

Original Article

Multifactorial Determinants of Adolescent Stunting in West Java, Indonesia: A Cross-Sectional Analysis Among Students Aged 13–15 Years

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ABSTRACT

Background: Stunting in adolescents remains a significant public health concern, with far-reaching implications for physical and cognitive development that extends into adulthood. This condition, characterized by a height below minus two standard deviations (-2 SD) from the WHO median growth standard, stems from chronic malnutrition and inadequate growth during critical developmental periods. **Objective:** This study aimed to identify factors influencing the incidence of stunting among adolescents aged 13–15 years at SMP Negeri 2 Cikarang Barat in 2022. **Methods:** A descriptive analytical study using a cross-sectional approach was conducted from March to June 2022. This study employed total sampling and recruited 34 adolescents who met the inclusion criteria. Data were collected via validated questionnaires and standardized anthropometric measurements. Statistical analysis included univariate descriptive statistics and bivariate analysis via the chi-square test ($\alpha = 0.05$). **Results:** The analysis revealed significant associations between the incidence of stunting and several factors, including nutritional patterns ($P = 0.027$), birth weight ($P = 0.046$), birth length ($P = 0.048$), breastfeeding history ($P = 0.048$), immunization status ($P = 0.050$), and family income ($P = 0.027$). The predominant characteristics of the study population were female sex (67.6%), unfulfilled nutritional patterns (70.6%), low birth weight (64.7%), and short birth length (67.6%). Additionally, 67.6% reported a nonexclusive breastfeeding history, and 70.6% came from low-income families. **Conclusion:** This study identified multiple significant factors associated with adolescent stunting, emphasizing the complex interplay between early-life factors, nutritional patterns, and socioeconomic conditions. Maternal age at delivery, height, education, and employment status were not significantly associated. These findings suggest a need for comprehensive interventions targeting both nutritional and socioeconomic factors to address adolescent stunting effectively.

KEYWORDS

Growth disorders, adolescent health, nutritional status, socioeconomic factors, body height, stunting

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INTRODUCTION

Adolescence (ages 10–19) represents a critical developmental phase characterized by significant physical, mental, and socioeconomic changes [1]. With the substantial global adolescent population, their role as future leaders necessitates comprehensive preparation to ensure their physical, mental, and spiritual well-being. One significant challenge affecting adolescent development is stunting, which is defined as impaired growth and development caused by poor nutrition, recurrent infections, and inadequate psychosocial stimulation [2–4].

The World Health Organization (WHO) health data from 2020 revealed varying stunting prevalence across continents: Africa (31.70%), Asia (30.10%), America (8.90%), and Europe (5.70%) [5]. In Indonesia, recent data from the Indonesian Nutritional Status Survey (SSGI) conducted in January 2023 revealed a decrease in stunting prevalence from 24.4% to 21.6%. However, globally, UNICEF reports that approximately 149 million children still experience stunting due to early-life malnutrition, maternal nutritional deficiencies, and poor sanitation conditions [6–8].

Multiple studies have identified various factors contributing to stunting, including maternal education, family income, nutritional knowledge, exclusive breastfeeding, protein consumption, infectious diseases, genetics, birth spacing, maternal employment, family size, immunization status, energy adequacy, and low birth weight [7,9–15]. Recent research by Aryanti et al. [16] demonstrated significant correlations between parental knowledge, attitudes, economic status, and stunting incidence in adolescents aged 13–15 years.

At SMP Negeri 2 Cikarang Barat, preliminary observations in 2022 identified 34 students meeting the stunting criteria among 259 seventh-grade students within a total school population of 974. This study aimed to investigate and analyze the factors influencing stunting incidence among adolescents (13–15 years) at SMP Negeri 2 Cikarang Barat in 2022, contributing to a broader understanding of adolescent stunting in Indonesian educational settings.

