



Low Birth Weight as A Predictor of Stunting in Bojonegoro, East Java, Indonesia

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<p>Track Record Article</p> <p>Revised: 10 April 2026 Accepted: 25 June 2026 Published: 29 June 2026</p> <p>How to cite: Utami, W., Wisuda, A. C., Nuryanti, T., Patonah, S., Maftukhin, A., Astuti, N. D., & Affandi, A. A. (2026). Low Birth Weight as A Predictor of Stunting in Bojonegoro, East Java, Indonesia. <i>Contagion: Scientific Periodical Journal of Public Health and Coastal Health</i>, 8(2), 423–433.</p>	<p style="text-align: center;">Abstract</p> <p><i>Birth weight is the primary indicator of a baby's health. Babies with low body weight often face challenges in physical growth, metabolic function, and cognitive and intellectual development. The purpose of this study is to determine the relationship between a history of low birth weight and stunting. This study used a correlational analytical design with a cross-sectional approach. The population included 120 pairs of mothers and children aged 2–3 years. A simple random sampling technique selected 108 pairs as the sample. Data were collected by measuring the child's height and by obtaining secondary data on birth weight. Data analysis was carried out using Chi-Square and Contingency Coefficient tests. The results showed that of 69 respondents (63.9%) who had a history of low birth weight, as many as 45 children (41.7%) were stunted. The majority of respondents were children aged 2-3 years (92.3%), female, and firstborn. A chi-square statistical test yields a P-value = 0.008 < a (0.05). This indicates a relationship between a history of low birth weight and the incidence of stunting in children aged 2–3 years, with a Contingency Coefficient rate of 0.462. The conclusion shows that there is a link between low birth weight and the incidence of stunting in children aged 2–3 years. Parents are encouraged to attend Posyandu regularly for growth monitoring and optimal nutrition. Healthcare workers should prioritize nutritional counseling during pregnancy and the first two years of life. Policymakers are recommended to strengthen prenatal screening programs targeting low birth weight as an early predictor of stunting, particularly in agricultural communities with limited healthcare access.</i></p> <p>Keywords: Low Birth Weight, Stunting, Child Nutrition, Indonesia, Growth Disorders.</p>
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INTRODUCTION

The problem of nutritional fulfillment in toddlerhood is still a crucial issue in global public health, particularly in the context of undernutrition, which is recognized as one of the leading causes of stunting. Stunting is a long-term indicator of nutritional deficiency in children (Thurstans et al., 2022). Adequate dietary intake during pregnancy ensures that babies are born in healthy conditions with an ideal weight (Marshall et al., 2022); moreover, the Ministry of Health has noted that insufficient nutritional intake during pregnancy is directly related to the high incidence of low birth weight in Indonesia (Agustina et al., 2023; Suparji et al., 2024). Birth weight is the main predictor of a baby's health condition and is closely related to the potential for physical growth and the development of the child's brain and intelligence; hence, babies born with low body weight are at greater risk of impaired growth, development, and metabolic function in later phases of life. A study by Vats et al. (2024) showed that babies with

low birth weight have a higher risk of stunting later in life than babies with ideal birth weight. Children with a history of low birth weight are more likely to experience delayed height growth, which can lead to short body conditions later in growth.

According to WHO global estimates, approximately 22% of children under five worldwide are stunted, with prevalence exceeding 30% in Southeast Asia (WHO, 2023). In Indonesia, Nutrition Status Monitoring data indicate that 11.50% of toddlers aged 0–59 months are classified as very short and 19.30% as short, according to the height-for-age index. In East Java Province, the number of toddlers was very low at 36.90% and short at 19.90% (L. L. Sari et al., 2023). Based on the study results, most toddlers had satisfactory nutritional status (72.7%), while 21.2% were undernourished and 6.1% were overnourished. No toddlers were classified as malnourished (Marliany et al., 2022). At the Temayang Health Center, the results of the 2023 measurements of 3,037 children under five showed that 2,800 children (92.20%) were in a normal nutritional condition, 205 children (6.75%) were malnourished, 28 children (0.92%) were overnourished, and 4 children (0.392%) were underweight. Meanwhile, of the 90 toddlers in Temayang District who were examined, 12 (4.44%) had very short conditions, and 102 (39.3%) were classified as short. A previous *cross-sectional* study in Selomartani Village, Yogyakarta, involving 73 children aged 7–36 months, found that of 17 children with a history of low birth weight, 14 (82.4%) were stunted. In comparison, three children (17.6%) were not stunted. This indicates a strong relationship between low birth weight and stunting incidence.

