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A CASE CONTROL IN A SUB-URBAN AREA : MATERNAL HEIGHT AND NUTRITIONAL STATUS WITH THE INCIDENCE OF STUNTING AMONG TODDLERS

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ABSTRACT

Indonesia is a country with a high incidence of stunting. In 2022, the prevalence of stunting in Bogor Regency was 24.9%, which was higher than the national average. The Padasuka subdistrict is recognized as a stunting locus area. Children's health is closely linked to the parenting style employed by their parents, particularly mothers. Therefore, this study aims to analyze the maternal factors contributing to the prevalence of stunting among toddlers. This study used an observational approach with a case-control design, conducted from December 2022 to August 2023 in Padasuka Village, Bogor Regency. Data collection encompassed anthropometric measurements, including the weight and height of toddlers and mothers, maternal characteristics such as age, education, and occupation, and nutritional status. The data were collected using questionnaires and interviews. The research sample consisted of 41 mothers of stunted toddlers (cases) and 41 mothers of normally developing toddlers (controls), resulting in a total of 82 participants. Bivariate analysis to explore the relationships between variables, as well as the chi-squared test and independent t-test to measure the differences in average height and nutritional status. The results of the analysis revealed that maternal height (p=0.000) and nutritional status (p=0.035) were significantly correlated with the incidence of stunting. In addition, there were notable differences in the average values of maternal height and nutritional status between the stunted group and the normally developing group with p-values of 0.038 and 0.040, respectively. Therefore, it can be concluded that maternal height and nutritional status contribute to the incidence of stunting among toddlers.

Keywords*: height, mother, nutritional status, stunting, urban*

INTRODUCTION

According to the World Health Organization (WHO), stunting is defined as a condition where a toddler's length or height falls below the age standard as measured on the standard deviation (SD) scale, placing them below the median length or height of the general population. Stunting occurs when a toddler's length or height falls below -2 SD from the median body length or height for their age as stipulated by the Indonesian Ministry of Health in 2018. This condition can manifest from before birth (in utero) until the age of 2 years, with visible symptoms typically emerging after the toddler reaches the age of 2 years. The age of 0-24 months is a critical period in a child's growth because malnutrition during this period can result in long-term and often irreversible consequences. Therefore, it is important to ensure that toddlers receive sufficient nutritional intake during this period to mitigate this risk (1).

Indonesia faces a significant problem of high incidence of stunting among its children. In 2022, the prevalence of stunting was 21.6%, indicating that more than one-fifth of Indonesian children experience stunting, a condition with serious implications for their health and overall development (2). In response to this issue, the government has formulated policies to address stunting, with focus areas (locus) at the village and subdistrict levels. The prevalence of stunting in West Java remains high at 20.2% (2). Within West Java, Bogor Regency boasts the largest population and bears a prevalence of stunting at 24.9%, higher than the national average (2).

Padasuka Village is designated as one of the stunting locus areas within Bogor Regency,

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as established by the 2021 Decree of the Bogor Regent. According to the 2021 Family Data Collection, the risk of stunting in Padasuka Village affects 2,013 families, or 41.7% of the population (3). This status underscores the urgency of addressing the issue of stunting in Padasuka Village as a top priority.

Padasuka Village consists of 14 community associations (*rukun warga*/RW) and has 18 integrated health service posts (*pos pelayanan terpadu*/*posyandu*) with a total of 96 cadres. In addition to these cadres, Padasuka Village has one family planning cadre and 23 family welfare program *(pemberdayaan kesejahteraan keluarga*/ PKK) cadres, and has formed a stunting reduction acceleration team (*tim percepatan penurunan stunting*/TPPS). The services provided by the integrated health service posts in Padasuka Village are administered under the supervision and guidance of the Laladon Community Health Center (*pusat kesehatan masyarakat*/ *puskesmas*). Padasuka Village covers an area of 132.8 ha, with boundaries adjoining Bogor City in the north, east, and southeast. This strategic location endows Padasuka Village with considerable economic potential. To the west and south, Padasuka Village shares borders with Dramaga Subdistrict and Tamansari Subdistrict, which are known for their potential agricultural lands. Padasuka Village benefits from easy access to transportation, with both urban public transportation and online-based alternatives available. The village's topography is marked by a dense population, amounting to 18,944 people. Of this population, 1,513, or 8% of the total population are babies and toddlers (4). Based on its characteristics, Padasuka Village falls into the suburban area category.

