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Risk Factors for Stunting among Infants on Java Island: A Cross-Sectional Study using the 2021 Indonesian Nutritional Status Survey Data

Faktor Risiko Stunting pada Baduta di Pulau Jawa: Studi Cross-Sectional *menggunakan Data Studi Status Gizi Indonesia Tahun 2021*

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ABSTRACT

Background: *Stunting is a malnutrition problem that requires attention, with a prevalence of 24.4% in 2021. As the most populous island in Indonesia, Java Island has a significant impact on the incidence of stunting.*
Objectives: *This study aims to determine the prevalence of stunting in infants and to identify factors associated with the incidence of stunting in each province of Java.*
Methods: *This study used secondary data from the Indonesian Nutrition Status Study (INSS) conducted in 2021 with a cross-sectional design. A logistic regression test with weighting was conducted to determine the relationship between each variable and the incidence of stunting.*
Results: *The prevalence of stunting in infants was measured in several regions of Indonesia, including DKI Jakarta (11.9%), West Java (16.3%), Central Java (13.2%), DI Yogyakarta (12.1%), East Java (15.9%), and Banten (14.6%). Risk factors for stunting were identified in DKI Jakarta, namely economic status in quintile 1 ($p = 0.001$), and in West Java, namely snack consumption ($p = 0.002$) and economic status in quintile 1 ($p < 0.001$). In Central Java, the risk factor was economic in quintile 1 ($p = 0.048$), while in the Special Region of Yogyakarta, it was age 12-23 months ($p = 0.022$). In East Java, infants aged 9-11 months ($p = 0.013$) and 12-23 months ($p < 0.001$) with low ($p = 0.010$) and middle ($p = 0.017$) mother's education level and economic status in quintile 1 ($p = 0.005$) were found to be at risk. In Banten were male infants ($p = 0.011$) in rural areas ($p = 0.039$) and with economic status in quintile 1 ($p = 0.019$) were found to be at risk.*
Conclusions: *Economic status is a risk factor for stunting on Java Island. Interventions can be targeted towards improving economic status.*

INTRODUCTION

Stunting is a form of malnutrition that is expected to decline each year. The Sustainable Development Goals (SDGs) aims to reduce stunting by 50% from the 2012 level by 2030 [1]. Stunting is defined as a height-for-age measurement that is less than -2 SD [2].

Stunting has both short-term and long-term effects. Short-term effects include stunted growth, impaired cognitive development, and impaired motor skills [3,4]. Long-term effects of stunting include reduced intellectual abilities due to impaired nerve and brain cell function [3]. Stunted children are also more likely to develop hypertension, obesity, and metabolic disorders as adults [5].

The handling of stunting incidence has been appropriate, but updates are needed to adapt to current conditions. According to the 2023 global data, the

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incidence of stunting was 22.3%, which is in the high category [6]. This is consistent with the incidence of stunting in Indonesia, which also falls in the high category with a stunting incidence of 24.4% [7]. Stunting is caused by both direct and indirect factors. In Indonesia, indirect factors that influence the incidence of stunting include food security, social environment, health environment, and housing conditions. These four factors can influence direct factors of stunting, such as nutritional intake and health status [3].

Java Island has the largest population in Indonesia, with over 150 million people [8]. This significant number of people has an impact on the incidence of stunting in children. The prevalence of stunting in the Special Capital Region of Jakarta is 16.8%, West Java is 24.5%, Central Java is 20.9%, the Special Region of Yogyakarta is 17.3%, East Java is 23.5%, and Banten is 24.5% 7. In addition, some areas in Java are part of the target areas for accelerated interventions to reduce stunting. In 2023, 108 out of 246 districts/cities included in the acceleration program were located on Java Island, indicating a focus on densely populated areas to reduce stunting [9]. Burundi, which has a high population density, has a stunting incidence of 58%. In this country, the risk factors for stunting include sex, age, place of birth, birth weight, mother's education level, number of children under five years, maternal knowledge of nutrition, and nutritional status [10].

The incidence of stunting may increase in densely populated regions. However, it remains necessary to identify the risk factors that lead to an increase in the incidence of stunting in densely populated regions. The main objectives of this study is to determine the prevalence of stunting among infants aged 6 to 23 months in each of the provinces of Java and to identify factors associated with stunting in each of the provinces. The results of this study will serve as a basis for designing programs that are more appropriate and effective in achieving the intended goals.

METHODS

This study used a cross-sectional design with secondary data from the Indonesian Nutrition Status Study (INSS) conducted in 2021, which was approved for use (IR.03.01/H.I/2730/2023). This study focused on infants under two years, specifically those aged 6-23 months residing on Java Island, which includes six provinces: the Special Capital Region of Jakarta, West Java, Central Java, the Special Region of Yogyakarta, East Java, and Banten.

Data from the Health Development Policy Agency were used for the selection of subjects for this study. The subjects were selected based on inclusion and exclusion criteria. The inclusion criteria of this study required complete data on the subjects, while the exclusion criteria included incomplete data and infants who are not healthy according to questions in the infant morbidity section of the questionnaire (**Image 1**). Analysis was then performed on the data used in this study.

