Vol. 8, Issue 2, August 2026, pp 566-578
https://doi.org/10.36590/jika.v8i2.2041
http://salnesia.id/index.php/jika
jika@salnesia.id, p-ISSN: 2337-9847, e-ISSN: 2686-2883
Penerbit: Sarana Ilmu Indonesia (salnesia)

RESEARCH ARTICLES

Study of Stunting Determinants in the Highest-Prevalence Area of Southeast Sulawesi, Indonesia

Studi Determinan Stunting di Wilayah dengan Prevalensi Tertinggi di Sulawesi Tenggara, Indonesia

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Abstract

While national interventions like the Free Nutritious Meal Program and breastfeeding promotion have shown regional success in Southeast Sulawesi, Buton District experiences a paradoxical rise in stunting. This study aimed to analyze the determinants of stunting in this high-prevalence area. A case-control study was conducted in the 6 subdistricts of Buton District from July to September 2025, involving 106 mothers of children aged 6–59 months (53 stunted and 53 non-stunted). Bivariate and multivariate logistic regression were used to identify factors associated with stunting. Multivariate analysis showed that younger age (aOR = 0.92; 95% CI: 0.87–0.97; p = 0.002), primigravida status (aOR = 0.07; 95% CI: 0.00–0.78; p = 0.031), higher maternal education (aOR = 0.01; 95% CI: 0.00–0.26; p = 0.004), and higher household income (high: aOR = 0.01; 95% CI: 0.00–0.13; p = 0.001; medium: aOR = 0.05; 95% CI: 0.00–0.92; p = 0.044) were protective against stunting. Other variables, including exclusive breastfeeding, maternal history of chronic energy deficiency, iron supplementation, drinking water treatment, and household size, were not significant. The model demonstrated good explanatory power (Nagelkerke R^2 = 0.665) and fit (*Hosmer–Lemeshow* = 0.830). Maternal education and household income are key determinants of stunting in Buton District. Interventions should target maternal knowledge, economic empowerment, and support for multigravida mothers to reduce stunting in high-risk areas.

Keywords: children, determinants, SES, stunting

Article history :

Submitted 19 April 2026
Accepted 17 May 2026
Published 05 August 2026

PUBLISHED BY:
Sarana Ilmu Indonesia (salnesia)
Address:
Jl. Dr. Ratulangi No. 75A, Baju Bodoa, Maros Baru, Kab. Maros, Provinsi Sulawesi Selatan, Indonesia

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Abstrak

Meskipun intervensi nasional seperti Program Makan Bergizi Gratis (MBG) dan promosi ASI eksklusif telah menunjukkan keberhasilan di Sulawesi Tenggara, Kabupaten Buton justru mengalami peningkatan stunting yang kontradiktif. Penelitian ini bertujuan untuk menganalisis determinan stunting di wilayah dengan prevalensi tinggi tersebut. Penelitian ini menggunakan desain case-control yang dilaksanakan di enam kecamatan di Kabupaten Buton pada Juli–September 2025. Sampel terdiri dari 106 ibu yang memiliki anak usia 6–59 bulan, masing-masing 53 kasus stunting dan 53 kontrol. Analisis bivariat dan regresi logistik multivariat digunakan untuk mengidentifikasi faktor yang berhubungan dengan stunting. Analisis multivariat menunjukkan bahwa usia ibu yang lebih muda (aOR = 0,92; 95% CI: 0,87–0,97; p = 0,002), status primigravida (aOR = 0,07; 95% CI: 0,00–0,78; p = 0,031), pendidikan ibu yang lebih tinggi (aOR = 0,01; 95% CI: 0,00–0,26; p = 0,004), serta pendapatan rumah tangga yang lebih tinggi (tinggi: aOR = 0,01; p = 0,001; sedang: aOR = 0,05; p = 0,044) merupakan faktor protektif terhadap stunting. Variabel lain seperti ASI eksklusif, riwayat kekurangan energi kronis, suplementasi zat besi, pengolahan air minum, dan jumlah anggota rumah tangga tidak berhubungan signifikan. Model menunjukkan kecocokan yang baik (Nagelkerke R^2 = 0,665; Hosmer–Lemeshow = 0,830). Pendidikan ibu dan pendapatan rumah tangga merupakan determinan utama stunting di Kabupaten Buton. Intervensi perlu difokuskan pada peningkatan pengetahuan ibu dan pemberdayaan ekonomi untuk menurunkan stunting di wilayah berisiko tinggi.

Kata kunci: *anak, determinan, SES, stunting*

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Highlight:

- High maternal education and household income are the strongest protective factors against child stunting.
- Younger maternal age and first-time pregnancy (*primigravida*) significantly lower stunting risk.
- Exclusive breastfeeding, maternal energy deficiency history, iron supplements, and drinking water treatment lost statistical significance in the multivariate model.