Maternal characteristics play an important role in influencing the incidence of stunting in children. These characteristics include diet, nutritional status, access to prenatal health services, and educational level. The health and nutritional status of a mother during pregnancy has a significant impact on fetal growth. Mothers who experience malnutrition, both undernutrition and overnutrition, can influence fetal growth, thereby increasing the risk of stunting in their children (5). In addition, the educational level of a mother can influence their knowledge and behaviors related to nutrition, healthcare, and family meal patterns. Mothers with lower educational levels may have limited knowledge about proper nutrition and optimal childcare (6–8).

Furthermore, the employment status of a mother can contribute to the incidence of stunting in their children (7). Mothers with busy work schedules or extended work hours may have limited time to provide adequate care to their children. This lack of time spent with children can affect the children's dietary intake, overall care, and attention. The employment status of a mother also influences her income level, which, in turn, affects access to the economic resources required to meet children's nutritional needs, such as nutritious food, clothing, healthcare, and adequate sanitation facilities. (8). Therefore, this study aims to analyze maternal characteristics contributing to the incidence of stunting in a suburban area, with the aim of tailoring intervention programs for more focused and impactful efforts in addressing the issue of stunting in the area.

METHODS

This study used an observational approach with a case-control study design, and was conducted from December 2022 to June 2023. This study involved activities such as field preparation, research instrument preparation, data collection, as well as data processing and analysis. This study was carried out in Padasuka Village, Ciomas Subdistrict, Bogor Regency. The tools utilized included writing and interview equipment, body scales, and microtoises to measure anthropometric data.

The minimum sample size was calculated using the sample size calculator for case-control studies available at sampsize.sourceforge.net. Information about the odds ratio (OR) value and the percentage of controls exposed to the variables of interest was entered into the software. According to Yanti (2022), with a minimum OR of 9.33, a power of 90%, and an alpha level of 5%, the minimum sample size required was 40 individuals per group or a total of 80 participants (9). The sample inclusion criteria were boys and girls aged 6-59 months residing in Padasuka Village, Ciomas Subdistrict, Bogor Regency, and their parents were willing to participate in this study. For the case group, the children had stunting nutritional status based on height-for-age with a Z-score of less

than -2.00. For the control group, the children had normal nutritional status based on height-for-age with a Z score of equal to or more than -2.00. Data on stunted children (cases) and normal children (controls) were obtained from the health center. Researchers took repeated height measurements at the time of the study. The exclusion criteria for this study were children who had congenital disabilities, physical and/or mental abnormalities, and a history of chronic diseases. Based on these criteria, the number of samples in each group was 41 individuals or a total of 82 participants. The sampling procedure is outlined in Figure 1.

In this study, the dependent variable was the nutritional status of toddlers, while the independent variables were their mothers' age at birth, height, nutritional status, educational level, and employment status. Measurement of the nutritional status of children and mothers was carried out at the time of the study. Children's nutritional status variables were categorized into normal and stunting (10), while mothers' nutritional status was categorized based on the IMT classification according to the Ministry of Health 2014 (11). Data obtained from interviews and measurements were tabulated, averaged, and subjected to descriptive analysis to assess the univariate data of each variable. The data used in the univariate analysis were the mean values and standard deviations. Subsequently, a correlation test was conducted using the chi-Square test, and a comparison test was conducted using an independent t-test to examine the differences in average age, height, and nutritional status between mothers in the case group and mothers in the control group. All statistical analyses were performed using SPSS 16 for Windows. This study received ethical approval from the Health Research Ethics Committe, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta (Certificate No.18/PE/KE/FKK-UMJ/II/2023).