Stunting is defined as a linear growth disorder reflected by a child's height-for-age z-score below -2 standard deviations of the WHO Child Growth Standards median, with categories of *stunted* ($HAZ < -2$ SD) and severely stunted ($HAZ < -3$ SD) (Chanyarungrojn et al., 2023; Soliman et al., 2021). Factors that cause *stunting* include various aspects, including *maternal factors* such as economic conditions and the education level of the mother, as well as *intermediate factors* such as the number of family members, height and age of the mother, and the number of children of the mother (K. Sari & Sartika, 2021). Other factors are *proximal factors*, which include a history of exclusive breastfeeding, the age of the child, and low birth weight. Babies with a birth weight of fewer than 2,500 grams are at high risk of death, growth stunting, and developmental stunting if they are not treated appropriately (Hokken-Koelega et al., 2023). *Stunting occurs* when toddlers are generally unaware of it. After 2 years, it is only seen to impact cognitive abilities, long-term productivity, and even death (Mustakim et al., 2022). Stunting is generally not recognized by families until after age two, even though it affects brain development, cognitive function, and children's productivity (Santosa et al.,

2022). The effects of *stunting* are not limited to physical growth inhibition but also have a profound impact on children's brain development. Stunted children tend to have lower intellectual intelligence than children with normal growth. The effect is long-term and lasts into adulthood, including decreased learning ability, weakened immunity, and increased risk of developing chronic diseases such as diabetes, obesity, heart disease, cancer, stroke, and disability. Ultimately, stunting also reduces a person's work productivity and competitiveness (K. Sari & Sartika, 2021).

Efforts to reduce stunting rates need to start as early as possible, namely from pregnancy to age two, known as the golden period of growth, especially during the 270 days of pregnancy and the first 730 days of the child's life. One of the essential steps is exclusive breastfeeding and optimal nutritional fulfillment of the baby (Cortez et al., 2024). Prevention efforts also include improving the nutritional status of pregnant women by consuming nutritious foods and supplements, such as iron tablets, folic acid, and vitamins, which must be taken at least 90 times during pregnancy. Advanced programs include early initiation of breastfeeding, exclusive breast milk until the age of six months, monitoring the growth and development of toddlers in integrated service settings, the implementation of a Clean and Healthy Lifestyle in the family, and improving the quality of the environment and clean water (Ademas et al., 2021; Wulandari et al., 2022). The Bojonegoro Regency Government also contributes through a program to improve the nutritional status of toddlers, which includes Nutrition Post activities, Positive *Deviance Method*, Foster Mothers, TFC (*Therapeutic Feeding Center*), Supplementary Feeding Recovery, and strengthening of the nutrition information system (Public Health Office, 2021). Strengthening partnerships between sectors is an essential step in supporting stunting prevention interventions.

Despite extensive evidence linking low birth weight (LBW) to stunting at the national level, studies examining this association in agricultural communities such as Temayang District, Bojonegoro, characterized by high rates of maternal agricultural employment and limited access to prenatal care, remain limited. Therefore, this study aims to determine the relationship between a history of low birth weight and the incidence of stunting in children aged 2–3 years in Temayang District, Bojonegoro Regency, Indonesia, providing locally relevant evidence to inform targeted interventions.

METHODS

Study Design and Protocol

This study employed a correlational analytical design with a cross-sectional approach to examine the association between birth weight history and stunting incidence in children aged 2–3 years.

Participants

This study's population consisted of 120 mother-child pairs registered at Temayang Community Health Center, Bojonegoro Regency. Inclusion criteria: (1) children aged 24–35 months at the time of data collection; (2) residing in Temayang District; (3) complete birth weight records available in health cards or medical records. Exclusion criteria: (1) children with congenital abnormalities affecting linear growth; (2) children whose parents refused to provide consent.

A total of 108 pairs were selected using stratified random sampling with proportional allocation across sub-villages. Birth weight data were retrieved from maternal health cards and Public Health Center records. Height was measured using a stadiometer (for children ≥ 24 months) calibrated before each session, conducted by trained healthcare workers. Stunting status was classified based on height-for-age z-score (HAZ) using WHO 2006 Child Growth Standards as referenced in Minister of Health Regulation Number 2 of 2020: normal ($HAZ \geq -2$ SD), short/stunted ($HAZ -3$ to < -2 SD), and very short/severely stunted ($HAZ < -3$ SD).

Data Collection and Data Analysis

Data were collected using two approaches. Independent variable (birth weight) data were extracted from secondary sources, specifically maternal health booklets and electronic health records at Temayang Community Health Center. Birth weight was recorded in grams and categorized as low birth weight (LBW) if < 2.500 grams, or normal if ≥ 2.500 grams.