INTRODUCTION

Stunting is one of the most serious chronic nutritional problems in Indonesia and poses long-term consequences for human capital development. Children who experience stunting are at risk not only of impaired physical growth but also delayed cognitive development, reduced productivity, and an increased risk of chronic diseases in adulthood (Popkin et al., 2020; Duke et al., 2022). According to the 2023 Indonesian Nutritional Status Survey (SSGI), the national stunting prevalence was 21.6%, exceeding both the WHO threshold of 20% and Indonesia's national target of 14% (Rahmat et al., 2021).

Although national figures have shown gradual improvement since 2022, several provinces and districts continue to report high prevalence rates. One of the most affected regions is Southeast Sulawesi Province, particularly Buton District. The 2023 Indonesian Health Survey (SKI) reported stunting rates of 37.2% in Buton and 37.1% in South Buton, the highest in the province (Kemenkes, 2023).

Multiple factors contribute to the high prevalence of stunting in this region.

Socioeconomic determinants, particularly low household income and parental education plays a significant role. In 2024, the poverty rate in Buton reached 13.77%, with the poverty line set at Rp. 313,831 per capita per month (Rahmat et al., 2021). Moreover, the average education level in Buton is equivalent to only the first year of junior high school (BPS, 2019). Prior research has demonstrated that mothers with limited education and financial resources are less likely to provide optimal care, increasing the risk of stunting in their children (Leroy et al., 2014; Mbuma et al., 2021).

Health-related factors further compound the issue. Nutritional deficiencies during pregnancy and infancy remain among the leading causes of stunting (Fitriani et al., 2020; Nisa et al., 2022; Laltanpuii et al., 2024). In Buton District, exclusive breastfeeding coverage is only 47.5%. In addition, data from 2023 indicate that 17.56% of the population in Buton Regency faces food insecurity, highlighting a significant challenge in ensuring adequate food access for a portion of the community (Rahmat et al., 2021; Fadhlurrahman, 2023). Additionally, the high incidence of infectious diseases such as acute respiratory infections (ARI) and diarrhea increases children's nutritional needs and worsens their overall health status, thereby contributing to stunting (Gayawan et al., 2022; Orunmoluyi et al., 2022; Nasrin et al., 2023). Although recent data on diarrhea and ARI prevalence in Buton are limited, these conditions remain major public health concerns in Southeast Sulawesi (Kemenkes, 2023).

Several government programs have been implemented to address stunting, including the Free Nutritious Meal Program (MBG), iron supplementation (TTD), exclusive breastfeeding promotion, and child growth monitoring. These interventions have shown effectiveness in improving nutritional outcomes in various parts of Southeast Sulawesi (Kemenkeu, 2024). However, in Buton District, stunting rates have continued to rise. According to E-PPGBM data, stunting prevalence increased from 16.79% in 2023 to 21.32% in 2024 (PEMKAB, 2024). Therefore, this study aims to analyze the determinants of stunting in Buton District by examining the relationships between social, economic, health, and environmental factors and stunting prevalence, and to provide evidence-based policy recommendations for reducing stunting in high-burden areas.

METHODS

This study employed a case-control design using primary data collected in the working area of the Barangka Community Health Center, Buton District, Southeast Sulawesi, which consists of six subdistricts in June-September 2025. The research was conducted among mothers with children aged 6–59 months. The population comprised all children under five living in the study area. Children in the case group (stunted) were diagnosed by health personnel based on WHO growth standards, defined as height-for-age more than two standard deviations below the median (WHO, 2015), while the control group consisted of non-stunted children with normal height-for-age according to the same standards. Cases were selected purposively based on diagnostic criteria, whereas controls were chosen using simple random sampling from the same population. A total of 106 respondents were included, comprising 53 cases and 53 controls. The sample size was calculated using a case-control formula with a 95% confidence level, 80% statistical power, an assumed odds ratio of 3, and proportions of 0.56 for cases and 0.30 for controls.

The dependent variable in this study was stunting, while independent variables included maternal, paternal, household, environmental, child, and antenatal care characteristics. Maternal and paternal characteristics consisted of age, age at marriage, age at first pregnancy, gravidity, education, and occupation. Maternal education was categorized into low (no schooling to junior high school), medium (senior high or vocational school), and high (higher education), while maternal occupation was grouped as housewife, civil servant,

entrepreneur, or others. Paternal education was similarly classified into low, medium, and high, and occupation into services, civil servant, entrepreneur, farmer, laborer, or fisherman. Household characteristics included income and expenditure, with income divided into high (>Rp. 2,500,000), medium (Rp. 1,500,000–2,500,000), and low (≤Rp. 1,500,000). Environmental variables covered the source and treatment of drinking water, drinking water storage, and the distance between the water source and septic tank. Child-related factors included age, sex, birth weight, household size, and history of infection, while antenatal care variables encompassed frequency of visits, maternal chronic energy deficiency, supplementary feeding, and iron supplementation.