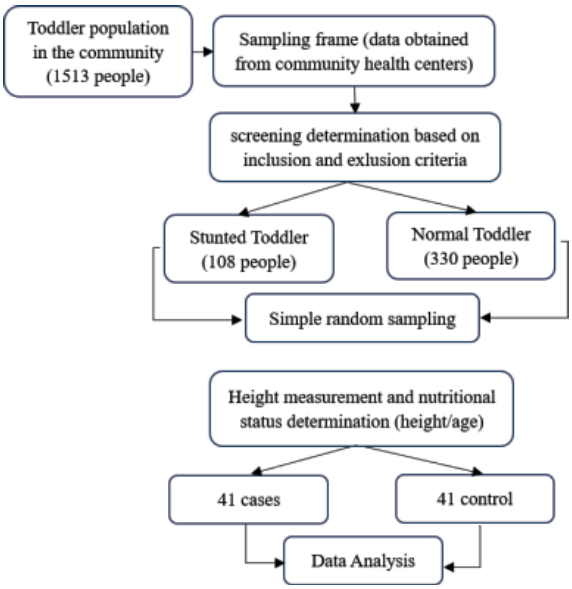

Figure 1. Sampling procedure.

RESULTS AND DISCUSSION

The characteristics of mothers of children under five in this study are presented in Table 1. A significant percentage of mothers in both the stunted (24.39%) and normal (26.82%) groups gave birth at an age considered risky. The age at which mothers gave birth ranged from 17 to 43 years. In terms of educational level, a majority of mothers in both groups had completed high school. More mothers in both gorups had higher education levels compared to those with only elementary and junior high school education levels. Regarding their employment status, most mothers in both were identified as housewives. When assessing the nutritional status of mothers in the stunted toddler group, it was observed that the majority (46.34%) had a normal nutritional status, while a smaller percentage (14.63%) exhibited poor nutritional status. In contrast, the majority of mothers (63.41%) in the normally developing toddler group fell into the fat category for nutritional status. In terms of maternal height, the majority of mothers (51.21%) in the stunted toddler group were shorter than 150 cm, while the majority of mothers (90.24%) in the normally developing toddler group had a height exceeding 150 cm.

Table 2 shows that 24.4% of stunted toddlers had mothers in the risky age category at birth. However, this number did not significantly differ from the normally developing toddler group (26.8%) with a p-value of more than 0.05. These results align with the research by Kiik & Nuwa (2021), which also found no significant relationship between maternal age and the incidence of stunting ($p = 0.611$) (12). This suggests that maternal age may indirectly influence the incidence of

Table 1. Characteristics of the participants

Variable	Nutritional status (height-for-age)			
	Stunting		Normal	
	n	%	n	%
Mother's age at giving birth				
At risk (<20 years or >35 years)	10	24.4	11	26.8
Not Risky (20-35 Years)	31	75.6	30	73.2
Mother's educational level				
Elementary school	5	12.2	4	9.7
Junior high school	3	7.3	8	19.5
Senior high school	22	53.6	17	41.5
College	11	26.8	12	29.3
Mother's employment status				
Housewife	33	80.5	34	82.9
Employee	8	19.5	7	17.1
Mother's nutritional status (BMI)				
Thin (BMI <18.5)	6	14.6	1	2.4
Normal (BMI 18.5-25.0)	19	46.3	14	34.1
Obese (BMI >25)	16	39.0	26	63.4
Mother's height				
<150 cm	21	51.2	4	9.7
≥150 cm	20	48.8	37	90.2

Table 2. the relationship between maternal age at delivery and the incidence of stunting

Variable	Nutritional status (height-for-age)				Total		p-value
	Stunting		Normal				
	n	%	n	%	n	%	
Risky (<20 or >35 y.o)	10	24.4	11	26.8	21	25.6	0.800 OR = 0.880
Not Risky (20-35 y.o)	31	75.6	30	73.2	61	74.4	
Mean ± SD	31.2 ± 5.9		30.8 ± 5.8				0.808
Total	41	100	41	100	82	100	

stunting (13). It is possible that when maternal age is considered risky, it may be mitigated by maternal knowledge about infant care procedures, resulting in healthy child growth and development. Typically, mothers in urban areas have good education and knowledge, making them more likely to adhere to recommended prenatal care practices, such as antenatal visits and exclusive breastfeeding (14).