The dependent variable (stunting status) was assessed through anthropometric measurement of child height by two trained midwives using a calibrated stadiometer. Height-for-age z-scores (HAZ) were calculated using WHO AnthroPlus software and classified according to the Minister of Health regulations Number 2/2020: very short ($HAZ < -3$ SD), short ($HAZ -3$ to < -2 SD), and normal ($HAZ \geq -2$ SD). Additional data (child age, sex, birth order and maternal characteristics) were obtained via a structured questionnaire administered by trained enumerators. The data obtained is then processed using *the Statistical Package for the Social Sciences (SPSS) for Windows* software. Descriptive analysis was carried out to describe variables through frequency distribution, percentage, and cross-tabulation between variables. To determine the relationship between independent and dependent variables, *the Chi-*

Square test was used with a significance criterion of $p < 0.05$, where if H_0 was rejected, there was a relationship between a history of low birth weight and the incidence of *stunting* in children aged 2–3 years in Temayang District. The level of relationship strength is measured using *the Contingency Coefficient* by interpreting the r value. Although multivariate logistic regression to control for potential confounders such as maternal education, age, and socioeconomic status was not performed in this study due to the exploratory scope of the analysis, the Odds Ratio (OR) was calculated to provide a more informative measure of association strength. Confounding adjustment is acknowledged as a limitation and is recommended for future studies.

Ethical Consideration

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was granted by the Ethics Committee of STIKes Rajekwesi Bojonegoro, with approval number 04/LPPM.STIKes.R/IX/2024, issued in September 2024. Prior to data collection, written informed consent was obtained from all parents or legal guardians of participating children. Participants were informed of the study's purpose, voluntary nature, and their right to withdraw at any time without consequence. Confidentiality of all personal data was maintained throughout the study.

RESULTS

Table 1. Characteristics of children aged 2-3 years

No	Characteristic	f	%
1	Age of child: 2 years	96	88.9
2	Female	57	52.8

Source: Primary data from questionnaire

Table 2. Mother's Characteristics in Bojonegoro

No	Characteristic	f	%
1	Mother's age: 21–30 years	96	88.9
2	Mother's education: high school level	54	50
3	Mother's occupation: farmer	57	52.8
4	Child order: firstborn	66	61.1

Source: Questionnaire primary from data

Table 3. Distribution of Low-Birth-Weight History in Bojonegoro

No	History of low birth weight	f	%
1	Weight: low	69	63.9
2	Weight: Normal	39	36.1
Total		108	100

Source: Questionnaire primary data

Based on Table 3 above, from 108 respondents, it shows that more than a part, namely 69 children aged 2-3 years (63.9%), have a history of low birth weight.

Table 4. Distribution of Nutritional Status (Height-for-Age) in Children Aged 2-3 Years

No	Nutritional Status (HAZ)	f	%
1	Severely Stunted	12	11.1
2	Stunted	33	30.6
3	Normal	63	58.3
4	Tall	0	0
Total		108	100

Source: Primary data from questionnaire

Based on Table 4, of 108 respondents, 45 (41.7%) experienced stunting

Table 5. Table of Relationships of Low-Birth-Weight History with Stunting in Children Aged 2-3 Years

No.	History of low birth weight	Stunting in children aged 2-3 years								Total	
		Very short		Short		Normal		Tall		F	%
		f	%	f	%	f	%	f	%		
1	Low	12	17.7	30	43.5	37	39.1	0	0	69	100
2	Normal	0	0	3	7.7	36	92.3	0	0	39	100
Total		12	11.1	33	30.6	63	58.3	0	0	108	100

P Value = 0.08

Source: Questionnaire primary data

Table 6. Chi-Square Analysis and Odds Ratio of Low-Birth-Weight (LBW) as a Predictor of Stunting

Variable	Stunted	Non-Stunted	Total	χ^2	p-value	OR (95% CI)
Birth Weight History						
Low Birth Weight	42	27	69	26.843	< 0.001*	18.67 (5.23 – 66.68)
Normal Birth Weight	3	36	39			
Total	45	63	108			

*Significant at $p < 0.05$

Source: Primary data processed (2026)

Based on Table 5, as many as 69 respondents had a history of low birth weight, and 30 children (43.5%) aged 2–3 years were recorded to have a short nutritional status. Meanwhile, of the 39 respondents without a history of low birth weight, the number of stunted children is fewer.

The statistical analysis using the Chi-Square test in Table 6 confirms a significant relationship between a history of low birth weight and stunting incidence ($p < 0.001$). To provide more informative data as suggested, the Odds Ratio (OR) was calculated. The results show an OR of 18.67 (95% CI: 5.23–66.68), which demonstrates that children with a history of low birth weight have 18.67 times higher odds of being stunted compared to those born with normal weight. This indicates that birth weight is a strong predictor of stunting among children aged 2–3 years in Temayang District, Bojonegoro Regency.

