

RESEARCH STUDY

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Low Maternal Nutrition Knowledge and Insufficient Energy Intake in Toddlers as Risk Factors for Stunting in Agricultural Areas

Rendahnya Pengetahuan Gizi Ibu dan Defisiensi Asupan Energi Balita sebagai Faktor Risiko Stunting di Wilayah Pertanian

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Received: 13-09-2024

Accepted: 31-12-2024

Published online: 31-12-2024

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DOI:

10.20473/amnt.v8i3SP.2024.259-268

Available online at:<https://e-journal.unair.ac.id/AMNT>**Keywords:**

Mother's Knowledge, Family Food Security, Nutritional Intake, Stunting

ABSTRACT

Background: Stunting is a significant nutritional problem in Indonesia, with higher incidence rates compared to other nutritional problems. Its influencing factors include toddler's nutritional intake, parenting practices, environmental health, access to health services, mother's education, and family food security.

Objectives: This study sought to identify the most significant factors that contribute to the incidence of stunting in Sumowono District.

Methods: This quantitative case-control study compared mothers of stunted toddlers (ages 12–59 months) against those of normally developing toddlers. Participants were selected through purposive sampling. The risk factors for stunting examined in this study included mother's knowledge, family food security, toddler's nutritional intake, mother's age, father's occupation, family income, Direct Cash Assistance (BLT) recipient status, parenting practices, access to health services, and environmental health. Data were collected using questionnaire surveys, observations, and 24-hour recalls. Data analysis used bivariate (chi-square) and multivariate (logistic regression) methods.

Results: Most mothers of stunted toddlers had poor knowledge (81.1%) and lived in food-insecure families (86.5%). Bivariate tests showed associations between stunting and factors such as father's occupation (p-value=0.019), family income (p-value=0.001), mother's knowledge (p-value=0.001), family food security (p-value=0.001), energy intake (p-value=0.001), protein intake (p-value=0.001), vitamin A intake (p-value=0.036), vitamin D intake (p-value=0.027), zinc intake (p-value=0.036), parenting practices (p-value=0.011), and environmental health (p-value=0.001). The main factors found to influence stunting were mother's knowledge (OR=19.144; CI: 1.919–190.953; p-value=0.012) and toddler's energy intake (OR=227.996; CI: 16.899–3,076.100; p-value=0.001).

Conclusions: The incidence of stunting in Sumowono District was significantly influenced by mother's knowledge and toddler's energy intake.

INTRODUCTION

Stunting, or a low height for age, is a long-standing, continuously debated nutritional issue among health circles in Indonesia. Typically, it occurs during the toddler years, a vulnerable period for both physical growth and mental development¹. It can be identified during the first 1000 days of life, starting from conception or from the womb to the age of two years. Its assessment is based on such indicators as height or length relative to age and a z-score between -3 SD and -2 SD². In the long term, it can threaten the quality of human resources and the overall competence of a nation³.

The year 2023 saw a decrease in the prevalence of stunting in Indonesia, from 24.4% to 21.6%. Despite this decline, Indonesia has yet to meet the World Health

Organization's (WHO) 20% threshold for stunting. In addition, the Indonesia Nutrition Status Survey (SSGI) recorded stunting prevalence rates of 20.8% for Central Java and 18.7% for Semarang Regency in 2022⁴, below the targeted 14% level for stunting reduction acceleration efforts in Indonesia by 2024. In 2020, Statistics Indonesia (BPS) reported a stunting prevalence rate of 13.8% in Sumowono District, higher than the rates for other nutritional problems, such as wasting and underweight.

According to a preliminary study, Sumowono District, Semarang Regency is an area renowned for its agriculture and plantations whose residents primarily rely on farming for their livelihoods, contributing to a fairly high level of food security. However, this area is

short on livestock and fishery supplies. With a mountainous geographical condition, it is difficult for some parts of the area to access animal protein from external sources⁶. This aligns with previous research stating that children living in mountainous areas often meet their daily protein needs from vegetable protein sources, which are incomplete in terms of amino acid levels⁷. Additionally, this area is prone to droughts during the dry season, which reduces the supply of agricultural products, particularly vegetables, leading to a limited variety of vegetables available⁸. It is evident from this description that the geographical condition of an area affects the diversity of foodstuffs available there, which reflects food security and impacts the variety of foods consumed by toddlers, directly influencing the incidence of stunting among them.

