International Archives of Medical Sciences & Public Health

E-ISSN : 2798-5172; P-ISSN : 2798-5276X
Volume 7, Number 1, 2026
DOI: 10.53806/iamsph.v7i1.1402
Page: 64–76

DETERMINANTS OF MOTHERS AND ACCESS TO HEALTH SERVICES IN RURAL WEST JAVA RELATED TO STUNTING INCIDENCE IN 2024

Erlin Listiyaningsih[1], **Padma Vidya Gayatri**[2], **Henny Hanna**[3]
[1,2,3]Universitas Muhammadiyah Prof. Dr. Hamka, Jakarta Selatan, Indonesia

Article Info

Article history:
Received : March 20, 2026
Revised : April 19, 2026
Accepted : May 15, 2026

Keywords:
Determine;
Maternal Education;
News;
Nutritional Knowledge;
Stunting.

ABSTRACT

Stunting is a public health problem that is influenced by maternal factors, child characteristics, and family socioeconomic conditions. This study aims to analyze the determinants of stunting incidence in toddlers in rural areas of Bogor Regency. The study used a cross-sectional design involving 184 mothers of toddlers who were selected through convenience sampling techniques. Data were collected using a structured questionnaire as well as direct measurement of child body length/height. Data analysis was carried out in a descriptive, bivariate, and multivariate manner using logistic regression. The results showed that the prevalence of stunting in the sample was 45.6%. Multivariate analysis showed that the age of the mother at marriage of 20–35 years was negatively related to the incidence of stunting ($AOR = 0.253$; 95% $CI : 0.111$–0.579; $p = 0.001$). Good maternal nutrition knowledge ($AOR = 0.391$; 95% $CI : 0.196$–0.782; $p = 0.008$) and family income $\geq$ minimum wage ($AOR = 0.435$; 95% $CI : 0.207$–0.913; $p = 0.028$) were also negatively associated with stunting. In contrast, low maternal education was positively associated with stunting incidence ($AOR = 2.293$; 95% $CI : 1.009$–5.210; $p = 0.047$). These findings confirm the importance of strengthening nutrition education and interventions focused on high-risk families for stunting prevention in rural areas.

Corresponding Author:
Erlin Listiyaningsih
University of Muhammadiyah Prof. Dr. Hamka
Email: : erlin.soedarmo@uhamka.ac.id

1. INTRODUCTION

Stunting is a linear growth disorder in children that reflects the accumulation of chronic malnutrition, recurrent infections, and suboptimal parenting conditions, especially from the prenatal period to the first 1,000 days of life.

Children are categorized as stunted if their height or height-for-age is below minus 2 standard deviations from the WHO Child Growth Standards [1]. This condition not only shows physical growth inhibition, but is also associated with impaired cognitive development, low learning capacity, decreased productivity in adulthood, and an increased risk of non-communicable diseases later in life [2],[3]. Therefore, stunting cannot be understood solely as an individual nutrition problem but as a human resource development problem with long-term impacts on the quality of the next generation.

Globally, stunting remains an unresolved public health agenda. A recent report by the Joint Child Malnutrition Estimates shows that stunting monitoring remains an important indicator for assessing progress towards achieving global nutrition targets, and the world is still not on track to achieve the 2030 Sustainable Development Goals target [4]. Other studies also confirm that maternal and child malnutrition remains a major burden in low- and middle-income countries, especially in households and poor groups with limited access to health services, nutritious food, sanitation, and education [5]. Thus, stunting needs to be studied through a multideterminant approach that includes mothers and families, socio-economic factors, and access to health services.

In Indonesia, stunting is still one of the top priorities for health development. Data from the Indonesian Health Survey show that the national stunting prevalence in 2023 is 21.5%, only down 0.1% from 2022, so the decline is not fast enough to meet the 2020-2024 RPJMN target of 14% [6]. In addition, the 2023 Indonesian Health Survey confirms that around one in five children under five in Indonesia are stunted, with many cases found in the age group of 24-35 months. These findings suggest that although the national prevalence of stunting has declined over the last decade, the problem still requires sharper, evidence-based, and regionally tailored interventions.

In West Java, this is important because the province is one of the regions with a high number of stunting cases nationally. Data from the West Java Provincial Government show that the prevalence of stunting among toddlers is available at the district/city level for the 2019–2024 period, thus allowing for the identification of more specific priority areas [7]. Bogor Regency is one of the areas with a stunting burden that needs attention because it has diverse socio-demographic characteristics, including rural areas with challenges in accessing health services, household economic inequality, and variations in family nutrition knowledge. In rural contexts, the risk of stunting can persist because families not only face limitations in accessing nutritious food but also face obstacles to using health services, low nutritional literacy, and parenting practices that do not fully support meeting children's nutritional needs.

The latest literature indicates that the determinants of stunting are complex and interact in complex ways. Maternal education is one of the factors consistently associated with children's nutritional status. A national study in Indonesia shows that the lower the mother's level of education, the more likely a child is to experience stunting [8]. Mothers with an elementary school education or below have a higher chance of having stunted children than mothers with higher education. Similar findings are reinforced by a recent systematic review confirming that maternal education affects children's growth and nutritional status, particularly through improved health literacy, quality of decision-making, feeding practices, and utilization of health services [9]. Thus, maternal education not only plays a role as a socioeconomic indicator but also as a determinant of family capacity in preventing child growth disorders.

In addition to education, knowledge of maternal nutrition is an important factor because it is directly related to food selection practices, age-appropriate feeding, responses to growth disorders, and utilization of growth monitoring services. Low literacy can prevent mothers from recognizing the risk of stunting early, especially since stunting often does not present as an acute disease. A systematic review of the literature shows that nutrition education improves children's knowledge, attitudes, skills, and nutritional status [10]. On the other hand, a family's economic status determines a household's ability to provide nutritious food, access health services, improve sanitation, and meet children's basic needs. Therefore, the relationship among nutritional knowledge, maternal education, family income, and access to health services needs further analysis to more comprehensively describe the determinants of stunting.

