Risk factor analysis in the first 1,000 days of life

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Abstract. Stunting is determined by the first 1,000 days of life, based on factors related to the child, parents, and environment. Unfortunately, previous studies have produced varying results regarding their impact on stunting. This study analyzes the impact of individual risk factors related to the child, family, and environment on stunting. Methods: This study is a case-control study. The total sample consisted of 74 stunted children and 197 non-stunted children in the working area of the Srandakan Community Health Center, Bantul District. Data collection was conducted using questionnaires. Bivariate analysis used chi-square and multivariate analysis used logistic regression. The risk factors with the greatest significant influence on stunting are maternal factors, namely a mid-upper arm circumference of less than 23.5 cm (OR= 2.078, p= 0.037). Individual child factors that prevent stunting include a normal birth height (OR= 0.100, p= 0.000<0.05) and the absence of infectious diseases (OR= 0.310, p= 0.019). Other risk factors significantly associated with stunting include abnormal birth weight and chronic maternal energy deficiency. Conclusion: Maternal factors are the greatest risk factors for stunting compared to individual, family, and environmental factors, but individual children's factors have a protective effect against stunting.

1 Introduction

Stunting remains a major nutritional problem in low- and middle-income countries, contributing to child morbidity, mortality, and impaired development [1,2]. In 2022, an estimated 148.1 million children were stunted worldwide, with Southeast Asia among the highest [3] . In Indonesia, prevalence declined to 21.6% in 2022 but remains above the 2024 target of 14% [4]. Stunting, largely determined by chronic undernutrition during the first 1,000 days of life, increases risks of morbidity, mortality, delayed cognitive and physical development, and reduced productivity in later life [5-6].

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Stunting is determined by the first 1000 days of life, based on factors related to the child, parents, and environment. Many studies have proven the factors that significantly influence stunting, including medical history, inadequate nutritional supplements, complementary feeding, formula feeding, lack of complementary feeding programs, lack of iron supplementation for mothers [7], low father's education, maternal height less than 150 cm, maternal age, low birth weight, and low birth length [8]. Child factors have a more significant and direct influence on stunting than maternal factors, but are greatly influenced by maternal factors [9]. Fetal growth restriction (FGR) and poor sanitation are major risk factors for stunting in developing countries [10].

However, previous studies have identified different risk factors for stunting. Risk factors in the first 1000 days of life have not been comprehensively analysed. To fill this gap, this study aims to analyse the significant influence of individual, family, and environmental factors on stunting.

2 Methods

This study is a quantitative analytical survey with a case-control research design. It was conducted in the Srandakan Community Health Center working area, Bantul Regency, Daerah Istimewa Yogyakarta. The population in this study consisted of mothers of children aged 24-59 months. A sample of 271 was obtained using random sampling. The number of cases of stunted children was 74 children, while those who were not stunted were 197 children. Primary data was collected and used using a questionnaire. Bivariate analysis uses chi square, while multivariate analysis uses logistic regression.

3 Results

3.1 Bivariate analysis of stunting risk factors

The individual factors analysed are gender, birth height, birth weight, birth prematurely, getting exclusive breast feeding, history of infectious diseases, age of introduction to solid foods. Family factors analysed as risk factors for stunting are mother's age, mother's education, mother's job, mother received additional food during pregnancy, mother received iron tablet, age of pregnant mother, pregnant women with anemia, pregnant women with chronic energy deficiency (CED), upper arm circumference of pregnant women, pregnancy spacing, number of visits by pregnant women to health facilities, father's age, father's education and family income. Environmental factors analyzed as risk factors for stunting are type of drinking water used and family members smoke at home. The following are the results of the bivariate analysis of stunting risk factors.

Table 1. Bivariate Analysis of Stunting Risk Factors (n= 271)

Variable	Category	Stunting (n= 74)	Not Stunting (n = 197)	Total (n= 271)	Sig.
Gender	Male	41 (55.4%)	97 (49.2%)	138 (50.9%)	0.366
	Female	33 (44.6%)	100 (50.8%)	133 (49.1%)	
Birth Height	Abnormal (Male < 48cm, Female < 47.3 cm)	18 (24.3%)	6 (3.0%)	24 (8.9%)	0.000