Data collection was conducted through structured interviews with mothers using questionnaires, combined with direct observations of household environmental conditions. Bivariate analyses were carried out using Chi-square, Fisher's exact, independent t-test, and Mann–Whitney U test where appropriate to assess associations between independent variables and stunting. Variables with a p-*value* < 0.1 and those considered clinically or theoretically relevant were subsequently included in a multivariate logistic regression model. The results were presented as odds ratios with 95% confidence intervals. Multicollinearity was examined, and the Hosmer–Lemeshow test was applied to evaluate the goodness of fit of the final model. The explanatory power of the logistic regression model was assessed using Nagelkerke R^2. This research was conducted in accordance with ethical principles for studies involving human participants. Informed consent was obtained from all respondents after explaining the study objectives, procedures, and participants' rights, including confidentiality. All data were stored securely and used solely for research purposes. Ethical approval was obtained from the Academic Integrity Committee of Institut Sains Teknologi dan Kesehatan Aisyiyah Kendari with approval number 004/KIA-ISTEKAK/VIII/2025.

RESULTS AND DISCUSSIONS

Maternal, paternal, and household characteristics

Table 1 presents the general characteristics of respondents based on group. The median age of mothers was similar between the two groups (32 years; $p = 0.242$). The case group had a higher proportion of mothers with lower educational attainment and those working as housewives ($p = 0.040$ and $p = 0.035$, respectively). This group also had significantly lower household income ($p < 0.001$) and higher household expenditure ($p < 0.001$). There were no significant differences between groups in terms of residential location, age at marriage for both mothers and fathers, or age at first pregnancy ($p > 0.05$). Additionally, the case group had a significantly higher proportion of multigravida mothers ($p = 0.002$).

Children characteristics

Table 2 presents the characteristics of children in the case (stunted) and control (non-stunted) groups. Children in the case group had a higher median age of 38 months compared to 23 months in the control group ($p = 0.017$).

Table 1. Relationship of maternal, paternal, and household characteristics and stunting in children under five in Buton district

Variables	Group		p-value
	Case (n=53)	Control (n=53)	
Mother's current age, median (range)	32 (19-48)	32 (21-45)	0.242[a]
Subdistrict			0.637[a]
Barangka	9 (17.0)	15 (28.3)	

Variables	Group		p-value
	Case (n=53)	Control (n=53)	
Boneatiro	9 (17.0)	10 (18.9)	
Boneatiro Barat	11 (20.8)	8 (15.1)	
Kamelanta	2 (40.0)	3 (5.7)	
Mabulugo	13 (24.5)	12 (22.6)	
Wakalambe	9 (17.0)	5 (9.4)	
Mother's age at marriage, median (range)	20 (14-41)	21(15-37)	0.144[a]
Father's age at marriage, median (range)	25 (15-42)	25 (16-40)	0.792[a]
Mother's age at first pregnancy	21 (14-31)	21 (15-38)	0.074[a]
Household size, median (range)	5 (2-11)	4 (2-9)	0.017 [a*]
Gravidity			
Primigravida	3 (5.7)	15 (28.3)	0.002[b**]
Multigravida	50 (94.3)	38 (71.7)	
Mother's education			
Low	28 (52.8)	16 (30.2)	
Medium	14 (26.4)	25 (47.2)	0.040[b**]
High	11 (20.8)	12 (22.6)	
Mother's occupation			
Housewife	50 (94.3)	39 (73.6)	
Civil servant	2 (3.8)	8 (15.1)	0.035[b**]
Entrepreneur	0 (0)	6 (11.3)	
Others	1 (1.9)	0(0)	
Father's education			
Low	25 (47.2)	21 (39.6)	
Medium	20 (37.7)	18(34.0)	0.352[b]
High	8 (15.1)	14 (26.4)	
Father's occupation			
Services	0(0)	5 (9.4)	
Civil servant	3 (5.7)	3 (5.7)	
Entrepreneur	6 (11.3)	8 (15.1)	0.202[b]
Farmer	12 (22.6)	7 (13.2)	
Laborer	5 (9.4)	7 (13.2)	
Fisherman	27 (50.9)	23 (43.4)	
Household income			
High	3 (5.7)	20 (30.7)	
Medium	14 (26.4)	23 (43.4)	<0.001[b**]
Low	36 (67.9)	10 (18.9)	
Household expenditure (Rp), median (range)	1.500.000 (1.250.000-6.000.000)	2.000.000 (1.500.000-3.000.000)	<0.001[b**]

Note: [a*]Uji Mann-Whitney U test; [b**]Uji Chi-Square or Fisher's Exact test, significant if p-value < 0.05

There was no significant difference in sex distribution between the two groups (p = 0.693). Birth weight also did not differ significantly (p = 0.164), although a greater proportion of children in the control group were born with a birth weight ≥2500 grams. The case group had a larger household size, with a median of 5 family members, compared to 4 in the control group (p = 0.017). History of infection showed no significant difference between

the two groups (p = 0.819). Children who were exclusively breastfed were significantly less likely to be stunted compared to those who were not (96.2% vs 75.5%, p = 0.002).