This study used stunting as the dependent variable. Meanwhile, the independent variables were infant age (6-8 months, 9-11 months, and 12-23 months), infant sex (male and female), dietary diversity (diverse and non-diverse), snack consumption (yes and no), age at complementary feeding (<6 months and ≥6 months), residence (urban and rural), availability of healthcare facilities (yes and no), access to nutrition services (yes and no), mother's education level (low, middle, and high), and economic status (quintile 1-5). The economic status was determined by analyzing the ownership of valuables using the principal component analysis (PCA) method.

The Minimum Dietary Diversity (MDD) method was used to determine dietary diversity. Infants were considered to have diverse diets if they consumed at least five out of eight food groups, which now includes breast milk. Previously, only seven food groups were included in the MDD method. The eight food groups consist of breast milk; grains, roots, and tubers; legumes and nuts; dairy products, flesh foods (including fish, beef, and chicken), eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables [11]. This study defines snacks as extruded foods with salty flavors and puff, dry, or hollow shapes.

This study conducted two types of data analysis. First, descriptive analysis was used to present the number and percentage of data used in general and from each province on Java Island. Second, bivariate analysis was conducted to determine the relationship between the independent and dependent variables, such as stunting, with all independent variables examined. The p-value shows the relationship between the independent and dependent variables. A p-value of less than 0.05 indicates a significant relationship. Moreover, logistic regression weighting was used to generate odds ratios and determine the likelihood of occurrence between exposure and outcome. The statistical analysis was performed using STATA 17.

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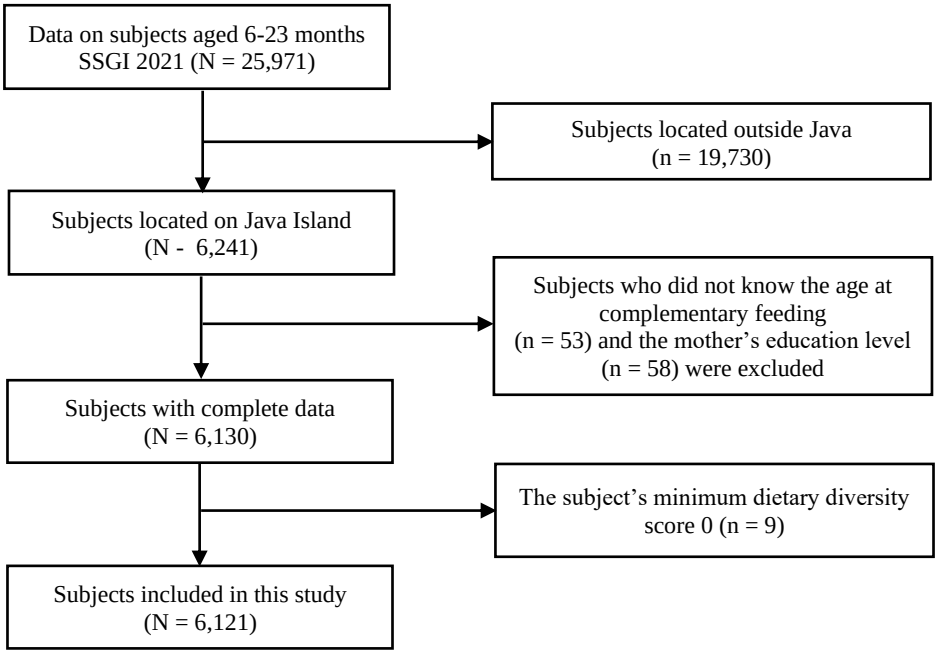

Image 1. Selection of the research subjects

RESULTS AND DISCUSSION

This study included 6,121 children aged 6 to 23 months. The prevalence of stunting in Java Island was 14.2%. More specifically, the prevalence of stunting was 14.2% in the Special Capital Region of Jakarta, 17.8% in West Java, 18.8% in Central Java, 13.3% in the Special Region of Yogyakarta, 20.1% in East Java, and 15.9% in Banten. The height-for-age nutritional status of the infants showed that 14.2% were stunted and 85.8% were not stunted.

Table 1 shows that the majority of infants (68.1%) were 12-23 months, followed by 9-11 months (16.5%) and 6-8 months (15.4%). Male infants accounted for 51.8%, while female infants accounted for 48.3%. In addition, 58.3% of the infants consumed diverse foods, while 41.7% did not. Moreover, 54.1% of the infants had snack consumption, while 45.9% did not. The prevalence of introducing complementary food other than breast milk was higher in infants aged ≥6 months (52.2%) compared to those aged <6 months (47.8%). Of the infants, 66.1% resided in urban areas and 33.9% in rural areas. Healthcare facilities were available for 92.9% of the infants, while 7.1% did not have access to them. Only 20.4% of the infants received nutrition services, while 79.6% did not. The majority of mothers in this study had a middle level of education (64.9%), while 20.5% had low education and 14.6% had high education. The infants were ranked by economic status, with quintile 4 (22.1%), quintile 5 (21.0%), quintile 3 (19.8%), quintile 2 (18.8%), and quintile 1 (18.2%) being the most represented.