Variable	Category	Stunting (n= 74)	Not Stunting (n = 197)	Total (n= 271)	Sig.
	Normal (Male ≥ 48cm, Female ≥ 47.3 cm)	56 (75.7%)	191 (97.0%)	247 (91.1%)	
Birth Weight	Abnormal (<2.5 kg)	11 (14.9%)	7 (3.6%)	18 (6.6%)	0.001
	Normal (≥ 2.5 kg)	63 (85.1%)	190 (96.4%)	253 (93.4%)	
Birth prematurely	Yes	6 (8.1%)	9 (4.6%)	15 (5.5%)	0.256
	No	68 (91.9%)	188 (95.4%)	256 (94.5%)	
Getting exclusive breast feeding	No	13 (17.6%)	27 (13.7%)	40 (14.8%)	0.425
	Yes	61 (82.4%)	170 (86.3%)	231 (85.2%)	
Formula Milk Consumption	Yes	42 (56.8%)	103 (52.3%)	145 (53.5%)	0.511
	No	32 (43.2%)	94 (47.7%)	126 (46.5%)	
History of infectious diseases	Yes	10 (13.5%)	11 (5.6%)	21 (7.7%)	0.030
	No	64 (86.5%)	186 (94.4%)	250 (92.3%)	
Age of Introduction to Solid Foods	< 6 months or > 6 months	14 (18.9%)	22 (11.2%)	36 (13.3%)	0.094
	6 months	60 (81.1%)	175 (88.8%)	235 (86.7%)	
Mother's age	<21 years or > 35 years	24 (32.4%)	58 (29.4%)	82 (30.3%)	0.717
	21 - 35 years	50 (67.6%)	139 (70.6%)	189 (69.7%)	
Mother's Education	Elementary & Intermediate	60 (81.1%)	139 (70.6%)	199 (73.4%)	0.081
	Higher education	14 (18.9%)	58 (29.4%)	72 (26.6%)	
Mother's Job	Working	18 (24.3%)	59 (29.9%)	77 (28.4%)	0.360
	Housewife	56 (75.7%)	138 (70.1%)	194 (71.6%)	
Mother Received Additional Food During Pregnancy	No	63 (85.1%)	159 (80.7%)	222 (81.9%)	0.399
	Yes	11 (14.9%)	38 (19.3%)	49 (18.1%)	
Mother Received Iron Tablet	No	19 (25.7%)	33 (16.8%)	52 (19.2%)	0.096
	Yes	55 (74.3)	164 (83.2%)	219 (80.8%)	
Age of Pregnant Mother	<20 years or > 35 years	11 (14.9%)	39 (19.8%)	50 (18.5%)	0.351
	20-35 years	63 (85.1%)	158 (80.2%)	221 (81.5%)	
Pregnant Women with Anemia	Yes	21 (28.4%)	37 (18.8%)	58 (21.4%)	0.086
	No	53 (71.6%)	160 (81.2%)	213 (78.6%)	
Pregnant Women with Chronic Energy Deficiency (CED)	Yes	13 (17.6%)	13 (6.6%)	26 (9.6%)	0.006
	No	61 (82.4%)	184 (93.4%)	245 (90.4%)	
Upper arm circumference of pregnant women	< 23,5 cm	23 (31.1%)	38 (19.3%)	61 (22.5%)	0.038
	≥ 23,5 cm	51 (68.9%)	159 (80.7%)	210 (77.5%)	

Variable	Category	Stunting (n= 74)	Not Stunting (n = 197)	Total (n= 271)	Sig.
Pregnancy spacing	< 2 years	8 (10.8%)	32 (16.2%)	40 (14.8%)	0.261
	≥ 2 years	66 (89.2%)	165 (83.8%)	231 (85.2%)	
Number of visits by pregnant women to health facilities	< 6 times	9 (12.2%)	30 (15.2%)	39 (14.4%)	0.522
	≥ 6 times	65 (87.8%)	167 (84.8%)	232 (85.6%)	
Father's age	< 25 years or > 40 years	19 (25.7%)	43 (21.8%)	62 (22.8%)	0.065
	25 - 40 years	55 (74.3%)	154 (78.2%)	209 (77.1%)	
Father's Education	Elementary & Intermediate	64 (86.5%)	159 (80.7%)	223 (82.3%)	0.267
	Higher education	10 (13.5%)	38 (19.3%)	48 (17.7%)	
Family income	< Rp 3 million	51 (68.9%)	129 (65.5%)	180 (66.4%)	0.572
	≥ Rp 3 million	26 (31.1%)	68 (34.5%)	91 (33.6%)	
Type of Drinking Water Used	Packaged Gallon	16 (21.6%)	39 (19.8%)	55 (20.3%)	0.911
	Boiled Water	54 (73.0%)	150 (76.1%)	204 (75.3%)	
	Water from the Regional Drinking Water Company	4 (5.4%)	8 (4.1%)	12 (4.5%)	
Family members smoke at home	Yes	47 (63.5%)	125 (63.5%)	172 (63.5%)	0.992
	No	27 (36.5%)	72 (36.5%)	99 (36.5%)	

Based on the bivariate analysis in table 3.1, significant risk factors associated with stunting are birth height, birth weight, history of infectious diseases, pregnant women with chronic energy deficiency (CED), and upper arm circumference of pregnant women < 23.5 cm.