Table 2. Relationship of children's characteristics and stunting in Buton district

Variables	Group		p-value
	Case (n=53)	Control (n=53)	
Age (months), median (range)	38 (17-54)	23(6-57)	0.017 [a*]
Sex			
Male	21 (39.6)	23 (43.3)	0.693[b]
Female	32 (60.4)	30 (56.6)	
Birth weight			
<2500 gr	10 (18.9)	5 (9.4)	0.164[b]
≥2500 gr	43 (81.1)	48 (90.6)	
Household size, median (range)	5 (2-11)	4 (2-9)	0.017 [a*]
History of infection (in last 3 months)			
Yes	12 (22.6)	13 (24.5)	0.819[b]
No	41 (77.6)	40 (75.5)	
Exclusive breastfeeding			
Yes	51 (96.2)	40 (75.5)	0.002[b**]
No	2 (3.8)	13 (24.5)	

Note: [a*]Uji Mann-Whitney U test; [b**]Uji Chi-Square or Fisher's Exact test, significant if p-value < 0.05

Environmental characteristics

Table 3 presents the characteristics of access to clean water between the case (stunted) and control (non-stunted) groups. The case group reported a significantly higher use of piped water/PDAM/pump as the main source of drinking water (85.6%) compared to the control group (64.2%) (p = 0.008). However, there was no significant difference in the distance between the clean water source and the septic tank between the two groups (p = 0.315). Regarding drinking water treatment, a significantly greater proportion of the case group boiled their water (86.6%) compared to the control group (62.3%) (p = 0.004). In terms of drinking water storage, the majority of respondents in both groups used covered containers, with no significant difference observed (p = 0.500).

Table 3. Relationship of environmental characteristics and stunting in Buton district

Variables	Group		p-value
	Case (n=53)	Control (n=53)	
Main source of drinking water			
Piped water/PDAM/pump	45 (85.6)	34 (64.2)	0.008*
Refilled/packaged water	7 (13.5)	19 (35.8)	
Distance between clean water source and septic tank			
≥10 meters	1 (1.9)	0 (0)	0.315
<10 meters	52 (98.1)	53(100)	
Drinking water treatment			
Boiled	46 (86.6)	33 (62.3)	0.004*
Filtered	7 (13.2)	20 (37.2)	
Drinking water storage			
Covered container	52 (98.1)	53 (100)	0.500

Variables	Group		p-value
	Case (n=53)	Control (n=53)	
Uncovered container	1 (1.9)	0 (0)	

Note: *Uji Chi-Square or Fisher's Exact test, significant if p-value < 0.05

Antenatal care history

Table 4 shows the antenatal care (ANC) characteristics between the stunted and non-stunted groups. The stunted group had a higher median number of ANC visits (5 vs. 2; p = <0.001). A higher proportion of mothers in the stunted group had a history of chronic energy deficiency (47.2% vs. 28.3%; p = 0.045). There were no significant differences in the receipt of supplementary feeding for CED (p = 0.845) or in the regular consumption of iron supplements (p = 0.080).

Table 4. Relationship of antenatal care history and stunting in Buton district

Variables	Group		p-value
	Case	Control	
ANC frequency, median (range)	5 (1-9)	2 (1-2)	<0.001[a*]
History of Chronic Energy Deficiency (CED)			
Yes	25 (47.2)	15 (28.3)	0.045[b*]
No	28 (52.8)	38 (71.7)	
Received Supplementary Feeding for CED			
Yes	24 (45.3)	23 (43.4)	0.845[b]
No	29 (54.7)	30 (56.6)	
Regularly consumed iron supplements (TTD)			
Yes	46 (86.8)	51 (96.2)	0.080[b]
No	7 (13.2)	2 (3.8)	

Note: [a*]Uji Mann-Whitney U test; [b**]Uji Chi-Square or Fisher's Exact test, significant if p-value < 0.05

Multivariate analysis

The multivariate analysis (Table 5) showed that several factors were independently associated with stunting among children in Buton District, with the model demonstrating good explanatory power (Nagelkerke R^2 = 0.665) and fit (*Hosmer–Lemeshow test* = 0.830). The multivariate analysis identified child age, maternal gravidity, maternal education, and household income as significant determinants of stunting. Younger age was protective, with each additional month associated with increased odds of stunting (aOR = 0.92; 95% CI: 0.87–0.97; p = 0.002). Children of primigravida mothers were less likely to be stunted compared to those of multigravida mothers (aOR = 0.07; 95% CI: 0.00–0.78; p = 0.031). Higher maternal education reduced the risk of stunting (aOR = 0.01; 95% CI: 0.00–0.26; p = 0.004), while medium education was not significant. Household income showed a strong protective effect, with high (aOR = 0.01; 95% CI: 0.00–0.13; p = 0.001) and medium income (aOR = 0.05; 95% CI: 0.00–0.92; p = 0.044) associated with lower odds compared to low income. Other factors, including exclusive breastfeeding, maternal history of chronic energy deficiency, iron supplementation, drinking water treatment, and household size, were not significantly associated with stunting.