Table 1. Characteristics of subjects on Java Island

Variable	Category	Number (n)	Percentage (%)
Infant age	6-8 months	943	15.4
	9-11 months	1,007	16.5
	12-23 months	4,171	68.1
Infant sex	Male	3,169	51.8
	Female	2,951	48.2
Dietary diversity	Diverse	3,566	58.3
	Non-diverse	2,555	41.7
Snack consumption	Yes	3,309	54.1
	No	2,812	45.9
Age at complementary food	<6 months	2,928	47.8
	≥6 months	3,193	52.2
Residence	Urban	4,049	66.1
	Rural	2,072	33.9
Availability of healthcare facilities	Yes	5,684	92.9
	No	437	7.1
Access to nutrition services	Yes	1,251	20.4
	No	4,870	79.6
Mother's education level	Low	1,254	20.5

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	Middle	3,974	64.9
	High	893	14.6
Economic status	Quintile 1	1,117	18.2
	Quintile 2	1,153	18.8
	Quintile 3	1,210	19.8
	Quintile 4	1,354	22.1
	Quintile 5	1,287	21.0
Province	DKI Jakarta	868	14.2
	West Java	1,088	17.8
	Central Java	1,148	18.8
	DI Yogyakarta	816	13.3
	East Java	1,230	20.1
	Banten	971	15.9
Infant's height-to-age nutritional status	Stunted	868	14.2
	No	5,223	85.8

Table 2 shows the characteristics of the subjects in each province of Java. The most common age group across all provinces was children aged 12-23 months. West Java (51.7%), Central Java (52.3%), the Special Region of Yogyakarta (53.4%), and East Java (53.5%) had a higher percentage of male infants. Meanwhile, the Special Capital Region of Jakarta and Banten had higher percentages of female infants at 50.6% and 50.3%, respectively. The prevalence of dietary diversity among infants aged 6-23 months was the highest in the Special Region of Yogyakarta at 75.0%, the Special Capital Region of Jakarta at 62.8%, Central Java at 60.7%, East Java at 60.5%, West Java at 49.9%, and Banten at 43.8%. Meanwhile, the highest prevalence of snack consumption was found in West Java (61.7%), Central Java (54.3%), the Special Region of Yogyakarta (54.2%), East Java (54.2%), the Special Capital Region of Jakarta (50.5%), and Banten (48.2%). In Banten, 62.5% of the infants started consuming complementary food other than breast milk before the age of six months, while in the Special Capital Region of Jakarta, the percentage was 52.3%. Healthcare facilities were available in almost all provinces. Meanwhile, nutrition services were most commonly found in the Special Region of Yogyakarta (29.0%), East Java (26.9%), Central Java (21.6%), West Java (21.0%), Banten (12.9%), and the Special Capital Region of Jakarta (9.3%). In each province, the mothers commonly had a middle level of education. The economic status varied across provinces, with the highest percentage of quintile 5 in the Special Capital Region of Jakarta (31.1%), quintile 1 in West Java (23.1%), quintile 3 in Central Java (22.2%), quintile 5 in the Special Region of Yogyakarta (26.0%), quintile 2 in East Java (23.0%), and quintile 5 in Banten (22.8%). The prevalence of stunting was lowest in the Special Capital Region of Jakarta (11.9%), the Special Region of Yogyakarta (12.1%), Central Java, 13.2%), Banten (14.6%), East Java (15.9%), and West Java (16.3%).

Table 2. Frequency of subject characteristics in each province of Java Island

Variable	Special Capital Region of Jakarta	West Java	Central Java	Special Region of Yogyakarta	East Java	Banten
Infant age						
6-8 months	14.3%	16.7%	16.1%	14.1%	14.1%	16.8%
9-11 months	18.9%	15.7%	16.6%	16.1%	15.8%	16.1%
12-23 months	66.8%	67.6%	67.2%	69.9%	70.1%	67.1%
Infant sex						
Male	49.4%	51.7%	52.3%	53.4%	53.5%	49.7%
Female	50.6%	48.3%	47.7%	46.6%	46.5%	50.3%
Dietary diversity						
Diverse	62.8%	49.9%	60.7%	75.0%	60.5%	43.8%
Non-diverse	37.2%	50.1%	39.3%	25.0%	39.5%	56.2%
Snack consumption						
Yes	50.5%	61.7%	54.3%	54.2%	54.2%	48.2%
No	49.5%	38.3%	45.7%	45.8%	45.8%	51.8%
Age at complementary food						
<6 months	52.3%	48.4%	44.6%	33.2%	45.3%	62.5%
≥6 months	47.7%	51.6%	55.4%	66.8%	54.7%	37.5%
Residence						
Urban	100%	67.7%	50.6%	70.1%	48.9%	71.0%
Rural	0%	32.2%	49.4%	29.9%	51.1%	29.0%
Availability of healthcare facilities						
Yes	87.3%	94.1%	96.3%	98.0%	93.8%	86.7%
No	12.7%	5.9%	3.7%	2.0%	6.2%	13.3%