3.2 Multivariate analysis of stunting risk factors

The stunting risk factors analysed multivariate are those that have a significant bivariate relationship.

Table 2. Multivariate Analysis of Stunting Risk Factors

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Pregnant Women with Chronic Energy Deficiency (CED)	-0.856	0.472	3.297	1	0.069	0.425
Upper arm circumference of pregnant women	0.732	0.35	4.367	1	0.037	2.078
Birth Height	-2.303	0.533	18.685	1	0.000	0.100
Birth Weight	-0.884	0.587	2.271	1	0.132	0.413

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
History of infectious diseases	-1.173	0.501	5.482	1	0.019	0.310
Constant	3.538	0.948	13.917	1	0	34.409

The results of the binary logistic regression test show that there are risk factors for stunting are upper arm circumference of pregnant women (p= 0.037, OR= 2.078), birth height (p= 0.000<0.05, OR= 0.100), and history of infectious diseases (p= 0.019, OR= 0.310).

4 Discussion

The chi-square analysis shows significant risk factors associated with stunting are birth height, birth weight, history of infectious diseases, pregnant women with chronic energy deficiency (CED), and upper arm circumference of pregnant women < 23.5 cm), however, after conducting a logistic regression test, only birth length, history of infectious diseases and upper arm circumference of pregnant women were affected. The results of this study indicate that babies with normal birth height are at lower risk of stunting compared to those with low birth height (OR = 0.001). These results align with research showing that babies with normal birth height have a 0.667 times lower risk of stunting compared to those with low birth height [7], low birth height (AOR 9.92; 95% CI 1.84 to 53.51; P=0.008) is strongly associated with stunting [8]. This shows the importance of monitoring the health of toddlers and mothers during pregnancy, especially by providing additional nutritional intake.

In addition to birth height, a history of infectious diseases is a risk factor for stunting among individual children. Healthy children who do not have infectious diseases such as respiratory infections, fever, or primary tuberculosis will prevent stunting (OR = 0.310). These results are consistent with previous research that various diseases, such as diarrhea, respiratory infections, and fever, contribute to child growth [9]. Diarrhea is a major risk factor for stunting and contributes to the global stunting burden [10]. Therefore, sustained efforts are needed to prevent and treat infections in mothers and children, particularly diarrhea. Improving maternal and family nutrition and sanitation is crucial.

Although low birth weight was not significantly associated with stunting in multivariate testing, the chi-square test showed a significant association (p=0.001). This study's findings align with previous research that low birth weight in newborns is a significant factor in determining the causes of stunting [7] (OR 7.29; 95%CI 2 to 26.53; P= 0.001) [9]. Low-birth-weight infants are more susceptible to infectious diseases, which increases the risk of stunting. Infectious diseases are bidirectionally related to a child's nutritional status. Infectious diseases can compromise nutritional status, and malnutrition can increase the risk of infection, both of which impact a child's growth and development [10].

Apart from individual child factors, family factors, namely mothers who have an upper arm circumference of less than 23.5 cm, have a 2,078 times risk of their child being stunted compared to mothers who have an upper arm circumference of more than or equal to 23.5 cm. A low mid-upper arm circumference indicates less than ideal maternal nutritional status and can increase the risk of giving birth to a child with a low birth weight (OR, 1.9; 95% CI, 1.7–2.1) [11], which makes them vulnerable to stunting [12].

Maternal malnutrition, measured not only by an upper arm circumference of less than 23.5 cm, but also by chronic energy deficiency, which is significantly associated with stunting (p=0.006). Chronic energy deficiency can impact fetal development, leading to prematurity and low birth weight, which can lead to stunting [13].

Babies born prematurely are more susceptible to infectious diseases (respiratory tract infections, gastrointestinal infections, skin infections, and others) because their immune systems are not yet fully developed [14]. Premature babies also have problems with their digestive system, so the nutrients they receive cannot be fully absorbed by the body [15].

Other maternal factors in this study—age, education, occupation, pregnancy spacing, anemia, age at pregnancy, number of ANC visits, consumption of iron tablets, and supplementary foods—were not significantly associated with stunting. Paternal factors, such as paternal age and education, were also not significantly associated with stunting. Individual child factors not associated with stunting were gender, exclusive breastfeeding, formula consumption, and age of introduction to solid foods. Family factors, such as family members smoking at home and drinking water sources, were also not significantly associated with stunting in this study. However, these factors should not be ignored, as previous research has shown them to be significant risk factors for stunting [9-12].

5 Conclusion

The risk factor with the most significant influence on stunting in the first 1000 days of life is maternal factors, namely maternal mid-upper arm circumference (MUAC) of less than 23.5 cm. Individual factors in children that can prevent stunting include normal birth height and no history of infectious diseases. Other risk factors that are significantly associated with stunting include birth weight less than 2.5 kg and chronic maternal energy deficiency.

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