Table 5. Multivariate logistic regression analysis of factors associated with stunting among children in Buton District

Variables	aOR (95% Confidence Interval)	p-value

Variables	aOR (95% Confidence Interval)	p-value
Age (months)	0.92 (0.87-0.97)	0.002*
Exclusive breastfeeding		
Yes	Reference	0.136
No	0.19 (0.02:1.67)	
Gravidity		
Primigravida	0.07 (0.00:0.78)	0.031*
Multigravida	Reference	
Mother's education		
Low	Reference	
Medium	0.70 (0.15:3.21)	0.649
High	0.01 (0.00:0.26)	0.004*
Household income		
High	0.01 (0.00:0.13)	0.001*
Medium	0.05 (0.00:0.92)	0.044*
Low	Reference	
History of CED		
Yes	0.69 (0.16:2.92)	0.073
No	Reference	
Regularly consumed iron supplements (TTD)		
Yes	0.09 (0.00:3.73)	0.207
No	Reference	
Drinking water treatment		
Boiled	Reference	0.064
Filtered	0.21 (0.04:1.09)	
Household Size	0.92 (0.63:1.35)	0.703

Note: *aOR = Adjusted Odds Rasio, ; CI = Confidence Interval. Values derived from multiple logistic regression analysis, significant if p-value < 0.05. Model fit was assessed via Hosmer–Lemeshow test p = 0.830, Nagelkerke R^2 = 0.665

The results of the multivariate analysis show that maternal socioeconomic status, particularly education and income play a significant role in the incidence of stunting among children in Buton District. Education and household income have long been identified as major factors contributing to stunting. A systematic review by Ramlan et al. (2025) which analyzed 298 articles from 1980 to 2024, found that poverty and stunting remain key issues affecting child development, especially in developing countries.

Maternal education is a more consistent factor influencing stunting (Ohonba et al., 2019; Cendana dan Kim, 2025). In contrast, the relationship between household income and stunting remains controversial. One study found a significant relationship between maternal and paternal education and stunting, but no significant relationship with household income (Khotimah et al., 2023). In this study, both maternal education and household income were the main factors influencing stunting. Our findings show that children with stunting are more likely to come from families with low maternal education and low household income. This results in limited capacity to meet adequate nutritional needs, as mothers with low education may have limited knowledge about nutritious feeding and appropriate childcare practices. Research shows that maternal knowledge of nutrition-focused care is closely linked to education level (Haryanti et al., 2024).

In addition, low household income also limits access to nutritious food. A study in the United States that developed a multidimensional tool to assess access to nutritious food

among low-income populations highlighted that access to healthy food is strongly influenced by economic, social, and spatial-temporal factors (Flocke et al., 2017). The study showed that many low-income individuals face barriers in accessing adequate nutritious food (Monroe-Lord et al., 2024). Furthermore, households with lower income also tend to experience greater food insecurity, which restricts their ability to obtain nutritious foods. However, a meta-analysis found that as per capita income increases, food demand elasticity including for nutritious foods declines, except for certain items such as vitamins and fish products (Zhao et al., 2022). These differences may be due to habitual, cultural preferences and varying levels of nutrition awareness across individuals and families.

Gravidity is another independent factor in this study. Our findings are consistent with previous evidence showing that higher maternal parity is an important determinant of stunting. In Indonesia, studies have reported that multigravida mothers are more likely to have stunted children, with paritas significantly associated with stunting prevalence (Septiani et al., 2020; Rahayu et al., 2023). This association is further supported by large-scale international research. A multi-country analysis of Demographic and Health Survey (DHS) data from 33 Sub-Saharan African countries demonstrated that children of higher-parity mothers faced a significantly greater risk of stunting and poor health outcomes, underscoring parity as a consistent determinant across diverse populations (Finlay et al., 2017). Taken together, these findings suggest that maternal gravidity may influence caregiving capacity, resource allocation, and overall child nutritional outcomes, thereby increasing the risk of stunting.

Our study also found that older children were more likely to be stunted. This finding is consistent with the nature of stunting as a chronic process, where the effects of prolonged nutritional deficiencies and repeated infections accumulate over time. Children under two years of age may not yet exhibit significant growth faltering, but the differences become more evident as they grow older. Previous studies have emphasized that the first 1,000 days of life represent a critical window for growth and development, and inadequate nutrition during this period often leads to irreversible deficits that manifest more clearly in later years (Victora et al., 2010; Danaei et al., 2016).