However, these results are different from several previous studies. For example, the research by Susilowati et al. (2019) showed that 40.5% of mothers who gave birth at an age considered risky were in the stunted group, compared to 27.0% in the normal group (15). This suggests a higher incidence of mothers at an age considered risky during pregnancy in the stunted group compared to the normal group. Maternal age is associated with a baby's birth weight. Young mothers may not have fully developed reproductive organs and physiological functions, increasing the risk of giving birth to low birth weight (LBW) babies, which, in turn, has a risk of causing stunting (16). According to the research by Wemakor et al. (2018), children of teenage mothers were eight times more likely to experience stunting (AOR = 7.56; 95% CI [4.20-13.63]), three times more likely to be underweight (AOR = 2.9; 95% CI [1.04-8.04]), and 13 times more likely to be undernourished (AOR 12.78; 95% CI [4.69-34.81]), compared to children of adult mothers (13). Maternal age at risk also carries a higher risk of maternal and fetal mortality during pregnancy, childbirth, or the postpartum period (17). A study in Yogyakarta revealed that maternal age at birth was the most significant factor related to the incidence of stunting, with a 3.6 times higher risk of giving birth to a stunted child for mothers aged less than 20 years compared to those aged between 20 and 35 (18).

Young mothers often face challenges in ensuring adequate food intake, accessing clean water, and maintaining favorable environmental conditions. They may find themselves competing with the fetus they are carrying for essential nutrients. In addition, young mothers may not be psychologically prepared for postnatal care, or they may lack the financial resources required to support their child's growth and development. Furthermore, the reproductive organs of young mothers may not function optimally compared to mothers aged between 20 and 35. These factors can hinder the growth and development of their children, ultimately contributing to stunting (13,18,19). A systematic review study revealed that teenage mothers, especially those aged under 20 years, had a significantly higher risk of stunting when compared to mothers aged over 20 years, with an

OR ranging from 3.41 to 9.97 for ages 13-17 years. The risk of stunting increases by 50% for pregnant women aged 13 years and gradually decreases by 20% until the mother reaches 27 years. Thereafter, the likelihood of stunting rises again for mothers aged 35 years. Children born to young mothers are at a heightened risk of experiencing poor health conditions such as diarrhea, anemia, malnutrition, wasting, and even infant mortality, compared to children born to older mothers (19).

Pregnant women over 30 years of age may experience a decline in their ability to digest certain nutrients, which can cause imbalanced nutritional intake and increased susceptibility to ilnesses due to decreased immunity. In addition, older mothers may experience reduced stamina during pregnancy, which can diminish their enthusiasm for prenatal care (17,18). This condition can increase the risk of stunting in children. However, advancements in medical and health sciences, coupled with improved healthcare infrastructure, hace the potential to reduce the risk of pregnancy and childbirth complications in mothers at ages considered risky (16).

Education is a learning process for individuals to achieve higher knowledge and understanding regarding specific subjects. This knowledge can be obtained formally, shaping their thought patterns and behaviors (Seftianingtyas, 2020). As a result, educational level also plays an important role in determining one's receptiveness to knowledge. Generally, higher levels of education are expected to facilitate the acquisition of information, particularly concerning nutrition. This study categorized maternal education into primary education (elementary to high school) and higher education (tertiary education).

Table 3. The relationship between mother's educational level and the incidence of stunting

Mother's educational level	Nutritional status (height-for-age)				Total		p-value
	Stunting		Normal				
	n	%	n	%	n	%	
Primary education (Elementary – high school)	30	73.2	29	70.7	59	72.0	0.806 OR = 1.129
Higher education (tertiary education)	11	26.8	12	29.3	23	28.0	
Total	41	100	41	100	82	100	

The results showed that maternal education was not associated with children's nutritional status, specifically stunting ($p = 0.806$; $p > 0.005$) (Table 3). This suggests that maternal education is not a direct variable that influences stunting. This finding aligns with the research by Dewi et al. (2022), which found that maternal education indirectly influenced toddlers' nutritional status. This research also revealed that the majority of mothers (73.2%) with primary education had children with stunted nutritional status. This indicates that mothers with higher education levels tended to be able to mitigate the risk of stunting, in accordance with the notion that education serves as a conduit for learning and mastering knowledge and skills.