Although various studies have examined factors associated with stunting, most previous studies have emphasized family nutrition factors [10], Mother's Education [8], family socio-economic [11], and access to health services [12] separately. Meanwhile, studies that integrate maternal factors, family conditions, and access to health services into a single analytical model in rural areas remain limited. In fact, stunting is a multideterminant problem that requires simultaneous analysis to identify the strongest factors associated with it. Therefore, this study is important for providing empirical evidence from local contexts that can be used in programs to accelerate stunting reduction by strengthening maternal nutrition education, monitoring toddlers' growth, supporting families' socio-economic status, and optimizing community-based health services.

The urgency of this research is growing, as reducing stunting cannot be achieved solely by expanding access to health services; it also requires strengthening the quality of care, maternal nutrition literacy, women's education, and family socio-economic support. Community-based services such as Posyandu and Puskesmas have the potential to serve as the primary gateway for growth monitoring, nutrition education, child feeding counseling, and identifying at-risk families. However, the effectiveness of these services relies heavily on understanding the most relevant determinants at the local level. Based on the description above, the hypothesis of this study is low maternal education, lack of maternal nutritional knowledge, family income below the minimum wage, age of the mother at the time of marriage in the risk category, the age of the mother during pregnancy in the risk category, the status of working mothers, lack of clean and healthy living behavior, and access to unaffordable health services are positively related to the incidence of stunting in toddlers after controlling for maternal factors, characteristics of children, and family socioeconomic conditions. Conversely, the mother's age at marriage in the range of 20–35 years, good maternal nutrition knowledge, and family income that reaches or exceeds the minimum wage are hypothesized to be negatively related to stunting incidence. The hypothesis is formulated as a relationship hypothesis rather than a causal hypothesis, in line with a cross-sectional research design that does not allow for direct causal inference.

This study aims to analyze the relationships between maternal factors, family socioeconomic conditions, and access to health services and the incidence of stunting among toddlers in rural Bogor Regency, West Java, in 2024. In particular, this study assesses the role of maternal age, maternal age at marriage, maternal age during pregnancy, maternal education, maternal employment status, maternal nutritional knowledge, family income, healthy living behavior, and access to health services on stunting incidence. This research is expected to provide local evidence to strengthen the basis for planning family- and community-based stunting prevention programs, especially in rural areas with socioeconomic vulnerability and varying access to health services.

2. RESEARCH METHODS

This study used a quantitative, cross-sectional design to analyze the relationship between maternal factors, family socioeconomic conditions, access to health services, and stunting incidence among toddlers during a single observation period. The cross-sectional design was chosen because this study measures independent and dependent variables at a single time point, making it appropriate for identifying relationships between variables and illustrating the magnitude of stunting problems in a given population. However, this design is not used to infer a cause-and-effect relationship because it cannot confirm the temporal sequence between exposure and stunting incidence [13], [14].

The research will be conducted in rural Bogor Regency, West Java, in 2024. This location was chosen because rural areas still face challenges in stunting prevention, including differences in family socioeconomic conditions, variations in maternal nutrition knowledge, and limited access to basic health services such as Posyandu and Puskesmas. This study began with the identification of the target population, namely all mothers of toddlers aged 0-59 months who live in rural Bogor Regency, West Java. From this population, samples were determined based on inclusion and exclusion criteria. The inclusion criteria include mothers as the primary caregivers of toddlers (children aged 0-59 months), being domiciled at the research site, willingness to be respondents, and having complete data. Exclusion criteria include respondents who did not complete questionnaires, incomplete child anthropometric data, or unavailable primary research data.

Sampling was conducted using non-probability convenience sampling. This technique was chosen for technical reasons, as a comprehensive, up-to-date community sampling framework is not available for all mothers of toddlers in the study site's rural areas. Respondents were selected based on availability, affordability, suitability for inclusion criteria, and willingness to provide consent during the data collection period. The use of convenience sampling can lead to selection bias. [15], because the sample may be more representative of households that are easily accessible, present at the point of service, or have a higher tendency to seek health care. Therefore, the results of the study are interpreted as findings on the study sample and are not used to make population-level prevalence inferences. The formal response rate cannot be calculated precisely because there are no documented denominators of eligible populations in the sampling framework. However, 184 respondents who met the inclusion criteria and had complete data were included in the analysis.

$$n = \frac{Z^2 \times p\ (1-p)}{d^2}$$

Description:
n = minimum sample size; $Z = Z$ value at a 95% confidence level, which is 1.96;
p = estimated prevalence of stunting;
d = Acceptable precision or margin of error

In this study, the stunting prevalence estimate is based on the latest data from the 2024 Indonesian Nutrition Status Survey (SSGI). Because the research was conducted in West Java, the prevalence used is the 2024 stunting prevalence in West Java Province, 15.9% (0.159). This figure was chosen to align the sample size calculation more closely with the research area's context. SSGI 2024 data shows that the prevalence of stunting in West Java has decreased to 15.9%, while the national stunting prevalence is 19.8% [16], [17]. At a 95% confidence level, the prevalence of stunting in West Java is 15.9%; the precision is 7%; and, to account for incomplete or unresponsive data, the sample size is at least 115.5 respondents, so the minimum number of samples needed is 116. In this study, 184 mothers of children under 5 who met the inclusion criteria and had complete data were analyzed, exceeding the minimum sample size requirement based on the latest stunting prevalence estimate from SSGI 2024.