This study identified several variables with multicollinearity, requiring careful selection in the final model. The main source of drinking water and drinking water treatment were closely correlated, as the type of water source often determined household treatment practices. To avoid redundancy, only drinking water treatment was retained, as it more directly reflects household behavior influencing water safety and child nutrition. Prior studies have shown that treatment practices are stronger predictors of child growth than source alone (Fink et al., 2011; Danaei et al., 2016).

A similar pattern was observed between mother's occupation and maternal education. Because maternal education has consistently been recognized as a more robust determinant of stunting across diverse settings, only education was included in the final model (Casale et al., 2018; Vikram and Vanneman, 2020). Household income and household expenditure also overlapped considerably, with expenditure essentially reflecting income capacity. To best capture socioeconomic status while preserving model stability, only household income was retained.

Although ANC frequency appeared significant in the bivariate analysis, it was excluded from the multivariate model. The association was likely confounded by reverse causality, as mothers of stunted children tended to seek ANC more frequently, often due to higher-risk pregnancies or program-targeted monitoring. This suggests that ANC frequency may reflect risk status rather than serve as a protective factor. Indeed, previous studies have emphasized that the quality of ANC services, rather than the number of visits alone, is more critical in improving child growth outcomes (Neupane et al., 2021; Girotra et al., 2023).

This study has several strengths, including the use of primary data collected in Buton

District, one of the areas with the highest stunting prevalence in Southeast Sulawesi. This setting provides high contextual relevance and ensures that the findings address an urgent public health issue in a high-risk population. Furthermore, stunting in the case group was diagnosed by trained health professionals at the local health center, ensuring accuracy and consistency in case identification based on WHO growth standards. Multivariate logistic regression further supports the identification of independent risk factors. However, the study also has limitations. The wide confidence intervals, particularly for maternal education and household income, likely reflect the limited sample size and variability among respondents. Nevertheless, the direction and magnitude of the associations are consistent with prior studies, and the findings remain relevant for informing public health strategies in high-prevalence settings.

These findings highlight the importance of improving maternal knowledge especially among low-income families, regarding child nutrition and care. Improving maternal education has been shown not only to enhance nutrition knowledge but also to increase health service utilization, both of which contribute to better child growth outcomes. In addition, enhancing family access to economic empowerment programs such as skills training, social assistance, or empowerment initiatives is expected to improve their ability to meet basic needs, including children's nutritional intake. Social support and healthcare services are also critical, particularly for multigravida mothers, to help them manage childcare more effectively despite limited resources.

CONCLUSIONS

This study highlights that maternal education and household income are the most influential determinants of stunting in Buton District, with younger maternal age and primigravida status also showing protective effects. The findings emphasize the need for interventions that strengthen maternal knowledge, promote economic empowerment of families, and provide greater support for mothers with multiple pregnancies. Addressing these key factors will be essential to reducing stunting prevalence in high-risk areas such as Buton District.

ACKNOWLEDGMENTS

This research was supported by the Ministry of Higher Education, Science, and Technology of Indonesia under the main contract number 130/C3/DT.05.00/PL/2025 and the subsidiary contract numbers 591/LL9/PG/2025 and 13/K/PN/LPPM/ISTEK-AK/VI/2025. We would like to express our sincere gratitude for their financial support, which made this study possible.

CONFLICT OF INTEREST

The author(s) declare that they have no conflict of interest

REFERENCES

[BPS] Badan Pusat Statistik., 2019. Indeks Pembangunan Manusia Kabupaten Buton. Badan Pusat Statistik, Buton.

Casale, D., Espi, G., Norris, S.A., 2018. Estimating The Pathways through Which Maternal Education Affects Stunting: Evidence from An Urban Cohort in South Africa. Public Health Nutrition 21(10), 1810–1818. Https://Doi.Org/10.1017/S1368980018000125

Cendana, P., Kim, S.Y., 2025. Maternal Factors and Breastfeeding Practices Associated with Stunting Among Indonesian Children Aged 6 to 23 Months. Asia Pacific Journal of Public Health 37(4), 402–410. Https://Doi.Org/10.1177/10105395251337970

Danaei, G., Andrews, K.G., Sudfeld, C.R., Fink, G., Mccoy, D.C., Peet, E., Sania, A., Smith Fawzi, M.C., Ezzati, M. And Fawzi, W.W., 2016. Risk Factors for Childhood Stunting in 137 Developing Countries: A Comparative Risk Assessment Analysis at Global, Regional, and Country Levels. PLOS Medicine 13(11), 1-12. Https://Doi.Org/10.1371/Journal.Pmed.1002164

Duke, T., Albuhairan, F.S., Agarwal, K., Arora, N.K., Arulkumaran, S., Bhutta, Z.A., Binka, F., Castro, A., Claeson, M., Dao, B., Darmstadt, G.L., English, M., Jardali, F., Merson, M., Ferrand, R.A., Golden, A., Golden, M.H., Homer, C., Jehan, F., Kabiru, C.W., Kirkwood, B., Lawn, J.E., Li, S., Patton, G.C., Ruel, M., Sandall, J., Sachdev, H.S., Tomlinson, M., Waiswa, P., Walker, D., Zlotkin, S., 2022. World Health Organization and Knowledge Translation in Maternal, Newborn, Child and Adolescent Health and Nutrition. Archives of Disease in Childhood 107(7), 644–649. Https://Doi.Org/10.1136/Archdischild-2021-323102

