Short Communication

The Relationship between Infectious Diseases and Stunting among Toddlers in Indonesia

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Abstract

Background: Chronic malnutrition can cause children to be underweight for their age, leading to stunting. This study aimed to examine the association between infectious diseases and stunting in toddlers. **Materials and Methods:** A cross-sectional study was conducted across Indonesia in 2021, involving 90,897 toddlers. Data were obtained through maternal interviews and anthropometric measurements. Bivariate and multivariate analyses were used. **Results:** Results showed that toddler age, gender, place of residence, and parental education and occupation were significantly associated with stunting, $p < 0.001$ (OR = 1.1–3.6). Infectious diseases, including Acute Respiratory Infections (ARIs), diarrhea, pneumonia, and worm infections, were also significantly associated with stunting, $p < 0.05$ (OR = 1.1–1.5). **Conclusions:** Infectious diseases, including ARIs, diarrhea, pneumonia, and worm infections, are significantly associated with stunting. These findings highlight the importance of preventing and managing infections to reduce stunting in Indonesian toddlers.

Keywords: *Indonesia, infectious diseases, malnutrition, stunting, toddlers*

Introduction

Stunting is a chronic nutritional problem that hinders human development globally. It manifests as impaired growth and development in toddlers due to prolonged malnutrition, resulting in children being significantly shorter than the standard height for their age.[1] According to the conceptual framework proposed by the World Health Organization (WHO), the causes of stunting are complex and multifactorial. Contributing factors include poor household conditions, non-exclusive breastfeeding, infectious diseases, political and economic factors, limited education, restricted access to healthcare, social and cultural influences, environmental challenges, inadequate sanitation, and poor water quality. Inadequate complementary feeding may involve insufficient food intake, excessive dependence on instant foods (often diluted with water), the use of contaminated water, and improper food storage in open or unclean containers, conditions that promote bacterial growth and increase the risk of infection.[2] Stunting rates in ASEAN countries remain higher in Indonesia compared to Vietnam (23%), Malaysia (17%), Thailand (16%), and Singapore (4%), though they are lower than in Myanmar (35%).[3] Research indicates that stunting is associated with increased susceptibility to infectious diseases such as Acute Respiratory Infections (ARIs), diarrhea, and pneumonia.[4] Moreover, stunting is linked to a greater risk of degenerative conditions later in life.[5] To address this issue, the WHO has set a global target to reduce stunting by 40% between 2012 and 2025, requiring an average annual reduction of 3.9%.[6] In response, the Indonesian government has introduced comprehensive policies, structured around five strategic pillars. Among these, the fifth pillar, enhancing monitoring and evaluation, is essential for the prevention and control of stunting and contributes significantly to its reduction.[7] According to the 2018 Basic Health Research (Riskesdas), the prevalence of stunting among Indonesian toddlers was 30.8%, down from 37.2% in 2013.[8] The 2021 Indonesian Nutritional Status Study (INSS) reported a further decline to 24.4%, compared to 27.7% in 2019. Despite this progress, the rate remains above the WHO's threshold of 20%.[9] Key contributing factors to stunting in Indonesia include chronic malnutrition, ineffective parenting, insufficient knowledge about balanced

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nutrition, lack of postnatal care, frequent infections, and poor sanitation.[10] The 2018 Riskesdas reported the prevalence of infectious diseases among toddlers as follows: ARIs (4.4%), diarrhea (12.3%), pulmonary TB (0.4%), pneumonia (2%), and intestinal worm infections (30.35%).[8] This study aimed to examine the association between infectious diseases and stunting in toddlers in Indonesia. Understanding this relationship is crucial for improving children's overall health, reducing infection-related mortality, and preventing long-term consequences on quality of life and future productivity.

Materials and Methods

This study employed a cross-sectional design, which is an observational and non-interventional approach. The 2021 Indonesian Nutritional Status Study (INSS) was conducted across 34 provinces and 514 districts/cities in Indonesia between August 1 and November 30, 2021. The study population included all toddlers aged 0 to 59 months residing within the service areas of the selected health centers, totaling 90,897 children. A stratified two-stage sampling method was used to select the sample. Inclusion criteria were children aged 0–59 months and parental or guardian consent to participate. Exclusion criteria included the inability to complete the questionnaire properly. Data collection involved structured interviews with mothers of toddlers and anthropometric measurements of the children's height. Children under two years of age were measured in the recumbent (lying down) position, while those aged two years and older were measured in the standing position. Interviews and measurements were conducted by trained enumerators who had received prior training and were supervised by researchers from the National Institute of Health Research and Development (NIHRD). Researchers closely monitored the enumerators to ensure proper interview techniques, which facilitated more accurate responses and measurements.