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Access to nutrition services						
Yes	9.3%	21.0%	21.6%	29.0%	26.9%	12.9%
No	90.7%	79.0%	78.4%	71.0%	73.1%	87.1%
Mother's education level						
Low	9.4%	28.1%	23.4%	7.2%	23.4%	25.7%
Middle	68.4%	62.7%	63.8%	71.2%	64.3%	61.2%
High	22.1%	9.2%	12.8%	21.6%	12.3%	13.1%
Economic status						
Quintile 1	8.1%	23.1%	19.9%	14.8%	19.9%	20.7%
Quintile 2	12.6%	20.9%	20.8%	15.9%	23.0%	17.0%
Quintile 3	18.4%	19.8%	22.2%	18.5%	20.8%	17.8%
Quintile 4	29.8%	20.1%	19.6%	24.8%	19.3%	21.7%
Quintile 5	31.1%	16.2%	17.4%	26.0%	16.9%	22.8%
Children's height-to age nutritional status						
Stunting	11.9%	16.3%	13.2%	12.1%	15.9%	14.6%
No	88.1%	83.7%	86.8%	87.9%	84.1%	85.4%
Breast milk						
Yes	59.8%	73.9%	78.7%	80.8%	67.6%	65.1%
No	40.2%	26.1%	21.3%	19.2%	32.4%	34.9%
Grains, roots, and tubers						
Yes	97.0%	95.6%	96.6%	96.3%	93.3%	95.8%
No	3%	4.4%	3.4%	3.7%	6.7%	4.2%
Legumes and nuts						
Yes	30.6%	33.5%	38.0%	46.7%	43.0%	28.9%
No	69.4%	66.5%	62.0%	53.3%	57.0%	71.1%
Dairy products						
Yes	62.9%	41.6%	42.2%	48.0%	47.5%	45.9%
No	37.1%	58.4%	57.8%	52.0%	52.5%	54.1%
Flesh foods						
Yes	71.5%	52.4%	54.0%	63.4%	56.4%	52.1%
No	28.5%	47.6%	46.0%	36.6%	43.6%	47.9%
Eggs						
Yes	39.9%	37.0%	42.1%	52.2%	48.4%	34.1%
No	60.1%	63.0%	57.9%	47.8%	51.6%	65.9%
Vitamin-A rich fruits and vegetables						
Yes	72.4%	61.8%	71.3%	80.4%	71.5%	54.3%
No	27.6%	38.2%	28.7%	19.6%	28.5%	45.7%
Other fruits and vegetables						
Yes	52.9%	48.1%	58.8%	69.0%	51.2%	48.1%
No	47.1%	51.9%	41.2%	31.0%	48.8%	51.9%

Table 3 shows the risk and protective factors for stunting in each province of Java, including the Special Capital Region of Jakarta, West Java, Central Java, the Special Region of Yogyakarta, East Java, and Banten.

In the Special Capital Region of Jakarta, infants who had complementary food before the age of six months had a lower risk of stunting (OR = 0.60; 95% CI: 0.36-0.98). In addition, economic status is a risk factor for stunting. Infants from families with economic status in quintile 1 (OR = 4.03; 95% CI: 1.81-8.94), quintile 2 (OR = 2.56; 95% CI: 1.08-6.09), quintile 3 (OR = 3.48; 95% CI: 1.59-7.66), and quintile 4 (OR = 2.63; 95% CI: 1.29-5.35) had a higher risk of stunting compared to those from families with economic status in quintile 5.

In West Java Province, infants aged 12-23 months had a higher risk of stunting (OR = 3.47; 95% CI: 1.70-7.07) compared to children aged 6-8 months. Snack consumption was associated with a higher risk of stunting (OR = 1.92; 95% CI: 1.26-2.92) than non-consumption. infants living in rural areas (OR = 1.49; 95% CI: 1.02-2.18) had a higher risk of stunting compared to those living in urban areas. Furthermore, the incidence of stunting was higher in infants whose mothers had lower education levels. Mothers with low (OR = 15.08; 95% CI: 4.97-45.78) and medium (OR = 8.31; 95% CI: 2.77-24.90) levels of education had a higher incidence of stunting in their children compared to mothers with higher education. Similarly, economic status was a risk factor for stunting in quintile 1 (OR = 5.82; 95% CI: 2.66-12.72), quintile 2 (OR = 3.13; 95% CI: 1.40-7.01), and quintile 3 (OR = 4.04; 95% CI: 1.71-9.56) compared to quintile 5. This study found that receiving nutrition services was a protective factor against stunting in West Java (OR = 0.61; 95% CI: 0.41-0.91).

In Central Java, family economic status was the risk factor for stunting. Infants whose family economic status was in quintile 1 (OR = 1.83; 95% CI: 1.00-3.22) were more likely to be stunted than those whose family economic status was in quintile 5.

In the Special Region of Yogyakarta, the risk factor for stunting was infant age. Infants aged 12-23 months (OR = 2.82; 95% CI: 1.17-6.84) had a higher incidence of

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stunting compared to infants aged 6-8 months. In addition, infants who did not have diverse diets were found to be less likely to be stunted (OR = 0.46; 95% CI: 0.26-0.80).