Fadhlurrahman, I., 2023. Prevalensi Ketidakcukupan Konsumsi Pangan di Buton Tengah Capai 17,56% pada 2023 [WWW Document]. https://databoks.katadata.co.id/demografi/statistik/97339bbed519090/prevalensi-ketidakcukupan-konsumsi-pangan-di-buton-tengah-capai-1756-pada-2023. [Diakses Mei 2026].

Fink, G., Günther, I., Hill, K., 2011. The Effect of Water and Sanitation on Child Health: Evidence from The Demographic and Health Surveys 1986–2007. International Journal of Epidemiology 40(5), 1196–1204. Https://Doi.Org/10.1093/Ije/Dyr102

Finlay, J.E., Norton, M.K., Guevara, I.M., 2017. Adolescent Fertility and Child Health: The Interaction of Maternal Age, Parity and Birth Intervals in Determining Child Health Outcomes. International Journal of Child Health and Nutrition 6(1), 16–33. Https://Doi.Org/10.6000/1929-4247.2017.06.01.2

Fitriani, H., Setya, A., Nurdiana, P., 2020. Risk Factors of Maternal Nutrition Status During Pregnancy to Stunting in Toddlers Aged 12-59 Months. Jurnal Keperawatan Padjadjaran 8(2), 175–183. Https://Doi.Org/10.24198/Jkp.V8i2.1305

Flocke, S.A., Ohri-Vachispati, P., Shon, E.J., Trapl, E.S., Borawski, E., Matlack, K., Freedman, D.A., 2017. Developing Multidimensional Measures of Healthy Food Access Among Low-Income Adults in Cleveland, Ohio, Usa. Public Health Nutrition 20(16), 2859–2868. Https://Doi.Org/10.1017/S1368980017002002

Gayawan, E., Orunmoluyi, O.S., Adegboye, O.A., 2022. Geostatistical Patterns of Comorbidity of Diarrhea, Acute Respiratory Infection, and Stunting Among Under-Five Children in Nigeria. Mathematical Population Studies 29(2), 58–72. Https://Doi.Org/10.1080/08898480.2021.1942654

Girotra, S., Malik, M., Roy, S., Basu, S., 2023. Utilization and Determinants of Adequate Quality Antenatal Care Services in India: Evidence from The National Family Health Survey. BMC Pregnancy and Childbirth 23(800), 1-12. Https://Doi.Org/10.1186/S12884-023-06117-Z

Haryanti, F., Hartini, S., Akhmadi, A., Andarwati, F., Risnawati, H., Pratiwi, A.N., Kusumawati, A.S., Cahyani, R.D., Lusmilasari, L., 2024. Maternal Knowledge on Nutritional-Focused Nurturing Care and Associated Factors Among Women with Stunted Children Aged 6-23 Months in Yogyakarta, Indonesia: A Cross-Sectional Study. Belitung Nursing Journal 10(4), 472–480. Https://Doi.Org/10.33546/Bnj.3481

[Kemenkes] Kementerian Kesehatan., 2023. Indonesian Health Survey 2023 in Numbers. Kementerian Kesehatan RI, Jakarta

[Kemenkeu] Kementerian Keuangan., 2024. Laporan Kinerja Anggaran dan Pembangunan Program Pencegahan dan Penurunan Stunting melalui Belanja Kementrian/Lembaga. Kementerian Keuangan RI, Jakarta.

Khotimah, H., Lintang, S.S., Azkiya, F., 2023. The Influence of Socio-Economy and Local Food Diversity on Stunting in Toddlers. Journal of Health Science and Policy 1(3), 147–160. Https://Doi.Org/10.56855/Jhsp.V1i3.524

Laltanpuii, L., Roy, V., Lukima S., Lalthanthuami, H., 2024. Relationship of Maternal Characteristics and Stunting Among Children. Indian Journal of Public Health Research and Development 15(4), 197–203. Https://Doi.Org/10.37506/S2j1p268

Leroy, J.L., Habicht, J.P., González De Cossío, T., Ruel, M.T., 2014. Maternal Education Mitigates The Negative Effects of Higher Income on The Double Burden of Child Stunting and Maternal Overweight in Rural Mexico. The Journal of Nutrition 144(5), 765–770. Https://Doi.Org/10.3945/Jn.113.188474

Mbuma, V., Lissner, L., Hunsberger, M., 2021. Parental Investment Can Moderate The Negative Effects of Low Socioeconomic Status on Children's Health: An Analysis of Kenyan National Data. Journal of Global Health Reports 5, 1-7. Https://Doi.Org/10.29392/001c.29462