DISCUSSION

Summary of Main Findings

Based on Table 3.69, out of 108 children aged 2–3 years (63.9%) had a history of low birth weight (LBW). Low birth weight is defined as a birth weight of less than 2,500 grams (Islam et al., 2024). In addition, 43 of 108 children aged 2–3 years (68.5%) had normal nutritional status, while 12 children (11.1%) were categorized as very short. The study also found a statistically significant association between LBW and stunting among children aged 2–3 years ($\chi^2 = (\text{score})$, $p = 0.008$), with a contingency coefficient of 0.462 indicating a moderate relationship. These findings suggest that children with a history of LBW are more likely to experience impaired linear growth during early childhood.

Comparison with Other Studies

The high prevalence of LBW in this study may be associated with several maternal characteristics identified in the data, including young maternal age, low maternal education level, and maternal occupation. Most mothers were aged 21–30 years during data collection, suggesting that some may have experienced pregnancy at a younger age, which is recognized as a risk factor for LBW due to incomplete reproductive maturity (Lutfia & Al Farizi, 2024). Maternal education has been associated with a moderate but statistically significant decrease in the risk of delivering a LBW infant in low- and middle-income countries (Godah et al., 2021). Low birth weight has been shown to contribute to children's poor health and nutritional outcomes (Islam et al., 2024).

The findings of this study are also consistent with a cross-sectional study in Yogyakarta, which reported that 82.4% of LBW children experienced stunting. However, the proportion observed in this study (43.5%) was lower, possibly reflecting differences in postnatal nutritional support and healthcare access between regions. Based on cross-sectional studies conducted in Brazil, Ethiopia, and Indonesia, LBW was found to increase the incidence of stunting in children aged 0–60 months by 3.64 times compared to non-LBW children (aOR = 3.64; 95% CI = 2.70–4.90; $p < 0.001$) (Putri et al., 2021). Additional studies similarly demonstrated that low birth weight is a key determinant of undernutrition among children under five (Aboagye et al., 2022).

Biological and Theoretical Explanation

From a biological perspective, poor maternal nutrition and maternal obesity are risk factors for serious fetal complications and neonatal outcomes, including intrauterine growth restriction and low birth weight (Lassi et al., 2021). Pregnancy at a young age further increases the risk because reproductive organs may not yet be fully mature, thereby limiting optimal fetal

growth (Lutfia & Al Farizi, 2024). In addition, mothers working as farmers (52.8%) may experience physically demanding labor and limited dietary diversity during pregnancy, both of which could contribute to poor maternal nutritional status and subsequent LBW outcomes.

According to the WHO Child Growth Standards, stunting is defined based on an index of body length or height for age with a z-score of less than 2 standard deviations (Rahmadiani et al., 2024). Chronic malnutrition that causes stunting and wasting will result in delays in the development of cognitive processes and permanent cognitive impairment (Handryastuti et al., 2022). The negative impact of stunting and severe underweight on the cognitive neurodevelopment of children is well documented (Suryawan et al., 2022).

These findings support the Developmental Origins of Health and Disease (DOHaD) hypothesis. The DOHaD hypothesis refers to the influence of early developmental exposures and fetal growth on the risk of chronic diseases in later periods, with cell differentiation and tissue formation during fetal and early postnatal life influenced by several factors, including genes, environment, and intrauterine growth restriction (Nobile et al., 2022). Low birth weight has been identified as a leading cause of illness during early childhood and contributes to poor physical and nutritional development (Islam et al., 2024). Poor maternal nutrition during pregnancy may contribute to fetal growth restriction, which subsequently affects child growth and development after birth (Lassi et al., 2021).

Potential Biases

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design limits causal inference, although the temporal relationship between LBW and later stunting is biologically plausible. Second, the absence of multivariate analysis means that important confounding variables, such as maternal nutritional status, exclusive breastfeeding practices, household socioeconomic conditions, infection history, and healthcare access, were not controlled for and may partially explain the observed association. Third, the geographic scope was limited to Temayang District, Bojonegoro, thereby restricting the generalizability of the findings to other populations. Finally, birth weight data were obtained from secondary sources, including Maternal and Child Health Books and Community Health Center records, which may contain documentation inaccuracies or incomplete data. Future studies using prospective cohort designs and multivariate analysis are recommended to strengthen causal evidence and reduce potential bias.

CONCLUSIONS

This study demonstrates a significant relationship between low birth weight and stunting in children aged 2–3 years (P-value = 0.008; Contingency Coefficient = 0.462). Of 69 children with a history of low birth weight, 45 (41.7%) were stunted, confirming that low birth weight is a meaningful predictor of impaired linear growth in early childhood. Parents are encouraged to routinely attend integrated child care for growth monitoring, while healthcare workers should prioritize nutritional counseling during pregnancy and the first two years of life to prevent stunting. Future studies should examine additional factors such as breastfeeding practices and socioeconomic status to further understand this relationship.

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