In East Java, the risk factors for stunting were infant age, infant sex, snack consumption, mother's education level, and economic status. Infants aged 9-11 months (OR = 3.20; 95% CI: 1.28-8.04) and 12-23 months (OR = 5.22; 95% CI: 2.30-11.89) had a higher incidence of stunting compared to infants aged 6-8 months. Male infants (OR = 1.55; 95% CI: 1.08-2.22) also had a higher incidence of stunting than female infants. In addition, infants who consumed snacks (OR = 1.51; 95% CI: 1.10-2.08) were more likely to be stunted than those who did not. Mothers with low (OR = 2.48; 95% CI: 1.24-4.94) and medium (OR = 2.16; 95% CI: 1.15-4.07) levels of education had a higher incidence of stunting in their children than mothers with higher education. Infants from families with economic status in quintile 1 (OR = 3.12; 95% CI: 1.41-6.91) and quintile 3 (OR = 2.52; 95% CI: 1.22-5.22) were at a higher risk of stunting compared to those from families with economic status in quintile 5.

In Banten, the risk factors for stunting were infant age, infant sex, snack consumption, residence, and economic status. Infants aged 12-23 months (OR = 6.62; 95% CI: 2.87-15.29) had a higher incidence of stunting compared to those aged 6-8 months. Male infants (OR = 1.76; 95% CI: 1.14-2.71) also had a higher incidence of stunting than female infants. In addition, infants who consumed snacks (OR = 2.57; 95% CI: 1.68-3.94) were more likely to be stunted than those who did not. Infants living in rural areas (OR = 1.59; 95% CI: 1.02-2.46) had a higher risk of stunting compared to those living in urban areas. Infants from families with economic status in quintile 1 (OR = 1.94; 95% CI: 1.12-3.37) had a higher risk of stunting compared to those from families with economic status in quintile 5.

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Tabel 3. Risk factors for stunting in provinces on Java Island

Variable	Province											
	Special Capital Region of Jakarta		West Java		Central Java		Special Region of Yogyakarta		East Java		Banten	
	OR	p-Value	OR	p-Value	OR	p-Value	OR	p-Value	OR	p-Value	OR	p-Value
Infant age												
6-8 months	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
9-11 months	1.35 (0.51-3.60)	0.542	1.02 (0.43-2.43)	0.958	0.68 (0.33-1.37)	0.279	0.56 (0.15-2.11)	0.393	3.20 (1.28-8.04)*	0.013	1.93 (0.70-5.28)	0.203
12-23 months	1.78 (0.77-4.09)	0.177	3.47 (1.70-7.07)*	0.001	1.12 (0.70-1.81)	0.638	2.82 (1.17-6.84)*	0.022	5.22 (2.30-11.89)*	<0.001	6.62 (2.87-15.29)*	<0.001
Infant sex												
Male	1.07 (0.60-1.73)	0.784	1.40 (0.99-1.96)	0.056	1.29 (0.87-1.91)	0.206	1.19 (0.72-1.97)	0.502	1.55 (1.08-2.22)*	0.017	1.76 (1.14-2.71)*	0.011
Female	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Dietary diversity												
Diverse	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Non-diverse	0.89 (0.54-1.47)	0.662	0.86 (0.58-1.26)	0.438	1.41 (0.99-2.02)	0.060	0.46 (0.26-0.80)*	0.006	0.95 (0.66-1.36)	0.784	0.96 (0.61-1.53)	0.877
Snack consumption												
Yes	1.31 (0.80-2.13)	0.278	1.92 (1.26-2.92)*	0.002	1.04 (0.73-1.47)	0.833	1.13 (0.70-1.83)	0.622	1.51 (1.10-2.08)*	0.011	2.57 (1.68-3.94)*	<0.001
No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Age at complementary food												
< 6 months	0.60 (0.36-0.98) *	0.043	0.69 (0.47-1.00)	0.052	1.05 (0.72-1.52)	0.802	0.96 (0.61-1.54)	0.880	1.17 (0.82-1.68)	0.388	1.23 (0.78-1.93)	0.367
≥ 6 months	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Residence												
Urban	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Rural	No villages		1.49 (1.02-2.18)*	0.041	0.96 (0.64-1.45)	0.861	1.27 (0.75-2.13)	0.371	0.95 (0.66-1.35)	0.758	1.59 (1.02-2.46)*	0.039
Availability of healthcare facilities												
Yes	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
No	0.95 (0.48-1.91)	0.893	1.12 (0.59-2.14)	0.732	2.12 (0.96-4.70)	0.064	0.97 (0.20-4.74)	0.966	0.96 (0.47-1.96)	0.905	0.89 (0.43-1.84)	0.744
Access to nutrition services												
Yes	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
No	1.18 (0.57-2.43)	0.657	0.61 (0.41-0.91)*	0.014	0.95 (0.62-1.46)	0.806	0.77 (0.47-1.27)	0.309	0.77 (0.53-1.12)	0.176	1.76 (0.90-3.47)	0.099