Stunting is a multifaceted issue as it can be influenced by multiple interconnected factors. Knowledge is one such factor that indirectly causes stunting. Maternal knowledge has been found to be closely linked to parenting practices, including feeding and daily hygiene care. It plays a crucial role in managing the availability and utilization of foods, ensuring that toddlers consume a balanced, nutritious diet that supports their growth and development. Toddlers with mothers who have low levels of knowledge face a 10.2 times higher risk of stunting compared to those with mothers who have adequate knowledge⁹. In the case of Sumowono District, a previous study reported that, in 2023, 44.7% of mothers had insufficient knowledge¹⁰.

Another factor of stunting is food security, which is supported by adequate resources, such as foodstuff diversity, effective food management, and income levels that support the purchasing power for food. Sumowono District is classified as a food-secure area¹¹, as reflected in food availability, access, and utilization. However, previous research found that, in 2023, 47.4% of households in Sumowono District had income below the regency minimum wage (UMK)¹⁰, which impacted their purchasing power for daily food consumption. This is in line with an earlier finding showing that income positively impacted the ability of farming households to achieve food security¹². Based on the situations in Sumowono District, as described above, researchers took an interest in examining the contribution of maternal knowledge, family food security, and other factors to the incidence of stunting in toddlers in the area.

METHODS

This quantitative research was conducted in the Sumowono Community Health Center working area, Semarang Regency, Central Java using a case-control study design. Purposive sampling was carried out to select participants, who were divided into control and case groups, based on predetermined criteria. The inclusion criteria were mothers living in the study area for at least three months, willing to participate in the study, and having stunted (for case group) and normal (for control group) toddlers aged 12 to 59 months. The final sample included 74 pairs of mothers and toddlers—37 pairs in the control group and another 37 pairs in the case group.

The incidence of stunting in this study was determined through screening of integrated services post (posyandu) data and by measuring the length or height of toddlers using an infantometer (for children under two years of age) or a microtoise (for children over two years of age). Toddlers were classified as stunted if their height-for-age measurements had a z-score value below -2 standard deviations (SD). The study included several variables, such as respondent characteristics, including toddler's age, toddler's gender, mother's age, mother's education, mother's occupation, father's age, father's education, father's occupation, family type, and Direct Cash Assistance (BLT) recipient status. The variables toddler's age, mother's age, and father's age were categorized into two groups based on the median cutoff values. The variables mother's education and father's education were divided into two categories: high (\geq senior high school) and low ($<$ senior high school). The variable mother's occupation was categorized as working or not working (housewife), while the variable father's occupation was categorized as laborer (farm laborer or construction worker) or self-employed (trader or farmer with own land). The variable family income was based on the total income of each family member, which was then compared to the Regional Minimum Wage (UMR) for 2024 (IDR 2,582,287). It was categorized into equal or higher than UMR (\geq UMR) or below UMR ($<$ UMR). The variable Direct Cash Assistance recipient status was determined based on questionnaire responses and was categorized as recipient (monthly payments) or non-recipient.

The variable maternal knowledge was assessed using a research questionnaire consisting of 25 closed-ended questions. The responses were scored and categorized into two groups: good if the total percentage of correct answers was $\geq 75\%$ and bad if it was $< 75\%$ ¹³. The variable family food security was evaluated using the Household Food Insecurity Access Scale (HFIAS), with respondents' answers to nine questions categorized accordingly. The variable toddler's history of infectious diseases was determined based on questionnaire responses, which included responses to a checklist of diseases, such as upper respiratory tract infections (URTI) and diarrhea, within the past month. This variable was categorized into two groups: having experienced one of the infectious diseases and having experienced both. The variable environmental health was assessed through observations of the toddler's home environment, considering factors such as air ventilation, lighting, flooring, walls, roofs, toilet, septic tank distance, and household wastewater sewerage (SPAL). These factors were scored and categorized as good or poor based on the median cutoff values.

Other variables in this study included toddler's nutritional intake variables, which were assessed using a 24-hour recall form, completed twice—once on a weekday and once on a weekend. A portion-size book was used to help respondents estimate the amounts of foods consumed. The data collected were then analyzed using the NutriSurvey software. The results of the calculations for toddlers were classified based on the Recommended Dietary Allowances (RDA) as follows: for energy and protein intake, a deficit was defined as $< 90\%$

RDA, and no deficit was defined as $\geq 90\%$ RDA; for vitamin A, vitamin D, calcium, and zinc intake, a deficit was defined as $< 77\%$ RDA, and no deficit was defined as $\geq 77\%$ RDA¹⁴.