MATERIALS AND METHODS

Study design and setting

This study employed a descriptive analytical approach with a cross-sectional design and was conducted from March to June 2022 at SMP Negeri 2 Cikarang Barat, Indonesia [17,18]. This study aimed to identify the factors influencing the incidence of stunting among adolescents aged 13–15 years through systematic data collection and analysis.

Sample, criteria and sampling technique

The study population consisted of all students aged 13–15 years who met the stunting criteria according to the WHO growth standards (height-for-age below -2 SD from the median). Using a total sampling technique, 34 respondents who fulfilled the inclusion criteria were recruited. The inclusion criteria were students aged 13–15 years who were enrolled at SMP Negeri 2 Cikarang Barat, were classified as stunted on the basis of WHO growth standards, and were willing to participate with parental consent. Students with chronic diseases or physical disabilities that affect their growth were excluded from the study.

Data collection

Instruments and Procedures Data were collected via a structured questionnaire that was validated through expert judgment and reliability testing (Cronbach's alpha > 0.7) [18]. The questionnaire captured information on multiple variables: nutritional patterns were assessed via a 24-hour food recall and food frequency questionnaire; birth history data, including weight and length, were obtained from maternal and child health books; breastfeeding history and immunization status were verified through immunization cards; and family income and maternal characteristics were documented through direct interviews. Anthropometric measurements were conducted via standardized equipment, with height measured via a stadiometer (0.1 cm precision), while participants stood without shoes in an upright position.

Ethical considerations

The study protocol was approved by the Ethics Committee of STIKes Medistra, Indonesia (institutional review board approval number: 421.3/107.113). Written informed consent was obtained from all the participants and their parents or guardians prior to data collection. Confidence in participant information was maintained throughout the study, and participation was voluntary, with the right to withdraw at any time without consequences

Statistical analysis

Data analysis was performed via SPSS version 25.0 software. Univariate analysis describes the frequency distribution of each variable, whereas bivariate analysis employs chi-square tests to examine the relationships between variables, with a significance level of $\alpha = 0.05$ [19]. For contingency tables with expected frequencies less than five, Fisher's exact test was applied to ensure statistical validity

RESULTS

Demographic characteristics of the participants

The study conducted at SMP Negeri 2 Cikarang Barat revealed significant findings regarding adolescent characteristics and stunting factors. Among the 34 participants, the sex distribution revealed a female predominance (67.6%, $n=23$) over a male predominance (32.4%, $n=11$). The age distribution indicated that 61.8% ($n=21$) of the patients were 13 years old, whereas 38.2% ($n=13$) were 14 years old. Notably, 70.6% ($n=24$) of the adolescents had unfulfilled nutritional patterns, whereas only 29.4% ($n=10$) met nutritional requirements. In terms of birth characteristics, 64.7% ($n=22$) had low birth weights (LBWs), and 67.6% ($n=23$) had short birth lengths. The distribution of adolescent characteristics is shown in [Table 1](#).

Maternal characteristics revealed that 67.6% ($n=23$) practiced nonexclusive breastfeeding, whereas 32.4% ($n=11$) practiced exclusive breastfeeding. The immunization status was relatively balanced, with 52.9% ($n=18$) meeting the requirements. Notably, 55.9% ($n=19$) of the mothers were in the high-risk age category during delivery, and 61.8% ($n=21$) were classified as having short stature. Family income analysis revealed that 70.6% ($n=24$) of mothers in the low-income category and 52.9% ($n=18$) of mothers were unemployed. The distribution of maternal characteristics is shown in [Table 2](#).