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Mother's education level												
Low	1.87 (0.66-5.27)	0.238	15.08 (4.97-45.78)*	<0.001	1.82 (0.92-2.60)	0.084	0.95 (0.28-3.21)	0.932	2.48 (1.24-4.94)*	0.010	1.78 (0.82-3.88)	0.146
Middle	1.97 (0.96-4.03)	0.063	8.31 (2.77-24.90)*	<0.001	1.07 (0.58-1.97)	0.827	1.43 (0.73-2.81)	0.294	2.16 (1.15-4.07)*	0.017	1.38 (0.66-2.87)	0.389
High	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Economic status												
Quintile 1	4.03 (1.81-8.94)*	0.001	5.82 (2.66-12.72)*	<0.001	1.83 (1.00-3.32) *	0.048	1.52 (0.62-3.71)	0.361	3.12 (1.41-6.91)	0.005	1.94 (1.12-3.37)*	0.019
Quintile 2	2.56 (1.08-6.09)*	0.033	3.13 (1.40-7.01)*	0.006	1.51 (0.822-2.79)	0.182	2.26 (0.99-5.16)	0.053	1.82 (0.80-4.11)	0.150	1.67 (0.83-3.39)	0.151
Quintile 3	3.48 (1.59-7.66)*	0.002	4.04 (1.71-9.56)*	0.002	1.21 (0.65-2.26)	0.542	2.10 (0.93-4.75)	0.074	2.52 (1.22-5.22)*	0.013	1.37 (0.69-2.69)	0.359
Quintile 4	2.63 (1.29-5.35)*	0.008	2.18 (0.92-5.18)	0.076	1.36 (0.72-2.58)	0.340	1.61 (0.69-3.77)	0.271	2.24 (1.00-5.00)	0.050	1.09 (0.54-2.18)	0.818
Quintile 5	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	

*p-value <0.05

Stunting in children under five is caused by various factors. Identifying these factors is important before intervention. This study found that infants in West Java aged 12-23 months were 3.47 times more likely to be stunted compared to those aged 6-8 months. This is consistent with research that was conducted in Northern Ethiopia [12]. Infants aged 6-23 months require complementary feeding as they transition from breastfeeding. It is crucial that this complementary feeding is optimized to promote healthy growth and prevent stunting. As food consumption changes with age, the infant's age is a risk factor for stunting. In Thailand, 8.7% of infants aged 6-11 months and 11.8% of infants aged 12-23 months were found to be stunted [13].

According to complementary feeding guidelines, the recommended amount and frequency of feeding varies for infants aged 6-8 months, 9-11 months, and 12-23 months are different [14,15]. For infants aged 6-8 months, feeding should begin with 2-3 small spoonsful and gradually increase to half a 250 ml bowl by 9-11 months. For infants aged 12-23 months, the recommended amount of food ranges from three-quarters to a 250 ml bowl [14]. For breastfed infants, it is recommended to provide two meals or snacks per day for infants aged 6-8 months and three meals or snacks per day for those aged 6-23 months. Meanwhile, non-breastfed infants should at least four times a day [15].

Dietary diversity is an important factor in assessing complementary foods. This study found that dietary diversity in the Special Region of Yogyakarta was a protective factor against stunting. Infants who did not consume diverse foods were less likely to be stunted. This is evident from the expected food consumption pattern score in the province, where protein consumption is good [16].

During the complementary feeding period, infants are encouraged to explore different types of foods. However, it is important to note that snacks, which are often high in energy and salt, can replace breast milk and reduce an infant's appetite for nutritious food. To ensure that infants receive adequate nutrition, it is important to provide them with salt-free complementary foods to avoid snacks. According to a study conducted in West Java, children aged ≥7 years who frequently consumed snacks had lower height-for-age values compared to those who rarely consumed snacks [17].

Infants living in rural areas of Banten had a 1.59 times higher risk of stunting than those living in urban areas. This is due to factors such as socioeconomic disparities, parental education level, and family welfare, including asset ownership, access to drinking water, and safe water [18]. Similar trends were observed in Ethiopia and Bangladesh, where children living in rural areas were 30% and 7.2% more likely to be stunted, respectively, compared to those living in urban areas [19,20]. A study conducted in Ecuador found that diarrhea was one of the causes of stunting children living in rural areas [21].

This study confirms that a mother's education level is a significant factor in child stunting. In East Java, mothers with low and medium levels of education had a 2.48 and 2.16 times higher risk of having stunted children, respectively, compared to mothers with higher education. A higher level of education among mothers often leads to a broader knowledge of child health, a greater use of available healthcare facilities, and a greater concern for family hygiene and sanitation [22]. At healthcare facilities, mothers can receive antenatal care (ANC) and postnatal care (PNC) to increase their knowledge about their children. They can also have their children immunized according to the recommended

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schedule [23]. Research conducted in Bangladesh shows that a child's dietary diversity increases with the mother's education level [24].

Furthermore, this study shows that social and economic conditions affect the incidence of stunting in the Special Capital Region of Jakarta, West Java, Central Java, East Java, and Banten. Families with lower economic status often have inadequate daily food intake, poor access to healthcare facilities, and low levels of cleanliness and hygiene [25]. Such families are highly vulnerable to food insecurity, which can lead to growth and development issues in children [26].