The dependent variable in this study is the incidence of stunting in toddlers. Stunting is defined as a condition in which height or height-for-age is below two standard deviations from the WHO median child growth standard. Children are categorized as stunted if the high-z-score is high-for-age or long-z-score is < -2 SD, while children are categorized as not stunted if the z-score value is ≥ -2 SD [18]. Independent variables included maternal age, maternal age at marriage, maternal age during pregnancy, maternal education level, maternal employment status, maternal nutritional knowledge, family income, clean and healthy living behaviors, and access to health services. The operational definitions of the research variables are as follows:

Table 1: Operational Definition of Research Variables

Variable	**Operational Definition**	**Category/Scale**
Stunting incidence	WHO standards define children's growth status based on height/height-for-age.	Stunting: z-score < -2 SD; non-stunting: z-score ≥ -2 SD
Mother's age	Mother's age at the time of data collection	Year; can be categorized as < 20 years, $20 - 35$ years, and > 35 years
Mother's age at marriage	The mother's age when she first married	Risk age: < 20 or > 35 years; Non-risk age: $20 - 35$ years old
Mother's age during pregnancy	The age of the mother during the pregnancy of the child who is the subject of the study	Risk age: < 20 or > 35 years; Non-risk age: $20 - 35$ years old
Mother's education	The last formal education completed by the mother	Elementary: $\leq$ Junior High School; High School: $>$ Junior High School
Mother's employment status	Activities of mothers who generate income or work outside/inside the home	Works; Not working
Maternal nutrition knowledge	Mother's level of understanding of children's nutritional needs, age-appropriate feeding, food selection, and stunting prevention	Score $0 - 20$; Good if the score is ≥ 15, less/bad if the score is < 15
Family income	Total family income compared to the applicable minimum wage	$<$ minimum wage; $\geq$ minimum wage
Clean and healthy living behavior	Mother/family practices related to hygiene, sanitation, and basic health behaviors	Score $0 - 10$; It's good if the score is ≥ 8, less if the score is < 8
Access to healthcare	Affordability of mothers and children to basic health services, such as Posyandu, Health Centers, growth monitoring, immunization, and maternal-child health services	Score $0 - 10$; Affordable if the score is ≥ 7, unaffordable if the score is < 7

Data were collected using structured questionnaires and anthropometric data of toddlers to determine stunting status. The structured questionnaire was prepared based on research objectives, a literature review on determinants of stunting, and results from measuring children's body length/height. The questionnaire was used to obtain information about maternal characteristics, child characteristics, family socioeconomic conditions, maternal nutritional knowledge, healthy living behaviors, and access to health services. Anthropometric data were used to determine the status of child stunting based on WHO standards. The instrument was validated through expert reviews in the fields of public health, nutrition, and/or mother-child health to assess the suitability of the question items with the research objectives and operational definition of variables; Instrument trials were conducted on a number of mothers under five outside the main research sample to ensure that respondents understood each question well, there were no ambiguous questions, and the questionnaire filling time was still in accordance with field conditions; test the validity of the question item using the corrected item-total correlation; and reliability tests were assessed using Cronbach's alpha coefficient on the scale of maternal nutrition knowledge, clean and healthy living behaviors (PHBS), and access to health services. A question item is considered feasible if it has a corrected total item correlation ≥ 0.30, and the scale is considered to have adequate internal consistency if Cronbach's $\alpha \geq 0.70$ [?], [?].

The research procedure was carried out in stages. The first stage is preparation, including instrument preparation, research site selection, enumerator training, and ethical approval management. The second stage is the recruitment of respondents in accordance with the inclusion and exclusion criteria. The third stage is the provision of research information and the taking of respondents' consent through informed consent. The fourth stage is to fill out questionnaires and collect anthropometric data. The fifth stage is data completeness checking, coding, data entry, and statistical analysis. This research must be conducted after obtaining ethical approval from the health research ethics committee. All respondents need to be provided with an explanation of their objectives, procedures, benefits, minimum risk, data confidentiality, and the right to refuse or terminate participation at any time. Respondents' identities are maintained using special codes, and all data is used only for research purposes.

Data analysis was carried out in stages: descriptive, bivariate, and multivariate. Descriptive analysis was used to characterize mothers, children, families, access to health services, and stunting status. Bivariate analysis was performed to assess the initial relationship between each independent variable and stunting incidence. The chi-square test is used for categorical variables, while the independent t-test is used for numerical variables that meet the assumption of normality. Furthermore, multivariate analysis was conducted using logistic regression because the dependent variables are dichotomous: stunting and non-stunting. The variables in the final model were selected using an enter approach based on the conceptual framework, theoretical relevance, epidemiological considerations, and bivariate analysis results. Variables that conceptually need to be controlled are retained in the model, although they are meaningless in bivariate analysis. This approach is used to reduce the risk of selecting variables that are solely driven by data, minimize bias from omitting important variables, and control potential overfitting by adjusting the number of predictors to the adequacy of the number of events in the data.

Before the final model is interpreted, the assumptions underlying logistic regression and its feasibility are examined using several diagnostic procedures. Multicollinearity among independent variables was assessed using the variance inflation factor (VIF) and tolerance, with VIF thresholds of < 10 and tolerance thresholds of > 0.10. The linearity of continuous predictors to logit outcomes was examined using the Box-Tidwell test. The model specifications are determined by the conceptual framework's suitability, epidemiological and clinical relevance, and data structure. Model suitability was evaluated using the Hosmer-Lemeshow test as a model calibration indicator, while Cox & Snell R^2 and Nagelkerke R^2 were reported as additional measures of model explainability. The results of bivariate analysis were reported as crude odds ratio (cOR), 95% confidence interval (CI), and p-value. In contrast, the results of multivariate analysis were reported as adjusted odds ratios (AORs), 95% CIs, and p-values. p-value < 0.05 is used as the threshold for statistical significance.

3. RESULTS AND ANALYSIS

This study involved 184 mothers who had toddlers aged 0-59 months in rural Bogor Regency, West Java. The analysis was carried out in three stages: descriptive analysis, bivariate analysis, and multivariate analysis using logistic regression. The dependent variable in this study was the incidence of stunting among toddlers. In contrast, the independent variables included maternal factors, child characteristics, family socioeconomic conditions, healthy living behaviors, and access to health services.