Table 1. Distribution of adolescent characteristics

Characteristics	N	%
Gender		
Female	23	67,6
Male	11	32,4
Age		
13 years old	21	61,8
14 years old	13	38,2
15 years old	0	0
Nutritional pattern		
Fulfilled	10	29,4
Less fulfilled	24	70,6
Birth weight		
Low Birth Weights	22	64,7
Not low birth weights	12	35,3
Birth length		
Short	23	67,6
Normal	11	32,4

Table 2. Distribution of maternal characteristics

Characteristics	N	%
Breastfeeding history		
Exclusive breastfeeding	11	32,4
Nonexclusive breastfeeding	23	67,6
Immunization status		
Immunization met	18	52,9
Immunization not met	16	47,1
Maternal age at delivery		
Age 20-35 years	15	44,1
High risk age	19	55,9
Mother's height		
Short	21	61,8
Normal	13	38,2
Family opinion		
Low	24	70,6
Medium	10	29,4
Mother's employment status		
Employed	16	47,1
Not working	18	52,9

Correlation testing

Statistical analysis via chi-square tests revealed several significant relationships with stunting incidence, as presented in Table 3. Nutritional patterns showed a significant correlation ($p=0.027$), birth weight ($p=0.046$), birth length ($p=0.048$), breastfeeding history ($p=0.048$), and family income ($p=0.027$), all of which demonstrated statistically significant relationships with stunting as presented in Table 3.

Table 3. Distribution of factors influencing the incidence of stunting in adolescents

Variables	Very short		Short		P value
	N	%	N	%	
Nutrition pattern					
Fulfilled	4	66,7%	6	21,4%	0,027
Less fulfilled	2	33,30%	24	78,6%	
Birth Weight					
Low Birth Weights	6	100%	16	57,1%	0.05
Not low birth weights	0	0	12	42,9%	
Length Of Birth					
Short	2	3,3%	21	72,0%	0,048
Normal	4	66,7%	7	25,0%	
Breast Milk History					
Exclusive breastfeeding	4	66,7%	7	25,0%	0.05
Nonexclusive breastfeeding	2	33,3%	23	75,0%	
Immunizations					
Not fulfilled	1	16,7%	17	60,7%	0.05
fulfilled	5	83,3%	11	39,3%	
Mother's age at delivery					
20-35 years old	2	33,3%	13	46,4%	0.56
High risk age	4	66,7%	15	53,6%	

Variables	Very short		Short		P value
	N	%	N	%	
Maternal Height					
Normal	2	33,3%	19	67,9%	0.11
Short	4	66,7%	9	32,1%	
Mother's Education					
Elementary and junior high school	1	16,7%	10	35,7%	0.37
High school-college	5	83,3%	18	64,3%	
Income family					
Below the minimum wage	2	33,3%	22	78,6%	0.03
minimum wage	4	66,7%	6	21,4%	
Mother's occupation					
Not working	2	33,3%	16	57,1%	0.29
work	4	66,7%	12	42,9%	

Remarks: ns indicates not significant, the p-value is above 0.05, with a significance level of 95%.

DISCUSSIONS

The findings revealed multiple interconnected factors that contribute to adolescent stunting. The significant relationship between nutritional pattern and stunting ($p=0.027$) underscores the crucial role of adequate nutrition in adolescent growth and development. This finding aligns with the fundamental principles of growth and development, in which proper nutrition serves as a cornerstone for optimal physical development [20–22]. The significant correlation between birth weight and stunting ($p=0.046$) supports the research of Kusumajaya et al. [20], which demonstrated that low birth weight (LBW) infants experience slower growth patterns. This is particularly noteworthy in small gestational age (SGA) babies, where intrauterine growth retardation begins during pregnancy and continues postnatally, affecting both physical and neurological development before 20 weeks of gestation [10,23,24].

The significant relationship between birth length and stunting ($P =0.048$) highlights the importance of early growth parameters in predicting future growth trajectories. The study revealed that postnatal factors compound the effects of birth length, as evidenced by the progressive decline in height-for-age z scores over time. These findings suggest that stunting is not solely determined by birth characteristics but is significantly influenced by postbirth nutritional and environmental factors [25–29]. The significant correlation between breastfeeding history and stunting ($p=0.048$) highlights the critical role of exclusive breastfeeding in early development. As a high-quality protein source, breast milk not only supports optimal growth but also enhances immune function and recovery from illness. However, the study revealed a concerning trend in which mothers with limited education often lack awareness of the importance of exclusive breastfeeding [20,23,30,31].