Bivariate analysis was used to analyze the data, with the chi-square test employed to determine whether there was an association between variables, using a significance level of 0.05 (p-value < 0.05). Variables with p-values < 0.25 were further analyzed using multiple logistic regression, with a significance level of 0.05 (p-value < 0.05)¹⁵. The analysis aimed to identify the variables with the most significant influences on the incidence of stunting in toddlers. This study received approval from the Health Ethics Committee of the Faculty of Public Health, Diponegoro University, with Approval Letter No. 101/EA/KEPK-FKM/2024, granted on February 27, 2024. All respondents provided informed consent to participate in the study, and all the collected information will be kept confidential.

RESULTS AND DISCUSSIONS

Respondent Characteristics

Based on the analysis results presented in Table 1, stunting was found to be more common among children aged 12 to 47 months. Additionally, stunting was more prevalent among female toddlers. The z-score values ranged from -5.54 SD to -2.02 SD. A child is considered stunted if his or her height-for-age z-score is below -2 standard deviations (SD). The majority of mothers in the stunted group were aged ≥ 28 years, low-educated ($<$ senior high school), and unemployed. Meanwhile, the majority of fathers in the stunted group were aged ≥ 30 years, low-educated, and working as laborers (farm laborers and construction workers). The toddlers in the stunted group mostly belonged to extended families or households living outside the nuclear family structure (i.e., including individuals other than the father, mother, and child). These families typically earned incomes below the Regional/Regency Minimum Wage (UMR/UMK) and did not receive the Direct Cash Assistance (BLT) from the local government.

Table 1. Respondent Characteristics

Characteristics	Incidence of Stunting		p-value
	Stunted	Not Stunted	
Toddlers			
Age (mean \pm SD)	38.73 \pm 12.56	31.97 \pm 15.47	
12 – 47 Months (n,%)	28 (75.7%)	28 (75.7%)	1.000 ^a
48 – 58 Months (n,%)	9 (24.3%)	9 (24.3%)	
Gender			
Male (n,%)	14 (37.8%)	21 (56.8%)	0.162 ^a
Female (n,%)	23 (62.2%)	16 (43.2%)	
Parents			
Mother’s Age (median,min-max)	30.0 (22 – 34)	27.0 (20 – 36)	
< 28 Years (n,%)	14 (37.8%)	20 (54.1%)	0.234 ^a
≥ 28 Years (n,%)	23 (62.2%)	17 (45.9%)	
Mother’s Education			
Low (n,%)	26 (70.3%)	23 (62.2%)	0.623 ^a
High (n,%)	11 (29.7%)	14 (37.8%)	
Mother’s Occupation			
Working (n,%)	9 (24.3%)	8 (21.6%)	1.000 ^a
Not Working (n,%)	28 (75.7%)	29 (78.4%)	
Father’s Age (median,min-max)	33,0 (23 – 53)	31,0 (22 – 45)	
< 31 Years (n,%)	16 (43.2%)	17 (45.9%)	1.000 ^a
≥ 31 Years (n,%)	21 (56.8%)	20 (54.1%)	
Father’s Education			
Low (n,%)	29 (78.4%)	23 (62.2%)	0.203 ^a
High (n,%)	8 (21.6%)	14 (37.8%)	
Father’s Occupation			
Laborer (n,%)	26 (70.3%)	15 (40.5%)	0.019 ^{*a}
Self-Employed (n,%)	11 (29.7%)	22 (59.5%)	
Toddler’s Family			
Type of Family			
Extended Family (n,%)	25 (67.6%)	23 (62.2%)	0.808 ^a
Nuclear Family (n,%)	12 (32.4%)	14 (37.8%)	
Family Income (IDR)			
(median,min-max)	1.500.000 (500.000-6.000.000)	3.000.000 (1.000.000 – 10.000.000)	
< UMR (n,%)	32 (86.5%)	18 (48.6%)	0.001 ^{*a}
\geq UMR (n,%)	5 (13.5%)	19 (51.4%)	
BLT Recipient Status			
Recipient (n,%)	28 (75.7%)	34 (91.9%)	0.058 ^a
Non-Recipient (n,%)	9 (24.3%)	3 (8.1%)	