Educational level also plays a significant role in determining one's receptiveness to knowledge. Consequently, individuals with higher education levels are generally better equipped to absorb nutritional information. Dewi et al. (2022) revealed that toddlers with parents who had higher education tend to have better nutritional status, which can be attributed to their parents' knowledge, motivation, and influence in providing nutritious meals. Parental education plays an important role in determining the ease with which individuals can absorb and understand the nutritional knowledge they have acquired, subsequently informing their meal preparation and child-rearing practices. The pattern of food preparation is closely related to a mother's knowledge of food ingredients, such as sources of carbohydrates, protein, fat, vitamins, and minerals (Seftianingtyas, 2020).

In line with the research by Firdaus et al. (2021), educational level can influence one's nutritional knowledge and skills, particularly in managing family members' dietary choices, thereby contributing to family food diversity. According to Suharjo (2009), one of the causes of nutritional problems is the low educational level within communities, which can hinder the acceptance of knowledge provided. Through education, mothers are expected to be better prepared to create balanced family meal plans,

Table 4. The relationship between mother's employment status and the incidence of stunting

Mother's employment status	Nutritional status (height-for-age)				Total		p-value
	Stunting		Normal				
	n	%	n	%	n	%	
Housewife	33	80.5	34	82.9	67	81.7	0.775 OR = 0.849
Employee	8	19.5	7	17.1	15	18.3	
Total	41	100	41	100	82	100	

which are a cornerstone for improving family well-being. Moreover, Lette et al. (2019) revealed that higher maternal education levels are associated with better child nutritional conditions.

Work is related to socioeconomic conditions, particularly income. According to Khairunnisa and Ghinanda (2022), a family's income greatly influences the extent to which their primary and secondary needs are met, including the attention and affection children receive as well as access to food. When family income increases, it is common for a significant portion of it to be allocated to obtaining additional food. Thus, income emerges as the predominant factor in determining the quantity and quality of food (Aulia et al., 2020).

A family's ability to buy food depends on the magnitude of their income. Families with limited income often face difficulties in fulfilling their dietary requirements, particularly with respect to meeting essential nutritional needs. Generally, with an increase in income, the quantity and variety of food tend to improve. Moreover, income determines the selection of food purchased with additional resources. The higher the income, the larger proportion of the income being allocated to buying food (Aulia et al., 2020). In other words, it can be concluded that occupation is one of the determinants of meeting a family's nutritional needs. This is related to access to food, that is, a family's ability to buy food to meet their nutritional needs.

The results of this study showed that maternal employment status had no significant relationship with stunting ($p = 0.775$; $p > 0.005$) (Table 4). This suggests that maternal employment status is not a direct variable that influences stunting. However, it can be noted that the majority of working mothers had children with stunted nutritional status (53.33%). Working mothers often have more limited time to care for their children than non-working mothers. This can affect parenting patterns, especially dietary habits, which ultimately affect a child's nutritional status. When a mother's work hours extend from morning to evening, she may have limited opportunities to attend to her child's dietary and nutritional requirements (Fauzia et al., 2019). Furthermore, Khairunnisa and Ghinanda (2022) revealed that this situation can be exacerbated if the child is entrusted to a caregiver who may not necessarily understand proper feeding practices. Alpin (2021) supported these results by showing that non-working mothers could prevent their toddlers from experiencing poor nutritional status compared to working mothers.

Nutritional status is important for both mothers and children. This study examined the relationship between maternal nutritional status and the incidence of stunting in children. The classification of maternal nutritional status by the child's nutritional status is presented in Table 5. In the stunted toddler group, six mothers had an underweight nutritional status, while in the normally developing toddler group, only one mother had an underweight nutritional status. The statistical analysis results showed a relationship between maternal nutritional status and the child's nutritional status ($p < 0.05$). In addition, the data in Table 5 shows a difference in the average maternal BMI values. It can be noted that lower maternal BMI values are associated with the risk of stunting in toddlers ($p < 0.05$).