Stunting was the dependent variable in this study. One key indicator of a child's nutritional status is Height-For-Age. According to the World Health Organization (WHO), the Height-For-Age z-score (HAZ), which measures deviation from the average height-for-age, is used to assess stunting. Nutritional status was categorized into two groups: stunted (z-score < -2.0 SD) and normal (z-score ≥ -2.0 SD). The children's age, weight, and height were used to calculate their z-scores based on WHO anthropometric standards. The independent variables in this study included toddler age and gender, place of residence, maternal age, education level, and occupation, as well as paternal age, education level, and occupation. Additionally, data on the diagnosis of infectious diseases (including ARIs, diarrhea, pneumonia, pulmonary TB, and measles) in toddlers were analyzed. Parental education was categorized as low for those who had completed junior high school or less (≤JHS), and high for those who had completed senior high school or more (>SHS).

Data were analyzed using bivariate and multivariate logistic regression methods. Bivariate analysis was conducted to assess the relationship between each independent variable and the dependent variable. Meanwhile, multivariate logistic regression was performed to simultaneously assess the associations between multiple independent variables and the dependent variable. This analysis helps determine which independent variables have the most significant influence on the outcome. Variables from the bivariate analysis with *P* values less than 0.25 were included in the multivariate logistic regression model.[11]

Ethical considerations

On November 4, 2021, ethical approval was granted by the Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia (No. LB.02.01/2/KE.677/2021).

Results

This study included 90,897 toddlers, of whom 19,173 experienced stunting 10,385 males (22.20%) and 8,788 females (20.50%). As shown in Table 1, stunting is more prevalent among toddlers in rural areas (24.50%) than in urban areas (18.90%). Male toddlers (22.20%) are more likely to be stunted than females (20.50%), with the highest prevalence observed in the 24–35-month age group (26.60%). Children of mothers with low education levels show a higher stunting rate (25.60%) compared to those whose mothers have higher education (16.50%). Similarly, children of non-working mothers are more likely to be stunted (22.30%) than those of working mothers (19.50%). Stunting is also more prevalent among children whose fathers have low education levels (25.50%) than those with highly educated fathers (16.80%). Infectious diseases, including ARIs, diarrhea, pneumonia, pulmonary TB, and warm infections, are significantly associated with stunting ($p < 0.05$), while no significant association is found with measles ($p > 0.05$). Table 2 shows that out of the 15 variables analyzed through multivariate analysis, 10 were significantly associated with stunting in toddlers ($p < 0.05$). These variables include the child's age and gender, place of residence, mother's education and employment status, father's education, and diagnoses of ARIs, diarrhea, pneumonia, and worm infections. Toddlers living in rural areas are 1.2 times more likely to experience stunting than those in urban areas. Children whose mothers have lower education levels are 1.4 times more likely to be stunted compared to those with more educated mothers. Similarly, toddlers with less-educated fathers face a 1.3 times higher risk of stunting than those with highly educated fathers. Toddlers diagnosed with ARIs or diarrhea have a 1.1 times greater risk of stunting than those without these illnesses. The risk of stunting is 1.5 times higher among toddlers diagnosed with pneumonia compared to those never diagnosed with it. Likewise, toddlers diagnosed with worms are 1.3 times more likely to experience stunting than those without a history of worm infection.

Discussion

This study underscores the ongoing public health challenge

Table 1: Relationship between characteristics of toddlers, parents of toddlers, and infectious diseases with stunting