Note: ^aChi-square test ^{*}significant if p-value <0.05

The chi-square test results presented in Table 1 show that father's occupation and family income had a significant relationship with the occurrence of stunting in toddlers. Toddlers with fathers working as laborers and with low family income (< UMR) were at a higher risk of being stunted compared to those with fathers who were self-employed and with a higher family income (≥ UMR). The majority of fathers of stunted toddlers worked as laborers (farm laborers and construction workers), with income dependent on seasonal work or available opportunities each month, resulting in uncertain income each month. Furthermore, low family income, combined with daily basic needs, contributed to food insecurity,

which could negatively impact the nutritional status of the family, including the under-five child¹⁶.

According to the results of the chi-square test presented in Table 2, maternal knowledge, family food security, and the intake of energy, protein, vitamin A, vitamin D, and zinc were significantly related to the incidence of stunting in the study area. However, calcium intake, access to health services, and toddler's history of infectious diseases were found to lack this significant relationship with the incidence of stunting. The variables identified as being significantly associated with the incidence of stunting were subsequently used in multivariate analysis.

Table 2. Results of the Correlation Analysis of Factors Contributing to the Incidence of Stunting

Variabel	Incidence of Stunting				p-value ^a
	Stunted		Not Stunted		
	n	%	n	%	
Mother's Knowledge					
Poor	30	81.1	5	13.5	0.001*
Good	7	18.9	32	86.5	
Family Food Security					
Not Secure	32	86.5	4	10.8	0.001*
Secure	5	13.5	33	89.2	
Toddler's Nutritional Intake					
Energy					
Deficient	36	97.3	4	10.8	0.001*
Not Deficient	1	2.7	33	89.2	
Protein					
Deficient	19	51.4	2	5.4	0.001*
Not Deficient	18	48.6	35	94.6	
Vitamin A					
Deficient	25	67.6	15	40.5	0.036*
Not Deficient	12	32.4	22	59.5	
Vitamin D					
Deficient	35	94.6	27	73	0.027*
Not Deficient	2	5.4	10	27	
Calcium					
Deficient	25	67.6	18	48.6	0.157
Not Deficient	12	32.4	19	51.4	
Zinc					
Deficient	23	62.2	13	35.1	0.036*
Not Deficient	14	37.8	24	64.9	
Parenting Practices					
Poor	25	67.6	13	35.1	0.011*
Good	12	32.4	24	64.9	
Access to Health Services					
Poor	7	18.9	7	18.9	1.000
Good	30	81.1	30	81.1	
History of Infectious Disease					
Experienced Both Disease	6	16.2	11	29.7	0.269
Experienced One Disease	31	83.2	26	70.3	
Environmental Health					
Poor	24	64.9	9	24.3	0.001*
Good	13	35.1	28	75.7	

Note: ^aUji Chi-Square Test; *signifikan if p-value < 0.05

This study indicates that maternal knowledge played a significant role in the occurrence of stunting in toddlers in Sumowono District, where mothers with poor knowledge were more likely to have children at risk of stunting. Overall, the maternal knowledge in this area

was generally good, with 52.70% of mothers demonstrating adequate knowledge. However, poor maternal knowledge was more common in mothers of stunted toddlers, of whom 40.54% fell into this category. These findings are consistent with the findings of a prior

study in Gunung Kidul Regency, Yogyakarta, which also showed a significant relationship between maternal knowledge and the incidence of stunting (p -value = 0.000)¹⁷. Maternal knowledge influences a mother's behavior and attitudes in caring for her toddler on a daily basis. It serves as the foundation for shaping attitudes, particularly when it comes to providing food for the child.

Inadequate food consumption in toddlers can lead to nutritional problems, as they may not receive the necessary intake to support their growth needs. Furthermore, insufficient nutritional intake can result in an imbalance between the nutrients consumed daily and the toddlers' actual nutritional requirements¹⁸.