According to the results of this study, male infants in Banten was 1.76 times more likely to be stunted than female infants. This difference may be caused by biological factors, social factors, or a combination of both factors. Biologically, differences in immune conditions may play a role. Socially, differences in feeding habits, weaning period, and daily activities may contribute [27]. According to a study conducted in Ethiopia, boys have a 40% higher risk of stunting compared to girls [19].

This study also found that giving complementary foods to infants aged <6 months was a protective factor against stunting in the Special Capital Region of Jakarta. According to data from Statistics Indonesia, women constitute 73.08% of the workforce in Jakarta [28]. A qualitative study conducted in Kenya showed that working mothers who gave complementary foods early could meet the nutritional needs of their children, especially those who worked full-time did not have access to a breast pump to ensure the quality of breast milk [29]. This situation may lead the mother to choose to give complementary foods before the child is six months old. Mothers who are taking medications that can be excreted in breast milk in amounts that can harm children should avoid breastfeeding [30].

According to the results of this study, parents who received nutrition services were a protective factor against stunting in West Java. While nutritional intervention does not guarantee prevention of stunting, educating parents, providing additional food, giving supplements, or helping when a child is stunted can be helpful [31]. Interventions for stunting depend on the programs implemented in each region. In Indonesia, stunted children receive counseling, education, information about the nutritional therapy that will be administered [32].

This study has described the incidence of stunting and its risk factors in infants aged 6-23 months on Java Island. However, this study has limitations due to incomplete data related to variables such as the age at complementary feeding and the mother's education level. In addition, the authors did not have access to several variables which could have supported the results and discussion, such as the father's education level.

CONCLUSION

Java Island is the most populous of the Indonesian islands. The prevalence of stunting in all provinces on Java Island falls within the moderate category. In almost all regions of Java, economic status is a significant factor in the incidence of stunting, particularly among those with the lowest economic status. Therefore, economic status should be of particular concern when addressing stunting.

Future research on food consumption could analyze children's eating frequency using the minimum meal frequency (MMF) method and determine food acceptance using the minimum acceptable diet (MAD) method. It is important to collect data on both parents, as fathers also have an impact on children's growth and development. Finally, stunting management programs carried out by the government and non-government organizations should focus more on families with low economic status.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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REFERENCES

1. Development Initiatives. *Global Nutrition Report 2021*. *Global Nutrition Report* https://globalnutritionreport.org/documents/851/2021_Global_Nutrition_Report_aUfTRv0.pdf (2021).
2. Menteri Kesehatan RI. *Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 tentang Standar Antropometri Anak*. (2020).
3. Kementerian PPN/ Bappenas. Pedoman Pelaksanaan Intervensi Penurunan Stunting Terintegrasi di Kabupaten/Kota. *Rencana Aksi Nas. dalam Rangka Penurunan Stunting Rembuk Stunting* 1–51 (2018).
4. Ekholuenetale, M., Barrow, A., Ekholuenetale, C. E. & Tudeme, G. Impact of stunting on early childhood cognitive development in Benin: evidence from Demographic and Health Survey. *Egypt. Pediatr. Assoc. Gaz.* **68**, 1–11 (2020).
5. Soliman, A. *et al.* Early and long-term consequences of nutritional stunting: From childhood to adulthood. *Acta Biomed.* **92**, 1–12 (2021).
6. UNICEF, WHO & The World Bank. *Levels and trends in child malnutrition: UNICEF, WHO, World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2023 edition*. https://www.who.int/publications/i/item/9789240073791 (2023).
7. Kementerian Kesehatan RI. *Buku Saku Hasil Studi Status Gizi Indonesia (SSGI) Tingkat Nasional, Provinsi, dan Kabupaten/Kota Tahun 2021*. (2021) doi:10.36805/bi.v2i1.301.
8. BPS. Jumlah Penduduk Menurut Provinsi di Indonesia (Ribuan Jiwa), 2020-2022. https://sulut.bps.go.id/indicator/12/958/1/juml

How to cite: *Paramita, M., Helmyati, S., Basrowi, R. W., Dilantika, C. (2023). Stunting Risk Factors among Infants in Java Island: Cross-Sectional Study using 2021 Indonesian Nutritional Status Survey Data. Amerta Nutrition, 7(3SP), 20-29.*

