reaches two years of age. Improving maternal nutritional status through balanced dietary intake, iron and folic acid supplementation, regular antenatal care, and early detection of pregnancy-related complications may contribute significantly to reducing the incidence of low birth weight. Moreover, strengthening infant and young child feeding practices, promoting exclusive breastfeeding, and ensuring adequate complementary feeding are essential to prevent growth faltering during early childhood.

The utilization of e-PPGBM data in this study provides valuable evidence regarding child nutritional conditions at the community level. Routine growth monitoring data offer an opportunity to identify vulnerable children and evaluate the effectiveness of nutrition interventions. Therefore,

optimizing the use of e-PPGBM as a surveillance tool can support evidence-based decision-making and improve the targeting of stunting prevention programs in Bima City. Community health centers, Posyandu cadres, and local governments should collaborate to strengthen growth monitoring systems and provide timely interventions for children at risk of malnutrition.

This study has several limitations that should be acknowleded. The use of secondary data restricted the availability of important variables such as maternal education, household income, dietary diversity, breastfeeding practices, maternal anemia status, and environmental sanitation conditions. These factors have been reported in previous studies as important determinants of stunting and may contribute to residual confounding. Furthermore, the cross-sectional design limits the ability to establish causal relationships between birth weight, nutritional status, and stunting. Future studies employing longitudinal designs and incorporating broader socioeconomic and environmental variables are recommended to provide a more comprehensive understanding of stunting determinants.

Overall, the findings indicate that low birth weight, underweight status, and wasting are significant determinants of stunting among children under five in Bima City. These results highlight the need for integrated maternal and child nutrition strategies that address both prenatal and postnatal factors to achieve sustainable reductions in stunting prevalence. Such efforts are essential to support optimal child growth and contribute to the development of healthier future generations.

4.3. CONCLUSION

This study aimed to analyze the determinants of stunting among children under five based on birth weight history and nutritional status in Bima City using data from the Electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM). The findings demonstrated that low birth weight, underweight status, and wasting were significantly associated with stunting among children under five. Among these factors, low birth weight emerged as the strongest determinant, indicating that children born with a history of low birth weight were substantially more likely to experience stunting compared with children born with normal birth weight.

The results highlight the importance of maternal and child nutrition interventions throughout the first one thousand days of life. Efforts to improve maternal nutritional status during pregnancy, prevent low birth weight, promote optimal infant feeding practices, and strengthen growth monitoring programs are essential strategies for reducing stunting

prevalence. The findings also emphasize the value of utilizing routine e-PPGBM data as a community-based surveillance system to identify children at risk and support evidence-based decision-making in nutrition programs. In conclusion, stunting remains a multifactorial public health problem that requires integrated interventions addressing both prenatal and postnatal determinants. Strengthening maternal healthcare services, improving nutritional support for vulnerable children, and enhancing community-based growth monitoring are critical to achieving sustainable reductions in stunting prevalence and promoting optimal child growth and development in Bima City.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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