Maternal age at delivery ($p=0.558$) and height ($p=0.114$) were not significantly related to stunting; these factors cannot be dismissed entirely. This study suggests that good parenting practices and adequate nutrition can potentially overcome genetic predispositions to stunting, even in cases of short maternal stature [32]. Family income emerged as a significant factor ($p=0.027$), demonstrating how economic status directly affects nutritional quality and quantity. Low-income families often face limitations in providing varied and nutritionally adequate diets, as they typically allocate most of their resources to basic food procurement. This economic constraint creates a cycle that perpetuates stunting across generations [2,5,7].

Interestingly, maternal employment status ($p=0.289$) and educational level ($p=0.365$) were not significantly correlated with stunting. This suggests that access to nutritional information through various media channels might compensate for formal educational limitations and that employment status alone does not affect a child's growth outcomes. Instead, the quality of care and nutritional provision appear to be more influential than maternal employment status [8,16,31]. These findings collectively emphasize the multifaceted nature of stunting in adolescents

and highlight the need for comprehensive interventions that address nutritional, socioeconomic, and healthcare factors simultaneously. This study particularly underscores the importance of early-life interventions, from pregnancy through early childhood, in preventing adolescent stunting.

Public health implications

This study's findings have several important implications for public health practices and policies. The significant relationships among nutritional patterns, birth characteristics, and stunting suggest the need for comprehensive early intervention programs. Healthcare providers should implement enhanced prenatal care protocols focusing on maternal nutrition and monitoring fetal growth to prevent low birth weight and short birth length. The strong correlation between family income and stunting implies that economic support programs and nutritional assistance should be targeted at low-income families, particularly during periods of critical growth. Additionally, the significance of breastfeeding history suggests a need for strengthened breastfeeding education and support programs, especially in communities with limited resources. These findings also indicate that school-based nutrition programs should be developed to address ongoing nutritional deficiencies in adolescents, particularly in areas with a high prevalence of stunting.

Limitations

This study had several methodological limitations that should be considered when interpreting the results. First, the cross-sectional design limits the ability to establish causal relationships between the identified factors and stunting outcomes. The relatively small sample size ($n=34$) may have affected the statistical power and generalizability of the findings to a broader population. Additionally, reliance on retrospective data collection methods, particularly for birth history and early childhood information, could have introduced recall bias. The focus of this study on a single school in Cikarang Barat may not fully represent the diversity of adolescent populations in other regions or socioeconomic contexts. Furthermore, the study did not account for potential confounding variables such as genetic factors, environmental conditions, and detailed dietary compositions that could influence stunting. The use of self-reported data for some variables, particularly nutritional patterns and family income, may have introduced reporting bias.

CONCLUSIONS

Stunting in adolescents aged 13-15 years was significantly associated with nutritional patterns, birth weight, birth length, breastfeeding history, immunization status, and family income. While maternal characteristics such as age at delivery, height, education, and employment status were not significantly correlated, this study highlights the crucial role of economic factors in determining nutritional outcomes. These findings emphasize the need for integrated interventions that address both immediate nutritional needs and underlying socioeconomic factors. Future public health initiatives should focus on preventive measures beginning from pregnancy through early childhood while considering the broader social determinants of health. This study contributes to the growing body of evidence supporting comprehensive approaches to prevent stunting and highlights the importance of early intervention in breaking the intergenerational cycle of malnutrition and stunting.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization, Methodology, Software, Writing - Original Draft: G.F; Formal analysis, Validation, Data Curation, Supervision, Writing - Review and Editing: M.B.K; Investigation, Resources, Visualization, Project administration, Funding acquisition: R.S.M.

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