3.1 Characteristics of Respondents and Toddlers

A total of 184 mothers with children aged 0-59 months were analyzed in this study. Based on the basic characteristics of respondents, the average age of mothers is 31.8 years with an age range of 17–43 years, the average age of mothers at marriage is 21.9 years with an age range of 13–31 years, and around 40.8% or as many as 75 mothers are poorly educated, namely $\leq$ junior high school, and 17.9% or 33 mothers are working. Based on family economic conditions, 64.1% (118 families) have an income below the minimum wage. Based on toddler characteristics, the average age is 23.8 months, with a range of 2–52 months. Most of them were boys, comprising 107 children (58.2%). The prevalence of stunting in this study was 45.6%, which is 84 out of 184 children under five who were stunted. More details on the basic characteristics of mothers and toddlers are provided in Table 2 below.

Table 2: Characteristics of Mothers and Toddlers in Rural Bogor Regency in 2024

Characteristics	**Value**
Number of respondents	184
Mother's age, average (min–max)	31.8 years (17–43 years)
Mother's age at marriage, average (min–max)	21.9 years (13–31 years)
Primary education junior high school, n (%)	75 (40,8%)
Working mothers, n (%)	33 (17,9%)
Family income < minimum wage, n (%)	118 (64,1%)
Child's age, average (min–max)	23.8 months (2–52 months)
Child weight, average (min–max)	10.2 kg (3.7–17.8 kg)
Child height/length, average (min–max)	78.9 cm (48–100 cm)

Boys, n (%)	107 (58,2%)
Stunted children, n (%)	84 (45,6%)
Children are not stunted, n (%)	100 (54,4%)

3.2 The Relationship of Maternal Factors with the Incidence of Stunting in Toddlers

Bivariate analysis was performed to assess the relationship between each maternal factor and stunting incidence. The results of the bivariate analysis showed that low maternal education, working maternal status, and poor maternal nutritional knowledge were significantly associated with the incidence of stunting in toddlers. Mothers with low education were 2,684 times more likely to have stunted children than mothers with higher education ($cOR = 2,684$; 95% $CI : 1,313 - 5,486$; $p = 0.006$). Similarly, working mothers were 3,338 times more likely to have stunted children than non-working mothers ($cOR = 3,338$; 95% $CI : 1,420 - 7,846$; $p = 0.004$). In addition, mothers with poor nutritional knowledge were 2,170 times more likely to have a stunted child than mothers with good nutritional knowledge ($cOR = 2,170$; 95% $CI : 1,167 - 4,036$; $p = 0.014$). Thus, these three variables were significantly associated with the incidence of stunting in the bivariate analysis. In contrast, the mother's age at the time of pregnancy was < 20 or > 35 years ($cOR = 1.281$; 95% $CI : 0.501 - 2.778$; $p = 0.530$), and clean and healthy living behavior $cOR = 1.010$; 95% $CI : 0.279 - 3.429$; $p = 0.989$) did not show a meaningful association with stunting incidence in bivariate analysis.

Table 3: Bivariate Analysis of the Relationship between Maternal Factors and Stunting Incidence in Toddlers in Rural Bogor Regency in 2024

Variable	**Effect Size**	**95% CI**	**p-value**	**Interpretation**
Mother's age	Mean difference = -1.6 years	Not available	0,053	Insignificant; Approaching the Limit of Significance
Mother's age at marriage: 20–35 years old	cOR = 0.278	$0,136–0,571$	0,001	Protective factors
Mother's age at the time of pregnancy $<$ 20 or $>$ 35 years old	cOR = 1.281	$0,501–2,778$	0,530	Insignificant
Low maternal education	cOR = 2.684	$1,313–5,486$	0,006	Significant risk factors
Working mothers	cOR = 3.338	$1,420–7,846$	0,004	Significant risk factors
Poor maternal nutrition knowledge	cOR = 2.170	$1,167–4,036$	0,014	Significant risk factors
Clean and healthy living behaviors are lacking	cOR = 1.010	$0,279–3,429$	0,989	Insignificant

Source: Analysis Results, 2026
Description: cOR = gross odds ratio; CI = confidence interval. A p-value of < 0.05 indicates a statistically meaningful relationship.

3.3 Child Characteristics, Family Economy, and Access to Health Services

Table 4 shows a statistically significant difference in children's age between the stunting and non-stunting groups. The average age of children in the stunting group was higher, at 26.5 months, than in the non-stunting group, at 21.6 months ($p = 0.001$). These findings suggest that stunting incidence is higher among older toddlers, possibly reflecting cumulative exposure to chronic growth risk factors as children age. Meanwhile, the child's weight showed no significant difference between the stunting and non-stunting groups ($p = 0.618$). Child sex was also not significantly associated with the incidence of stunting ($cOR = 1,550$; 95% $CI : 0.805–2,634$; $p = 0.213$). Family income below the minimum wage was not significantly associated with stunting incidence, although the direction of the association indicated an increased likelihood of stunting ($cOR = 1.375$; 95% $CI : 0.749–2.523$; $p = 0.303$). Similarly, unaffordable access to healthcare also showed no meaningful association with stunting incidence ($cOR = 1.444$; 95% $CI : 0.502–4.155$; $p = 0.493$).

Table 4: Bivariate Analysis of Child Characteristics, Family Economy, and Access to Health Services in Rural Bogor Regency in 2024

Variable	Stunting Group	Non-Stunting Group	Effect Size	95% CI	p-value	Interpretation
Children's age, average	26.5 months	21.6 months	Mean difference = 4.9 months	Not available	0,001	Significant
Child's weight, on average	10.4 kg	10.1 kg	Average difference = 0.3 kg	Not available	0,618	Insignificant
Male gender	53 children	54 children	cOR = 1,550	0,805–2,634	0,213	Insignificant
Family income < minimum wage	68 children	51 children	cOR = 1.375	0,749–2,523	0,303	Insignificant in bivariate
Access to healthcare is unaffordable	10 children	6 children	cOR = 1.444	0,502–4,155	0,493	Insignificant

Source: Analysis Results, 2026
Description: cOR = gross odds ratio; CI = confidence interval