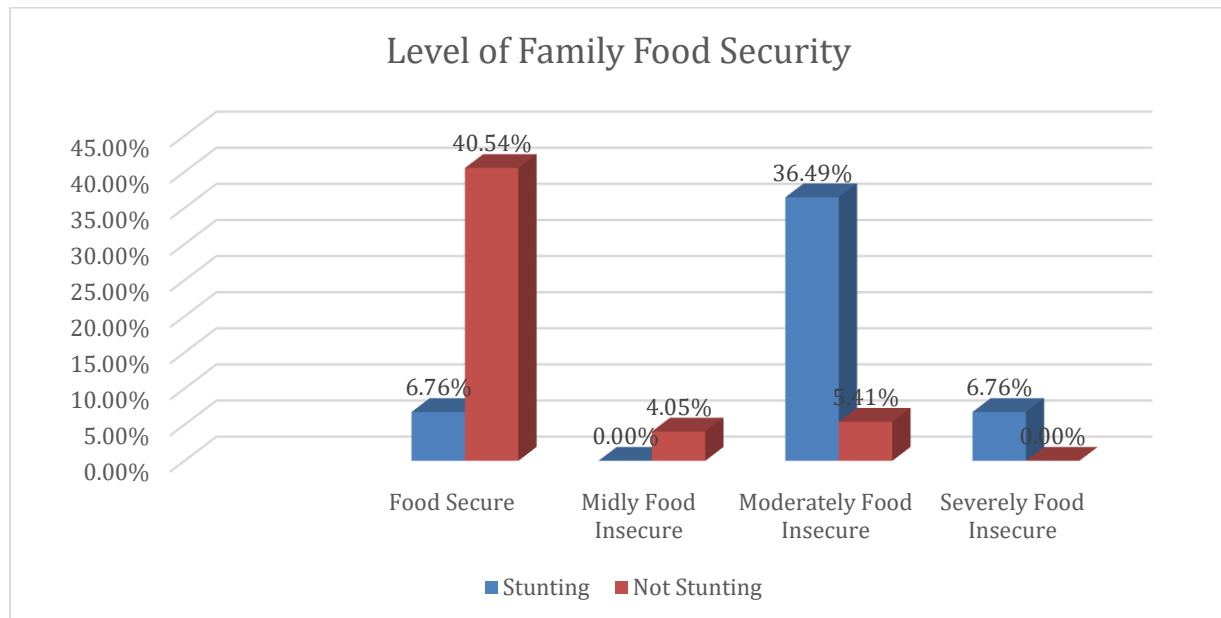


Figure 1. Overview of the Food Security Level of Families of Toddlers Aged 12-59 Months in Sumowono District

Furthermore, this study indicates a relationship between family food security and the incidence of stunting in Sumowono District. Families experiencing food insecurity were more likely to have stunted toddlers. Overall, the majority of toddlers in the Sumowono Community Health Center working area fell into the food-secure category, accounting for 47.30% of all toddlers involved in the study, compared to 41.98% in the moderately food-insecure category, 4.05% in the mildly food-insecure category, and 6.76% in the severely food-insecure category. However, high food security was more commonly found among families with normal toddlers, accounting for 40.54%. In contrast, severe food insecurity was exclusively found in families with stunted children under five, accounting for 6.76%. These findings align with a study in Bandungan District, Semarang Regency, which also reported a significant relationship between family food security and the incidence of stunting (p -value = 0.049). Families with high food security have easier access to food in terms of both quantity and quality, which promotes adequate nutritional intake and supports optimal nutritional status. Conversely, toddlers in families facing food insecurity often encounter growth obstacles due to limited access to necessary food¹⁹.

This study further reveals a relationship between the intake of macronutrients, specifically protein and energy, and the occurrence of stunting among toddlers in Sumowono District, where toddlers with deficits in the intake of these nutrients were at a higher risk of stunting. This finding is consistent with previous research in Rejang Lebong Regency, Bengkulu, which demonstrated a

significant relationship between energy intake in toddlers and the occurrence of stunting (p -value = 0.001). Energy intake reflects the toddler's current nutritional status, with stunting resulting from the accumulation of poor eating habits over time²⁰. Additionally, it also aligns with previous research in Kawalu District, Tasikmalaya City, which found a strong association between protein intake and the incidence of stunting (p -value = 0.000). Protein intake is linked to serum transthyretin (TTR), serum amino acid, and serum insulin-like growth factor-1 (IGF-1) levels, which play vital roles in the linear growth and development of toddlers. Thus, adequate protein quality is essential to improving the growth of stunted toddlers²¹.