Characteristic	Stunting		*p*	OR (95% CI)
	Yes *n* (%)	No *n* (%)		
Toddler age groups (months)				
0–11	1,467 (8.30)	15,308 (91.70)		Ref.
12–23	4,544 (23.20)	15,037 (76.80)	<0.001	3.32 (3.02–3.66)
24–35	4,909 (26.60)	14,315 (73.40)		3.98 (3.61–4.38)
36–47	4,507 (24.30)	14,080 (75.70)		3.35 (3.21–3.88)
48–59	3,746 (22.70)	12,984 (77.30)		3.23 (2.92–3.57)
Toddler gender				
Male	10,385 (22.20)	36,199 (77.80)	<0.001	1.11 (1.05–1.16)
Female	8,788 (20.50)	35,525 (79.50)		Ref.
Place of residence				
Urban	11,886 (24.50)	37,198 (75.50)	<0.001	1.39 (1.32–1.47)
Rural	7,287 (18.90)	34,526 (81.10)		Ref.
Mother age				
<20 years	341 (20.60)	1,266 (79.40)	0.640	0.95 (0.78–1.16)
≥20 years	18,832 (21.40)	70,458 (78.60)		Ref.
Mother education				
Low (≤JHS*)	11,576 (25.60)	33,801 (74.40)	<0.001	1.75 (1.66–1.85)
High (>SHS**)	7,597 (16.50)	37,923 (83.50)		Ref.
Mother occupation				
Not work	13,299 (22.30)	46,239 (77.70)	<0.001	1.18 (1.12–1.25)
Work	5,874 (19.50)	25,485 (80.50)		Ref.
Father age				
<20 years	58 (17.80)	251 (82.20)	0.328	0.79 (0.50–1.26)
≥20 years	19,115 (21.40)	71,473 (78.60)		Ref.
Father education				
Low (≤JHS*)	11,626 (25.50)	33,972 (74.50)	<0.001	1.70 (1.61–1.79)
High (>SHS**)	7,547 (16.80)	37,752 (83.20)		Ref.
Father occupation				
Not work	308 (21.10)	999 (78.90)	0.897	0.99 (0.80–1.22)
Work	18,865 (21.40)	70,725 (78.60)		Ref.
ARIs diagnosis				
Yes	1,150 (25.60)	3.550 (74.40)	<0.001	1.28 (1.14–1.44)
No	18,023 (21.10)	68,174 (78.90)		Ref.
Diarrhea diagnosis				
Yes	1.349 (25.90)	3,845 (74.10)	<0.001	1.31 (1.18–1.44)
No	17,824 (21.10)	67,879 (78.90)		Ref.
Pneumonia diagnosis				
Yes	137 (33.10)	277 (66.90)	<0.001	1.82 (1.33–2.51)
No	19,036 (21.30)	71,447 (78.70)		Ref.
Pulmonary TB diagnosis				
Yes	40 (37.10)	93 (62.90)	0.003	2.17 (1.29–3.64)
No	19,133 (21.30)	71,631 (78.70)		Ref.
Measles diagnosis				
Yes	349 (24.40)	1,160 (75.60)	0.067	1.19 (0.99–1.43)
No	18,824 (21.30)	70,564 (78.70)		Ref.
Warm diagnosis				
Yes	385 (32.80)	793 (67.20)	<0.001	1.81 (1.49–2.19)
No	18,788 (21.20)	70,931 (78.80)		Ref.

*JHS=Junior high school. Low education ≤ junior high school, **SHS=Senior high school. High education > senior high school

of stunting in Indonesia, despite a slight decline in its prevalence.[12] The findings reveal that stunting is more common in rural areas, among male toddlers, and in children whose parents have lower levels of education. Furthermore, infectious diseases such as ARIs, diarrhea, pneumonia, and intestinal worm infections are significantly associated

Table 2: Multivariate analysis of factors related to stunting in toddlers

Variable	*B*	SE	*p*	OR (95% CI)
Toddler age groups (months)				
0–11				Ref.
12–23	−1.18	0.05	<0.001	3.33 (3.03–3.67)
24–35	0.02	0.04	0.575	4.03 (3.65–4.45)
36–47	0.21	0.04	<0.001	3.58 (3.26–3.94)
48–59	0.09	0.04	0.018	3.26 (2.95–3.60)
Toddler gender				
Male	0.11	0.02	<0.001	1.11 (1.06–1.17)
Female				Ref.
Place of residence				
Urban	−0.20	−0.03	<0.001	1.22 (1.15–1.30)
Rural				Ref.
Mother education				
Low (≤JHS*)	0.35	0.03	<0.001	1.42 (1.32–1.51)
High (>SHS**)				Ref.
Mother occupation				
Not work	0.12	0.03	<0.001	1.13 (1.07–1.19)
Work				Ref.
Father education				
Low (≤JHS)	0.27	0.03	<0.001	1.31 (1.23–1.40)
High (>SHS)				Ref.
ARIs diagnosis				
Yes	0.14	0.06	0.021	1.15 (1.02–1.30)
No				Ref.
Diarrhea diagnosis				
Yes	0.15	0.05	0.005	1.16 (1.04–1.28)
No				Ref.
Pneumonia diagnosis				
Yes	0.42	0.17	0.013	1.53 (1.09–2.13)
No				Ref.
Warm diagnosis				
Yes	0.27	0.10	0.009	1.31 (1.07–1.60)
No				Ref.