Monroe-Lord, L., Ardekani, A., Weitman, C., 2024. The Impact of Covid-19 on Food Security Across Income Levels. Journal of Nutrition Education and Behavior 56(8), 1-22. Https://Doi.Org/10.1016/J.Jneb.2024.05.086

Nasrin, D., Liang, Y., Verani, J.R., Powell, H., Sow, S.O., Omore, R., Hossain, M.J., Doh, S., Zaman, S.M.A., Jones, J.C.M., Awuor, A.O., Kasumba, I.N., Tennant, S.M., Ramakrishnan, U., Kotloff, K.L., 2023. Stunting Following Moderate-To-Severe Diarrhea Among Children Aged <5 Years in Africa Before and After Rotavirus Vaccine Introduction: A Comparison of The Global Enteric Multicenter Study and The Vaccine Impact on Diarrhea in Africa (VIDA) Study. Clinical Infectious Diseases 76(S1), S49–S57. Https://Doi.Org/10.1093/Cid/Ciac948

Neupane, S., Scott, S., Nguyen, P., Menon, P., 2021. Both Quantity and Quality of Antenatal Care Matter for Child Birthweight: An Analysis of Nationally Representative Data from Bangladesh, India, Nepal, and Pakistan. Current Developments in Nutrition 7(5), 1-22. Https://Doi.Org/10.1093/Cdn/Nzab046_091

Nisa, T.I.Z., Adriani, B.B., Murti, B., 2022. Effect of Early Initiation of Breastfeeding on Exclusive Breastfeeding and Stunting: A Meta-Analysis. Journal of Maternal and Child Health 7(6), 685–698. https://thejmch.com/index.php/thejmch/article/view/867

Ohonba, A., Ngepah, N., Simo-Kengne, B., 2019. Maternal Education and Child Health Outcomes in South Africa: A Panel Data Analysis. Development Southern Africa 36(1), 33–49. Https://Doi.Org/10.1080/0376835x.2018.1456908

Orunmoluyi, O., Gayawan, E., Manda, S., 2022. Spatial Co-Morbidity of Childhood Acute Respiratory Infection, Diarrhoea and Stunting in Nigeria. International Journal of Environmental Research and Public Health 19(3), 1-16. Https://Doi.Org/10.3390/Ijerph19031838

[PEMKAB] Pemerintah Kabupaten., 2024. Publikasikan Hasil Pengukuran Prevalensi Stunting E-PPGBM. Pemerintah Kabupaten Buton.

Popkin, B.M., Corvalan, C., Grummer-Strawn, L.M., 2020. Dynamics of The Double Burden of Malnutrition and The Changing Nutrition Reality. The Lancet 395(10217), 65–74. Https://Doi.Org/10.1016/S0140-6736(19)32497-3

Rahayu, E.P., Yastirin, P.A., Sehmawati, S., 2023. Studi Korelasi Karakteristik dan Status Gizi Ibu Hamil terhadap Prevalensi Stunting pada Balita. Jurnal Inovasi Riset Ilmu Kesehatan 1(3), 298–314. Https://Doi.Org/10.55606/Detector.V1i3.2479

Rahmat, A., Indrasuri, W.O.V., Wigati, R.S., 2021. Profil Anak Kabupaten Buton 2021. Dinas Pemberdayaan Perempuan dan Perlindungan Anak, Buton.

Ramlan, P., Sukri, P., Abdullah, Muh. T., Ibrahim, M.A., Hardianti., Cahyani, A., 2025. Poverty and Stunting: A Socioeconomic Analysis of Vulnerable Communities; A Systematic Literature Review. Earth and Environmental Science 1475(1), 1-9. Https://Doi.Org/10.1088/1755-1315/1475/1/012026

Septiani, W., Harahap, E.S., Ismainar, H., Zaman, M.K., Alamsyah, A., Maharani, R., 2020. Maternal Factors on Stunting in Pekanbaru Local Health Center, Indonesia. Academia Open 2, 1-12. Https://Doi.Org/10.21070/Acopen.2.2020.488

Victora, C.G., De Onis, M., Hallal, P.C., Blössner, M. Shrimpton, R., 2010. Worldwide Timing of Growth Faltering: Revisiting Implications for Interventions. Pediatrics 125(3), E473–E480. Https://Doi.Org/10.1542/Peds.2009-1519

Vikram, K., Vanneman, R., 2020. Maternal Education and The Multidimensionality of Child Health Outcomes in India. Journal of Biosocial Science 52(1), 57–77. Https://Doi.Org/10.1017/S0021932019000245

[WHO] World Health Organization., 2015. Stunting in A Nutshell.

Zhao, J., Huang, J., Nie, F., 2022. The Income Elasticities of Food, Calories, and Nutrients in China: A Meta-Analysis. Nutrients 14(22), 1-24. Https://Doi.Org/10.3390/Nu14224711