ah-penduduk-menurut-provinsi-di-indonesia.html (2023).
9. Menteri PPN/Kepala Bappenas. *Penetapan Kabupaten/Kota Lokasi Fokus Intervensi Percepatan Penurunan Stunting Terintegrasi Tahun 2024*. 1–21 (2023).
10. Nkurunziza, S., Meessen, B., Van geertruyden, J. P. & Korachais, C. Determinants of stunting and severe stunting among Burundian children aged 6-23 months: Evidence from a national cross-sectional household survey, 2014. *BMC Pediatr.* **17**, 1–14 (2017).
11. WHO & UNICEF. Indicators for Assessing Infant and Young Child Feeding Practices. *World Health Organization and the United Nations Children's Fund (UNICEF)* 19 at https://www.who.int/publications/i/item/9789240018389 (2021).
12. Abeway, S., Gebremichael, B., Murugan, R., Assefa, M. & Adinew, Y. M. Stunting and its determinants among children aged 6-59 Months in Northern Ethiopia: A cross-sectional study. *J. Nutr. Metab.* **2018**, (2018).
13. Benedict, L., Hong, S. A., Winichagoon, P., Tejativaddhana, P. & Kasemsup, V. Double Burden of Malnutrition and its Association with Infant and Young Child Feeding Practices among Children Under-Five in Thailand. *Public Health Nutr.* **24**, 3058–3065 (2021).
14. UNICEF. Improving Young Children' s Diets During the Complementary Feeding Period. *Unicef Programming Guidance* 76 at (2020).
15. UNICEF. *Fed to Fail? The Crisis of Children's Diets in Early Life*. *Child Nutrition Report* https://data.unicef.org/resources/fed-to-fail-2021-child-nutrition-report/ (2021).
16. Bappeda Provinsi Yogyakarta. Daerah Istimewa Yogyakarta Skor Pola Pangan Harapan. *Aplikasi Dataku* https://bappeda.jogjaprov.go.id/dataku/data_dasar/cetak/124-skor-pola-pangan-harapan-pph (2023).
17. Sekiyama, M., Roosita, K. & Ohtsuka, R. Snack foods consumption contributes to poor nutrition of rural children in West Java, Indonesia. *Asia Pac. J. Clin. Nutr.* **21**, 558–567 (2012).
18. Srinivasan, C. S., Zanello, G. & Shankar, B. Rural-urban disparities in child nutrition in Bangladesh and Nepal. *BMC Public Health* **13**, 1–15 (2013).
19. Mengesha, H. G., Vatanparast, H., Feng, C. & Petrucka, P. Modeling the predictors of stunting in Ethiopia: Analysis of 2016 Ethiopian demographic health survey data (EDHS). *BMC Nutr.* **6**, 1–11 (2020).
20. Rahman, A. & Rahman, M. S. Rural-Urban Differentials of Childhood Malnutrition in Bangladesh. *Int. J. Child Heal. Nutr.* **8**, 35–42 (2019).
21. Ortiz, J., Van Camp, J., Wijaya, S., Donoso, S. & Huybregts, L. Determinants of child malnutrition in rural and urban Ecuadorian highlands. *Public Health Nutr.* **17**, 2122–2130 (2013).
22. Das, S. & Gulshan, J. Different forms of malnutrition among under five children in Bangladesh: A cross sectional study on prevalence and determinants. *BMC Nutr.* **3**, 1–12 (2017).
23. Vikram, K. & Vanneman, R. Maternal Education and the Multidimensionality of Child Health Outcomes in India. *J Biosoc Sci* **52**, 57–77 (2020).
24. Ahmed, M. S., Sen, L. C., Farhana, J. A. & Yunus, F. M. Association between Dietary Diversity and Nutritional Status of The Children Aged 6–23 Months in Bangladesh: Evidence from The Multiple Indicator Cluster Survey 2019. *Nutrire* **47**, 1–10 (2022).
25. Ahmad, D., Afzal, M. & Imtiaz, A. Effect of socioeconomic factors on malnutrition among children in Pakistan. *Futur. Bus. J.* **6**, 1–11 (2020).
26. Ali, N. B. *et al.* Association of Food Security and other Socioeconomic Factors with Dietary Diversity and Nutritional Statuses of Children Aged 6-59 Months in rural Bangladesh. *PLoS One* (2019) doi:10.1371/journal.pone.0221929.
27. Thurstans, S. *et al.* Boys are more likely to be undernourished than girls: A systematic review and meta-analysis of sex differences in undernutrition. *BMJ Glob. Heal.* **5**, 1–17 (2020).
28. BPS Provinsi DKI Jakarta. Persentase Wanita Usia Subur (15-49 Tahun) yang Bekerja Seminggu yang Lalu Menurut Status Pekerjaan di DKI Jakarta (Persen), 2021. *Bada Pusat Statistik Provinsi DKI Jakarta* (2021).
29. Ickes, S. B. *et al.* Exclusive breastfeeding among working mothers in Kenya: Perspectives from women, families and employers. *Matern. Child Nutr.* **17**, 1–14 (2021).
30. Becker, M., Weinberger, T., Chandy, A. & Schmukler, S. Depression During Pregnancy and Postpartum. *Curr. Psychiatry Rep.* **18**, 1–9 (2016).
31. Goudet, S. M., Bogin, B. A., Madise, N. J. & Griffiths, P. L. Nutritional interventions for preventing stunting in children (Birth to 59 months) living in urban slums in low-and middle-income countries (LMIC). *Cochrane Database Syst. Rev.* **2019**, (2019).
32. Kemenkes RI. *Pedoman Nasional Pelayanan Kedokteran Tata Laksana Stunting*. 1–52 (2022).

How to cite: *Paramita, M., Helmyati, S., Basrowi, R. W., Dilantika, C. (2023). Stunting Risk Factors among Infants in Java Island: Cross-Sectional Study using 2021 Indonesian Nutritional Status Survey Data. Amerta Nutrition, 7(3SP), 20-29.*