*JHS=Junior high school. Low education ≤ junior high school,
**SHS=Senior high school. High education> senior high school

with stunting. Maternal employment also emerges as a contributing factor, with children of unemployed mothers more likely to be stunted. These results highlight the critical influence of both socioeconomic and health-related factors in the persistence of childhood stunting.

The higher prevalence of stunting in rural areas (24.50%) compared to urban areas (18.90%) is consistent with findings by Gebru *et al*.,[13] who reported that children in rural settings face increased stunting risks due to limited access to healthcare, sanitation, and adequate nutrition. While our study attributes this disparity primarily to differences in healthcare availability, other research suggests that cultural dietary practices and economic factors may also contribute.[14] Further research is needed to explore these additional influences.

The study's findings on gender differences in stunting are higher among male toddlers (22.20%) compared to females (20.50%), which are in line with global trends. However, a study conducted in China found no significant association between gender and stunting.[15] This discrepancy may stem from variations in genetic factors, cultural feeding practices, or access to healthcare across different countries. Further investigation is necessary to determine whether these gender disparities are primarily driven by biological or environmental factors.

Parental education, particularly maternal education, is strongly associated with stunting, with mothers who have lower education levels being 1.7 times more likely to have stunted children. This finding aligns with previous research emphasizing the importance of maternal knowledge in areas such as nutrition, childcare, and health-seeking behaviors. While this study highlights the role of maternal education, other studies, including that by Wicaksono *et al*.,[16] have shown that paternal education also significantly influences child nutrition. Therefore, intervention strategies should consider the educational levels of both parents.

The relationship between maternal employment and stunting (OR = 1.12) remains a topic of debate. Although this study identifies a significant association, a study conducted in Blora, Indonesia, reported no such correlation.[17] This discrepancy suggests that factors such as childcare practices, income stability, and available support systems may mediate the impact of maternal employment on child nutrition.[17,18] Further context-specific research is needed to clarify these underlying mechanisms.

The association between infectious diseases and stunting ($p < 0.001$) supports existing evidence that chronic infections impair nutrient absorption and immune function, thereby increasing the risk of malnutrition. Research has shown that infected children often experience reduced appetite, which further contributes to nutrient deficiencies. This study also reinforces previous findings that children diagnosed with pneumonia and worm infections are at significantly higher risk of stunting. While earlier studies have examined these associations, they have not always considered the cyclical relationship whereby stunted children, due to compromised immunity, are also more susceptible to infections.[19-22] Stunting and infectious diseases are closely linked in a complex, bidirectional relationship: children who are stunted are more vulnerable to infections due to weakened immune function, while frequent infections can further impair nutritional status, exacerbating stunting. Therefore, efforts to prevent stunting should go beyond nutritional interventions and also focus on improving sanitation, access to healthcare, and parental education on childcare and nutrition.

This study has several important limitations. First, its cross-sectional design restricts the ability to establish causal relationships between stunting and its associated factors, including infectious diseases. To better understand the temporal

nature and directionality of these associations, longitudinal studies are warranted. Second, the analysis did not include other important determinants of stunting, such as dietary intake, micronutrient deficiencies, household food security, and environmental conditions. Incorporating these variables in future research would provide a more comprehensive understanding of the multifactorial causes of stunting. Finally, while the study is nationally representative, regional variations in healthcare infrastructure, socioeconomic conditions, and cultural practices may influence stunting prevalence in context-specific ways.

Conclusion

This study highlights the multifactorial nature of stunting in Indonesia, emphasizing its strong associations with socioeconomic status, parental education, maternal employment, and infectious diseases. The findings demonstrate that stunting remains a significant public health concern, particularly in rural areas and among children of parents with lower educational attainment. Moreover, infections such as ARIs, diarrhea, pneumonia, and worm infestations further elevate the risk of stunting. Although some progress has been made in reducing prevalence, stunting rates in Indonesia remain above the World Health Organization (WHO) threshold, underscoring the need for sustained and targeted intervention efforts. Addressing this complex issue requires a comprehensive, multi-sectoral approach that integrates healthcare improvements, educational initiatives, and nutritional interventions. Future research should prioritize longitudinal studies to establish causal relationships and explore additional contributing factors, thereby informing more effective policy development and implementation.

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Conflicts of interest

Nothing to declare.

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