A significant association between the intake of some micronutrients, such as vitamin A, vitamin D, and zinc, and the incidence of stunting was also observed in this study, with toddlers who experienced deficiencies in these nutrients being at a higher risk of being stunted. This finding supports an earlier study in Bandar Lampung, which identified a significant relationship between vitamin A intake and the incidence of stunting in toddlers (p -value = 0.001). Vitamin A deficiency was found to impair growth function and negatively affect a toddler's height²². Additionally, research in Sijunjung Regency, West Sumatra, also found a significant relationship between vitamin D intake and stunting cases in toddlers (p -value = 0.000), where insufficient vitamin D intake was discovered to increase toddlers' risk of contracting infectious diseases^{23,24}. Furthermore, findings from Enrekang Regency, South Sulawesi, revealed a clear relationship between zinc intake and the occurrence of stunting in children under five (p -value = 0.004),

highlighting zinc's crucial role in the growth and development of children²⁵. However, this study found no significant relationship between calcium intake and the incidence of stunting. This is consistent with previous research in Pati Regency, Central Java, which found no association between calcium intake and the occurrence of stunting in toddlers (p-value = 0.803). The study noted that although calcium was available from sources such as milk, spinach, long beans, tofu, and tempeh, the average intake of this micronutrient among toddlers remained insufficient²⁶.

Another factor found to be significantly associated with stunting in this study was parenting practices. This finding is consistent with research in Lampung, which identified a significant relationship between parenting practices and the incidence of stunting (p-value = 0.000). The occurrence of stunting is influenced by such factors as exclusive breastfeeding, complementary feeding, psychosocial stimulation, environmental hygiene and sanitation, child care during illness, and the choice of health care facilities²⁷. Child feeding practices are particularly crucial to child development, with establishing a comfortable environment and a positive relationship with children helping the children finish their meals^{28,29}. Providing psychosocial stimulation also plays a vital role in stimulating growth hormones, supporting the development of a toddler's organs and positively influencing their nutritional care. According to positive deviance theory, various forms of stimulation provided by mothers or caregivers, such as visual, verbal, and auditory stimuli, can activate growth hormones, optimize energy metabolism, and enhance the body's immune response³⁰.

Additionally, poor environmental health was significantly associated with stunting. This finding aligns

with research conducted in South Asia, Sub-Saharan Africa, and the East Asia and Pacific regions, which highlights the significant impact of environmental factors on the history of infectious diseases and the nutritional status of children under five. The study suggests that 7.2 million cases of stunting worldwide are caused by poor environmental sanitation conditions. Poor sanitation can lead to infectious diseases, such as diarrhea, which not only threaten health but also undermine the nutritional status of young children³¹. In Sumowono District, observations of the conditions of the surrounding environment, including such aspects as air ventilation, lighting, flooring, roofs, walls, toilet, and septic tank distance, revealed that stunted toddlers from food-insecure families mostly lived in houses lacking adequate ventilation and lighting. Environmental health, particularly within the home, is crucial to maintaining optimal health status. It includes factors such as residential infrastructure, waste disposal, clean water supply, garbage management, and livestock areas. The quality of the environment must be carefully managed, as poor conditions foster the spread of diseases like diarrhea and respiratory infections, both of which adversely impact the nutritional status of toddlers, contributing to stunting³².

Based on the analysis results presented in Table 3, it is evident that the factors consistently influencing the incidence of stunting in Sumowono District were maternal knowledge and toddlers' energy intake. The R-squared value of 0.855 obtained from multivariate analysis indicates that maternal knowledge, environmental health, and energy intake together accounted for 85.5% of the variance in stunting incidence among children under five in Sumowono District, while the remaining 14.5% was influenced by factors not included in this study.

Table 3. Analysis of Dominant Factors Contributing to the Incidence of Stunting

	S.E	OR	CI 95%	p-value	R Square
Mother's Knowledge					
Poor	1.174	19.144	1.919 – 190.953	0.012* ^b	0.855 [^]
Good			reff		
Toddler's Energy Intake					
Deficient	1.328	227.996	16.89 – 3076.1	0.001* ^b	
Not Deficient			reff		

Note: ^bMultiple Logistic Regression Test; OR: odds ratio; CI: confidence interval; *significant if p-value < 0.05; [^]Negelkerke R-Squared