Table 5. The relationship between mother's nutritional status and the incidence of stunting

Mother's nutritional status (BMI)	Nutritional status (height-for-age)				Total		p-value
	Stunting		Normal				
	n	%	n	%	n	%	
Thin (BMI <18.5)	6	14.6	1	2.4	7	8.5	0.035*
Normal (BMI 18.5-25.0)	19	46.4	14	34.2	33	40.3	
Obese (BMI >25)	16	39.0	26	63.4	42	51.2	
Mean ± SD	24.3 ± 5.3		26.6 ± 4.4				0.040**
Total	41	100	41	100	82	100	

*significantly associated with $\alpha < 0.05$ using chi square test
**significantly different with $\alpha < 0.05$ using independent t-test

Stunting can result from various factors, particularly in the context of Indonesia, with maternal nutritional status being one of the significant contributors, alongside breastfeeding practices, complementary food introduction, and susceptibility to infections (20). Mothers with a low nutritional status are at a heightened risk of developing anemia, especially during pregnancy (21). Anemia in pregnant women can lead to low birth weight (LBW) in newborns (22) and is a risk factor for stunting in toddlers (23). Dietary intake also plays a crucial role in shaping nutritional status. For mothers, especially pregnant women, their intake can substantially impact their nutritional status and that of their children (24). Previous research findings showed that a mother's vegetarian diet had a significantly correlation with stunting and wasting in children (25). Improving maternal health through dietary intake can lead to improvements in maternal nutritional status and a reduction in the risk of stunting in children (26). In other words, maternal health interventions, including maternal health services and dietary diversification, can reduce the risk of stunting and wasting in children (26).

Maternal height is a well-known risk factor for stunting in children (24). The classification of the mother's height by the child's nutritional status is presented in Table 6. The results of this study showed that 57 mothers had a height of equal to and taller than 150 cm, while 25 mothers were shorter than 150 cm. Moreover, most of the mothers in the stunted toddler group had a height of shorter than 150 cm (51.2%). In contrast, the toddler group with normal nutritional status had mothers with a height of equal to and taller than 150 cm (69.5%). In other words, the average maternal height in the stunted toddler group was lower than the normally developing toddler group (Table 6). Subsequent t-test analysis showed that the heights were significantly different, with a p-value of less than 0.05. The statistical analysis results show that maternal height was significantly correlated to the incidence of stunting in children ($p < 0.05$; OR = 9.713). This indicates that mothers whose height was shorter than 150 cm have a nine times greater risk of having stunted children.

Table 6. The relationship between mother's height and the incidence of stunting

Mother's height	Nutritional status (height-for-age)				Total		p-value
	Stunting		Normal				
	n	%	n	%	n	%	
<150 cm	21	51.2	4	9.8	25	30.5	0.000* (OR = 9.713)
≥150 cm	20	48.8	37	90.2	57	69.5	
Mean ± SD	150.6 ± 5.2		152.8 ± 4.1				0.038**
Total	41	100	41	100	82	100	

*significantly associated with $\alpha < 0.05$ using chi square test
**significantly different with $\alpha < 0.05$ using independent t-test

The results of this study align with previous studies (20,23,24). In Indonesia, stunting in children is associated with premature birth, LBW, non-exclusive breastfeeding, maternal stunting, low maternal educational level, low household socioeconomic status, poor hygiene and sanitation, and limited access to health services, and residents in rural areas (20). Short mothers have a higher risk of experiencing intrauterine growth restriction (27), a condition leading to suboptimal fetal growth due to inadequate nutritional transfer from the mother to the fetus during pregnancy. Intrauterine growth restriction is associated with reduced birth weight in children (28), impeding linear growth as well as affecting brain and cognitive development (29), which ultimately increases the risk of metabolic syndrome (30). Intrauterine growth restriction can be prevented by ensuring the mother's nutritional status at a healthy level, particularly during pregnancy. Normal maternal nutritional status will support optimal fetal growth and prevent maternal anemia (31).

CONCLUSION AND SUGGESTION

Characteristics of mothers in urban areas that are related to the incidence of stunting are maternal nutritional status and height. Meanwhile, maternal age, educational level, and employment status are not related to the incidence of stunting in urban areas. Maternal nutritional status in the stunted toddler group corresponds to a lower average BMI value, indicating that mothers with a low nutritional status tend to have stunted toddlers. In addition, mothers who are shorter than 150 cm are 9.713 times more likely to have stunted toddlers.

The results of this study underscore the importance of stunting prevention programs, with a particular emphasis on improving the nutritional status of adolescent girls because linear growth peaks at adolescence, giving young women the opportunity to reach optimal height.

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