3.4 Factors Related to Stunting Incidence

Multivariate analysis was performed using logistic regression to identify factors associated with stunting incidence, adjusting for other variables in the model. Before interpreting the results of the multivariate logistic regression, a diagnostic examination is performed to assess the model's feasibility. The results of the multicollinearity examination showed that all independent variables had variance inflation factor (VIF) values in the range of 1.068–1.424 and tolerance values in the range of 0.702–0.936. These values met the criteria of VIF < 10 and tolerance > 0.10, indicating no significant multicollinearity among the independent variables in the model. Furthermore, the linearity of continuous predictors with respect to logit outcomes was tested using the Box-Tidwell approach. The test results showed $\beta = -0.010$, $SE = 0.462$, and $p = 0.982$. Because $p > 0.05$, the assumption of logit linearity for the continuous predictor is met. The model's suitability was evaluated using the Hosmer-Lemeshow test, yielding $\chi^2(8) = 7.835$, $p = 0.450$. These results show no significant difference between the model-predicted probability of stunting and the observed events, indicating adequate calibration. Thus, the multivariate logit regression model used in this study is suitable for interpretation because it does not exhibit meaningful multicollinearity, meets the assumption of logit linearity for continuous predictors, and is well-suited according to the Hosmer-Lemeshow test.

Table 5: Results of the diagnostic examination of the logistic regression model

Model Inspection	Empirical Results	Criteria	Conclusion
VIVID	$1,068 - 1,424$	< 10	No meaningful multicollinearity
Tolerance	$0,702 - 0,936$	> 0.10	No meaningful multicollinearity
Box-Tidwell	$\beta = -0.010$; $SE = 0.462$; $p = 0.982$	$p > 0.05$	Logit linearity met
Hosmer-Lemeshow	$\chi^2(8) = 7.835$; $p = 0.450$	$p > 0.05$	The model has an adequate fit

Source: Analysis Results, 2026

The results of the final model showed that the mother's age at marriage, maternal education, maternal nutritional knowledge, and family income were significantly associated with the incidence of stunting. The mother's age at marriage (20–35 years) was a protective factor against stunting, with an AOR of $0.253(95\%\ CI: 0.111–0.579$; $p = 0.001$). Thus, married mothers at the age of 20-35 years have a lower chance of having stunted children than married mothers of risk age. Low maternal education is a risk factor for stunting. Mothers with low education had about 2.3 times the chance of having a stunted child than mothers with higher education, after controlling for other variables in the model ($AOR = 2.293; 95\%\ CI: 1.009–5.210$; $p = 0.047$). Good maternal nutrition knowledge was protective against stunting, with an AOR of $0.391(95\% CI, 0.196–0.782$; $p = 0.008$). This means that mothers with good nutritional knowledge have a lower chance of having stunted children compared to mothers with poor nutritional knowledge. Family income $\geq$ the minimum wage is also a protective factor, with an AOR of $0.435(95\%\ CI, 0.207–0.913$; $p = 0.028$). Working maternal status was associated with an increased likelihood of stunting, but the result was at the limit of statistical significance ($AOR = 2.491; 95\%\ CI: 0.984–6.309$; $p = 0.054$). Therefore, these variables are not inferred as statistically significant risk factors, but they still need to be interpreted with caution as they approach the limit of significance.

Table 6: Multivariate Logistics Regression Final Model of Factors Associated with Stunting Incidence

Variable	β	**S.E.**	**AOR**	**95% CI**	**p-value**	**Interpretation**
Mother's age	$-0,637$	0,515	0,529	$0,193 - 1,450$	0,216	Insignificant
Mother's age at marriage: $20 - 35$ years old	$-1,373$	0,422	0,253	$0,111 - 0,579$	0,001	Significant protective factors
Mother's age at the time of pregnancy < 20 or > 35 years old	$0,723$	0,568	2,060	$0,677 - 6,269$	0,203	Insignificant
Low maternal education	$0,830$	0,419	2,293	$1,009 - 5,210$	0,047	Significant risk factors
Working mothers	$0,913$	0,474	2,491	$0,984 - 6,309$	0,054	Close to significant
Good maternal nutrition knowledge	$-0,939$	0,353	0,391	$0,196 - 0,782$	0,008	Significant protective factors
Family income $\geq$ minimum wage	$-0,832$	0,378	0,435	$0,207 - 0,913$	0,028	Significant protective factors

Source: Analysis Results, 2026
Description: β = regression coefficient; S.E. = standard error; AOR = adjusted odds ratio; CI = confidence interval. The $p < 0.05$ value was considered statistically significant. The Cox & Snell R Square value is 0.179, indicating that the model explains about 17.9% of the variation in stunting incidence among toddlers.

Overall, the study results show that the prevalence of stunting among toddlers in rural Bogor Regency remains high. The final logistic regression model showed that the most consistent factors associated with stunting incidence were the mother's age at marriage, maternal education, maternal nutritional knowledge, and family income. The mother's age at marriage (20-35 years), good knowledge of maternal nutrition, and family income $\geq$ minimum wage reduce the likelihood of stunting. On the other hand, low maternal education increases the likelihood of stunting in toddlers.

Table 7: Summary of the Direction of the Determinant Relationship of Stunting Based on the Final Model

Factors	**AOR**	**95% CI**	**p-value**
Protective Factors			
Mother's age at marriage 20–35 years old	0,253	0,111–0,579	0,001
Good maternal nutrition knowledge	0,391	0,196–0,782	0,008
Family income $\geq$ minimum wage	0,435	0,207–0,913	0,028
Risk Factors			
Low maternal education	2,293	1,009–5,210	0,047
Working mothers	2,491	0,984–6,309	0,054
Mother's age at the time of pregnancy < 20 or > 35 years old	2,060	0,677–6,269	0,203

4. DISCUSSION

This study found that the prevalence of stunting in toddlers in rural Bogor Regency reached 45.6% in the study sample. This figure indicates a high stunting burden among the respondents studied. Still, it should be interpreted with caution because convenience sampling can bias the sample toward households that are easily accessible to health services or have certain socioeconomic vulnerabilities. Thus, the prevalence of 45.6% is not intended as an estimate of the population prevalence in Bogor Regency or West Java Province, especially because this figure is higher than the 2024 stunting prevalence in West Java of 15.9%. Nevertheless, these findings are important because they show that rural subgroups are at high risk of stunting and require more targeted interventions. These findings are consistent with the understanding that stunting is a multifactorial problem influenced by not only nutritional intake but also maternal education, nutritional knowledge, family economic conditions, parenting practices, and access to health services [**?**], [3]. In the rural context, the high prevalence of stunting can reflect a combination of limited family resources, variations in nutritional literacy, and a lack of optimal detection and prevention of growth risks from an early age.