This study found that low maternal knowledge significantly influenced the incidence of stunting, as shown by both bivariate (Table 2) and multivariate (Table 3) analyses. Toddlers whose mothers had lower levels of knowledge tended to face a higher risk of stunting compared to those whose mothers possessed better knowledge. Knowledge is a collection of understandings or ideas that individuals have about the world and its various aspects, including humans and their daily lives. Maternal knowledge plays a crucial role in shaping the daily parenting practices for toddlers. Optimal growth and development in toddlers are supported by adequate nutritional intake, physical activity, and sufficient rest. The feeding practices of mothers or caregivers directly influence the nutritional status of toddlers, as these

practices are closely related to family habits and routines. Based on the analysis of questionnaire responses, it was found that toddlers in Sumowono District experienced sleep deprivation due to limited napping opportunities and unrestricted nighttime sleeping patterns. This lack of sleep could negatively impact the toddlers' body, hindering their growth and development. Studies have also shown that children with insufficient protein intake and inadequate sleep are at an increased risk of stunting. This is because sleep is a critical period for the body to produce growth hormones, which play an essential role in increasing height. During sleep, the child's body produces three times more growth hormones than when the child is awake^{33,34}.

Maternal knowledge is influenced by several factors, including the level of education. The level of education affects how individuals acquire and comprehend information, which mothers then use to care for their toddlers, particularly regarding balanced nutritional intake for the toddlers^{9,35}. In Sumowono District, the majority of mothers of stunted toddlers (79.3%) had a low level of education. This indicates that educational factors play a significant role in shaping a person's mindset, his or her ability to receive information, and the speed at which he or she can apply theoretical knowledge, particularly in relation to family health and nutrition³⁶. The knowledge possessed by mothers is a fundamental factor that shapes their attitudes toward feeding their children. Effective toddler feeding practices require mothers to have the ability to select appropriate foods that meet the toddler's daily nutritional needs. Mothers must understand the various types of foods that contain essential nutrients, such as carbohydrates, proteins, fats, vitamins, and minerals. It also involves the role of family food security, which pertains to the availability of foods in terms of both quality and quantity. Strong food security ensures that families have sufficient access to nutritious foods, enabling mothers to make healthy and balanced food choices for their toddlers. In contrast, food-insecure families face difficulties in accessing adequate foods, which can negatively impact children's nutritional intake. As a result, the children may not receive the nutrients they need for their growth and development³⁷. Therefore, a mother's understanding and ability to select the right foods are crucial to supporting optimal child growth and development.

Furthermore, as the multivariate analysis results indicate, energy intake consistently and significantly influenced the incidence of stunting in toddlers. Toddlers who experienced energy deficits were more likely to be stunted compared to those who did not experience such deficits. Nutritional intake in toddlers refers to the intake of necessary nutrients that support optimal growth and development. In Sumowono District, toddlers in the stunted group tended to have low energy intake, with many experiencing significant energy deficits. This might be due to insufficient food intake (which led them to fail to meet the recommended dietary allowances), the consumption of foods that were lacking in terms of both variety and quantity, and irregular meal times set by mothers. Many toddlers in Sumowono District consumed more of packaged snacks, which were not adequately balanced with foods rich in carbohydrates, proteins, vitamins, and minerals. Insufficient nutritional intake can lead to frequent illness in children, highlighting the importance of fulfilling their nutritional needs to promote optimal health and development.

Toddlers who consume insufficient amounts of energy may experience delays in both growth and cognitive development. Energy deficiency in stunted toddlers can be influenced by several factors, including feeding frequency, portion sizes, food variety, and the toddlers' appetite. Energy intake comes from key macronutrients, such as carbohydrates, proteins, and fats. Ensuring adequate energy intake in toddlers is crucial, as it supports growth processes, body metabolism, and physical activity²⁰. The nutritional intake

of toddlers is closely linked to parenting practices, particularly practices in feeding. These practices are essential to supporting a child's growth and development. These include encouraging the consumption of varied foods to prevent picky eating, creating a comfortable eating environment, and fostering a strong bond with the child to ensure he or she finishes his or her meals^{28,29}.