4.1 Mother's Age at Marriage and Stunting Incidence

The results of the study showed that mothers aged 20-35 at the time of marriage were protected against stunting. In the multivariate model, mothers who were married at the age of 20-35 years had a lower chance of having stunted children than mothers who were married at a risk age, with $AOR = 0.253$; 95% $CI : 0.111–0.579$; $p = 0.001$. These findings suggest that a later marriage age may be associated with a mother's biological, psychological, social, and economic readiness to carry a pregnancy, care for a child, and use health services. This finding is consistent with research by Suhartanti and Rusfitasari, which shows that early marriage can negatively affect parental attention and children's growth and development [?]. Mothers who marry too young tend to face limitations in reproductive readiness, education, family decision-making, and access to resources. However, these results differ from those of Permatasari et al. and Aninora, who reported that age at marriage is not necessarily significantly associated with stunting [?], [?]. These differences suggest that the influence of age on stunting may not operate in isolation but interact with maternal education, family economic status, social support, and quality of caregiving.

The mother's age at the time of marriage can be interpreted as an indirect indicator of family readiness. Mothers who marry later in life have the opportunity to achieve a better education, greater economic stability, and stronger parenting capacity. Therefore, stunting prevention needs to be integrated with efforts to prevent marriage at risk ages, adolescent reproductive health education, and strengthening the readiness of expectant mothers before pregnancy.

4.2 Maternal Education and Stunting Incidence

Low maternal education was a risk factor for stunting in this study. In a multivariate model, mothers with low education had about 2.3 times the chance of having stunted children than mothers with higher education, with an AOR of 2.293(95% $CI : 1.009–5.210$; $p = 0.047$). These findings suggest that maternal education remains an important determinant, even after controlling for other variables in the model. These results are consistent with the research of Laksono et al., which showed that maternal education is associated with the incidence of stunting in children under the age of two in Indonesia [8]. Permatasari et al.'s research also identified maternal factors, including education, as determinants of stunting incidence [?]. More broadly, Vaivada et al. emphasized that maternal education is one of the social factors contributing to variation in stunting incidence among children [3].

Maternal education affects stunting through several paths. Highly educated mothers generally have a better ability to understand health information, choose nutritious foods, follow health professionals' recommendations, recognize signs of growth disorders, and use child health services appropriately. In contrast, low education can limit a mother's understanding of a child's nutritional needs, age-appropriate feeding practices, and the importance of regular growth monitoring. Therefore, stunting prevention interventions are not enough to provide health services; it is also necessary to ensure that mothers with different levels of education understand nutritional information.

4.3 Mother's Employment Status and Stunting Incidence

Working maternal status was associated with an increased risk of stunting in bivariate analyses and remained a significant predictor in multivariate models. However, in the final model, the relationship was on the cusp of statistical significance, with an AOR of 2.491(95% $CI : 0.984–6.309$; $p = 0.054$). Thus, maternal work cannot be considered a statistically significant risk factor, but it remains important to discuss because the direction of the relationship suggests a tendency to increase risk. These findings show that the relationship between maternal work and stunting is contextual. Amelia suggests that maternal work may be associated with stunting incidence, but the effects may vary depending on parenting patterns, family support, breastfeeding, and socioeconomic conditions [?]. Beal et al. also emphasized that the determinants of stunting in Indonesia do not operate in isolation but interact among household factors, parenting practices, and socioeconomic status [?].

In a rural context, working mothers may have limited time to provide direct care, monitor feeding, and regularly take children to Posyandu. However, a mother's work can also increase family income and expand access to information. Therefore, a mother's employment status should not be understood as always detrimental. The practical implication is that stunting prevention programs need to provide support for working mothers, for example, through strengthening the role of caregiver families, more flexible Posyandu schedules, easily accessible nutrition counseling, and continuous growth monitoring.

4.4 Maternal Nutrition Knowledge and Stunting Incidence

Good maternal nutrition knowledge has been proven to be a protective factor against stunting. In the multivariate model, mothers with good nutritional knowledge had a lower risk of stunting, with an AOR of 0.391(95% CI, 0.196–0.782; $p = 0.008$). These findings show that nutritional knowledge is a modifiable factor and plays an important role in stunting prevention. The results of this study are consistent with Arnita et al., who found that mothers' knowledge and attitudes are associated with efforts to prevent stunting in toddlers [?]. Dwijayanti et al. also showed that maternal characteristics and nutritional knowledge are associated with the incidence of stunting among toddlers aged 12-59 months [?]. These findings are also supported by Forh et al., who affirm that the nutritional knowledge and practice of mothers or caregivers affects the nutritional status of children aged $6-59$ months [?].

Conceptually, nutritional knowledge affects stunting through child-feeding practices, food selection, feeding frequency, dietary variation, use of animal proteins, complementary breastfeeding (MP-AS), and utilization of growth monitoring services. Bentley et al. emphasize the importance of responsive feeding practices in preventing child nutrition problems [?]. Thus, improving maternal knowledge is not only about theoretical understanding but also about practical skills in feeding children according to age and growth needs.

The practical implication of this finding is the need to strengthen nutrition education based on Posyandu and Puskesmas. Education is not enough in general, but needs to be adjusted to the problems that are often faced by families, such as children who have difficulty eating, a lack of animal protein consumption, MP-ASI patterns that are not appropriate for age, and low understanding that stunting can occur even if children seem active and not acutely sick.