The low nutritional intake of toddlers in Sumowono District might be attributed to improper feeding practices, particularly when it comes to milk consumption. Many toddlers tended to prefer sweetened condensed milk over powdered formula or liquid milk specifically designed for toddlers. Sweetened condensed milk contains a high amount of sugar, about 22 grams per serving, equivalent to four tablespoons of sugar in one glass of milk. If toddlers consume it twice a day, their sugar intake exceeds the recommended limits set by the American Heart Association (AHA), which advises children over the age of two to consume no more than six teaspoons or 25 grams of sugar per day and to limit the consumption of sugary drinks to no more than once a week (240 mL of sugary drinks)³⁸. To address improper practices in relation to milk consumption, the local government launched a milk distribution program to help improve children's nutritional status. Through this program, children are provided with Isocal milk, which is intended to be consumed twice a day. The milk is specifically formulated for children in certain conditions, such as those who are recovering after an illness or surgery, and for children over the age of one who are experiencing growth failure, experiencing malnutrition, or at risk of experiencing malnutrition. The milk contains essential nutrients, including protein, omega-3, omega-6, DHA, zinc, selenium, calcium, magnesium, vitamin A, vitamin C, vitamin E, and vitamin D, which are crucial for a child's growth and development. However, the milk distribution program is faced with problems such as irregular distribution and inadequate dissemination of information regarding the importance of consuming milk with the appropriate nutritional content to address stunting in toddlers.

Mother's age, father's education, family income, Direct Cash Assistance recipient status, family food security, parenting practices, and toddler's nutritional intake (including protein, vitamin A, vitamin D, calcium, and zinc) did not significantly influence the occurrence of stunting in the Sumowono Community Health Center working area. This was due to the relatively homogeneous data regarding these variables, with the majority of mothers being over the age of 28. Furthermore, most fathers had low education levels and worked as laborers. The families in this study area mostly had incomes below the regional minimum wage, but only a few received the Direct Cash Assistance. Parenting practices did not have any influence on the occurrence of stunting either. Finally, toddler's intake of protein, vitamin A, vitamin D, calcium, and zinc was not identified as a factor influencing stunting, as the majority of toddlers experienced deficiencies in these nutrients.

This study was implemented using a case-control research design and a sample of participants who were selected through purposive sampling, which allowed for

a more in-depth analysis of the risk factors contributing to stunting. The involvement of participants who met the research criteria ensured alignment with the study's objectives, resulting in more representative findings. Comprehensive data collection through various methods, such as questionnaire surveys, observations, and 24-hour recalls also added to the strength of this study, as it provided a deeper understanding of the factors contributing to stunting in the study area. However, this study has limitations, particularly when it comes to the variable family food security, as data collection on this variable used the Household Food Insecurity Access Scale (HFIAS). This instrument focuses on measuring family food security in terms of access to and availability of foods but does not assess other aspects of food security, such as food utilization. This means that important factors affecting the quality and utilization of nutrition within households might be overlooked. Furthermore, the analysis of toddler's nutritional intake was limited to six types of nutrients: energy, protein, vitamin A, vitamin D, calcium, and zinc. Besides, measurements of nutritional intake were carried out using 24-hour recalls, which depend on the mother's ability to remember the foods consumed by the toddler in a day. This method may introduce bias, as human memory is often influenced by various factors, including stress and the number of activities done in a day. Therefore, it is important to consider these limitations when evaluating the research results and drawing conclusions.

CONCLUSIONS

It was found that the majority of mothers with stunted toddlers had poor knowledge (81.1%) and belonged to food-insecure households (86.5%). Mothers with poor knowledge were found to face a higher risk of having stunted children. This was in contrast to mothers with good knowledge, whose risk of having stunted children was lower. Both bivariate and multivariate analyses showed that maternal knowledge and the amount of energy intake by the child were significantly associated with the occurrence of stunting. Meanwhile, only bivariate analysis showed that other factors such as mother's age, father's education, family income, Direct Cash Assistance recipient status, family food security, parenting practices, and toddler's nutritional intake (zinc, vitamin A, vitamin D, and protein) were significantly associated with the occurrence of stunting.

ACKNOWLEDGEMENT

The authors express deep gratitude to all parties who have provided invaluable support and contributions during the implementation of this research. Special thanks are extended to Mrs. Ami, a staff member of Sumowono Community Health Center, village midwives, posyandu cadres, and mothers and toddlers who assisted in the research process as respondents.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare that there are no conflicts of interest related to this article. This research was funded by the researchers.

AUTHOR CONTRIBUTIONS

SNZ: data curation, formal analysis, investigation, project administration, resources, software, writing of the initial draft; DRP, AK: conceptualization, funding, methodology, resources, supervision, validation, review writing, and manuscript editing.

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