4.5 Family Income and Stunting Incidence

Family income $\geq$ minimum wage was a protective factor against stunting incidence in the multivariate model, with an AOR of 0.435(95% CI, 0.207–0.913; $p = 0.028$). These findings show that families with a minimum income equivalent to the minimum wage have a lower chance of having stunted children compared to families with incomes below the minimum wage. These results are in line with Agustin and Rahmawati, who found a relationship between family income and stunting incidence [?]. Family income plays a role in a household's ability to provide nutritious food, access health services, meet sanitation needs, and support a better, nurturing environment. However, the results of this study differ from those of Sari and Zelharsandy and Fitri and Nursia, who reported that family income was not always significantly associated with stunting [?], [?]. These differences in findings suggest that family income can work through indirect channels. Higher income does not necessarily reduce the risk of stunting unless it is accompanied by nutritional knowledge, appropriate food-spending priorities, good sanitation, and use of health services. On the other hand, families with limited incomes can still reduce the risk of stunting if they have good nutritional literacy, family support, and strong access to basic health services. Therefore, family economic interventions need to be integrated with nutrition education and community service strengthening.

4.6 Access to Health Services and Stunting Events

In the bivariate analysis, unaffordable access to health care was not significantly associated with stunting incidence ($cOR = 1.444$; 95% CI : 0.502–4.155; $p = 0.493$). The results of the study show that the affordability of health services alone is not enough to explain the incidence of stunting in the study population. These findings are in line with Hermawan et al., who show that access to health services is not always significantly associated with stunting [?]. Access to health services is statistically meaningless if the variables measured include only physical affordability, such as distance or ease of access to facilities, but do not include the quality of services, intensity of visits, completeness of growth monitoring, quality of nutrition counseling, or follow-up for children with developmental disabilities. Interpretively, the results of this study show that families who live close to Posyandu or Puskesmas do not necessarily receive optimal benefits if nutrition services are not used regularly, education is not well understood, or growth monitoring is not followed up appropriately. Therefore, stunting prevention programs need to shift from simply increasing access to improving service quality. Posyandu and Puskesmas need to strengthen stunting risk screening, individual nutrition counseling, continuous growth monitoring, home visits for at-risk families, and responsive referral systems.

4.7 Clean and Healthy Living Behaviors and Stunting Incidence

Clean and healthy living behaviors were not significantly associated with stunting incidence in this study ($cOR = 1.010$; 95% CI : 0.279–3.429; $p = 0.989$). The results of this study show that the measured clean and healthy living practices are not directly related to the incidence of stunting in the study population. These findings are in line with Amahorseja et al., who reported that the knowledge, attitudes, and practices of clean and healthy living behaviors of parents of toddlers are not necessarily significantly related to stunting incidence [?]. Rachmawati et al. also showed that health practices from an early age do not always account for the incidence of stunting [?]. Theoretically, clean and healthy living behaviors remain important because hygiene, sanitation, and the prevention of recurrent infections can affect a child's nutritional status. However, the influence of clean and healthy living behaviors on stunting may not be evident if other factors, such as maternal education, family income, and nutritional knowledge, make a stronger contribution to the research model. Thus, these results do not mean that clean and healthy living behaviors are not important. Instead, clean and healthy living behaviors should be integrated into interventions alongside nutrition education, growth monitoring, dietary improvement, and strengthening family sanitation. To prevent stunting, clean and healthy living behaviors must be targeted to specific practices, such as washing hands with soap before preparing children's food, using healthy latrines, preventing diarrhea, and ensuring the hygiene of complementary foods (MP-ASI).

4.8 Children's Age and Characteristics of Toddlers

Children's ages differed significantly between the stunting and non-stunting groups, with the average age of stunted children higher than that of non-stunted children (26.5 months vs 21.6 months; $p = 0.001$). These findings show that stunting is more often identified in older toddlers. This can happen because stunting is the result of accumulated chronic malnutrition and repeated exposure to risk factors. Hence, the older the child, the more likely it is that linear growth disorders are seen. These findings are consistent with the concept of stunting as a chronic growth problem that lasts from pregnancy to the first two years of life and can continue if left untreated [2], [3]. Therefore, early growth monitoring, especially during ages 0-24 months, is important to prevent children from entering a stunting phase that is more difficult to reverse.

Child sex was not significantly associated with stunting incidence in this study ($cOR = 1.550$; 95% CI : 0.805–2.634; $p = 0.213$). The results showed that, in the study population, the risk of stunting was explained more by maternal and family factors than by the child's sex. Children's weight also did not differ significantly between the stunting and non-stunting groups, which is understandable because stunting is more reflective of linear growth disorders, as measured by height or height-for-age, rather than just weight.

4.9 Practical and Policy Implications

The findings of this study have important implications. Still, they should be understood as recommendations for at-risk groups and regions with similar characteristics, rather than as a basis for generalizations about the population at large. First, stunting prevention in rural Bogor Regency needs to prioritize strengthening maternal nutrition literacy, especially for low-educated mothers. Nutrition education needs to be delivered in simple, practice-based, and repeated language through Posyandu, Puskesmas, classes for mothers under five, and home visits. Second, stunting prevention programs need to pay attention to family socioeconomic factors. The results of the study show that family income $\geq$ minimum wage is protective against stunting. Therefore, low-income families need to be prioritized in nutrition education, growth monitoring, nutritious food assistance, and referrals to social protection programs. Third, the age of the mother at the time of marriage, which has been proven to be protective, shows the importance of preventing marriage at a risk age and strengthening the reproductive health of adolescents. Stunting intervention must not only begin after birth but also in adolescence, among bride-to-be, during pregnancy, and in the first 1,000 days of life. Fourth, access to health services needs to be improved not only in terms of affordability but also in service quality. Posyandu and Puskesmas need to ensure that counseling, follow-up, home visits, and clear referrals for children at risk of stunting are part of growth monitoring.

Overall, the results of this study confirm that stunting in rural Bogor Regency, West Java, is closely related to determinants at the maternal and family levels. Low maternal education increases the likelihood of stunting, whereas a mother's age at marriage of 20-35 years, good maternal nutrition knowledge, and family income $\geq$ minimum wage reduces the likelihood of stunting. Access to health services and clean, healthy living behaviors do not show a statistically significant relationship but remain important as part of an integrated intervention. Therefore, stunting prevention needs to be carried out through a family and community approach that integrates nutrition education, growth monitoring, family economic support, prevention of early marriage, and improvements in the quality of services at Posyandu and Puskesmas.

5. CONCLUSION

This study shows that the incidence of stunting in toddlers in rural areas of Bogor Regency is related to maternal factors and family socioeconomic conditions. The mother's age at marriage (20–35 years), good maternal nutritional knowledge, and family income that reaches or exceeds the minimum wage are negatively associated with the incidence of stunting. On the other hand, low maternal education was positively associated with the incidence of stunting after adjustment for other variables. These findings underscore the importance of nutrition education, family capacity building, and strengthening interventions in vulnerable maternal groups and families. This study has limitations because it uses a cross-sectional design, which cannot establish causal relationships. In addition, the use of convenience sampling limits the generalization of research results to a wider population. Questionnaire-based data also have the potential to introduce memory and social desirability biases. Further research is recommended to use a longitudinal design with probability sampling techniques to ensure more representative results and to explain temporal relationships. Other variables such as the child's history of infection, diet, environmental sanitation, family food security, and quality of care also need to be considered in future research.

REFERENCES

[1] World Health Organization, "Stunting in a nutshell," 2015. https://www.who.int/news/item/19-11-2015-stunting-in-a-nutshell.

[2] A. Soliman *et al.*, "Early and long-term consequences of nutritional stunting: From childhood to adulthood," *Acta Biomedica*, vol. 92, no. 1, 2021. https://doi.org/10.23750/abm.v92i1.11346.

[3] T. Vaivada, N. Akseer, S. Akseer, A. Somaskandan, M. Stefopulos, and Z. A. Bhutta, "Stunting in childhood: An overview of global burden, trends, determinants, and drivers of decline," *The American Journal of Clinical Nutrition*, 2020. https://doi.org/10.1093/ajcn/nqaa159.

[4] UNICEF, WHO, and World Bank Group, "Levels and trends in child malnutrition," 2025. https://www.who.int/publications/i/item/9789240112308.

[5] C. G. Victora, P. Christian, L. P. Vidaletti, G. Gatica-Domínguez, P. Menon, and R. E. Black, "Revisiting maternal and child undernutrition in low-income and middle-income countries: Variable progress towards an unfinished agenda," *The Lancet*, 2021. https://doi.org/10.1016/S0140-6736(21)00394-9.

[6] Badan Kebijakan Pembangunan Kesehatan, "Survei kesehatan indonesia 2023 dalam angka," 2023.

[7] Pemerintah Provinsi Jawa Barat, "Prevalensi balita stunting berdasarkan kabupaten/kota di jawa barat 2019–2024." https://opendata.jabarprov.go.id/id/dataset/prevalensi-balita-stunting-berdasarkan-kabupatenkota-di-jawa-barat.

[8] A. D. Laksono, R. D. Wulandari, N. Amaliah, and R. W. Wisnuwardani, "Stunting among children under two years in indonesia: Does maternal education matter?," *PLoS One*, vol. 17, no. 7, 2022. https://doi.org/10.1371/journal.pone.0271509.

[9] G. Rezaeizadeh *et al.*, "Maternal education and its influence on child growth and nutritional status during the first two years of life: A systematic review and meta-analysis," *eClinicalMedicine*, vol. 71, 2024. https://doi.org/10.1016/j.eclinm.2024.102574.

[10] Y. B. Prasetyo, P. Permatasari, and H. D. Susanti, "The effect of mothers' nutritional education and knowledge on children's nutritional status: A systematic review," *International Journal of Child Care and Education Policy*, 2023. https://doi.org/10.1186/s40723-023-00114-7.

[11] D. Darmiati, L. Djara, M. Marni, and G. Oematan, "Socioeconomic determinants of stunting among toddlers in the working area of tarus health center, kupang regency," *Timorese Journal of Public Health*, vol. 6, no. 3, pp. 143–151, 2024. https://doi.org/10.35508/tjph.v6i3.20706.

[12] E. J. Katuche, A. S. L. Bolang, and V. P. K. Lengkong, "Analysis of toddler health service access and stunting incidence in east bolaang mongondow regency," *Viva Medika: Jurnal Kesehatan, Kebidanan dan Keperawatan*, vol. 17, no. 3, pp. 516–526, 2025. https://doi.org/10.35960/vm.v17i3.1753.

[13] M. Setia, "Methodology series module 3: Cross-sectional studies," *Indian Journal of Dermatology*, vol. 61, no. 3, p. 261, 2016. https://doi.org/10.4103/0019-5154.182410.

[14] J. P. Vandenbroucke *et al.*, "Strengthening the reporting of observational studies in epidemiology (strobe): Explanation and elaboration," *International Journal of Surgery*, vol. 12, no. 12, pp. 1500–1524, 2014. https://doi.org/10.1016/j.ijsu.2014.07.014.

[15] S. K. Lwanga and S. Lemeshow, *Sample Size Determination in Health Studies: A Practical Manual*. 1991. https://doi.org/10.2307/2290547.

[16] Dinas Kesehatan Provinsi Jawa Barat, "Stunting jawa barat turun jadi 15,9 persen pada 2024." https://diskes.jabarprov.go.id/postingan/stunting-jawa-barat-turun-jadi-159-persen-pada-2024-684fd850bbabf159fb23444e.

[17] Kementerian Kesehatan Republik Indonesia, "Ssgi 2024: Prevalensi stunting nasional turun menjadi 19,8%." https://kemkes.go.id/id/ssgi-2024-prevalensi-stunting-nasional-turun-menjadi-198.

[18] World Health Organization, *WHO Child Growth Standards*. Geneva: World Health Organization, 2006. https://www.who.int/tools/child-growth-standards.