



The Interaction Between Environmental Sanitation and Pregnant Women's Nutritional Intake on the Risk of Stunting in Toddlers

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ABSTRACT

Stunting is a chronic nutritional problem that impacts the physical growth and development of children. Environmental sanitation factors and maternal nutritional intake during pregnancy play a crucial role in determining toddlers' nutritional status. This study analyzes the relationship between environmental sanitation and pregnant women's nutritional intake on the incidence of stunting in toddlers. In addition, their interactions with stunting incidence. The study used an analytical observational design with a cross-sectional approach. The study population comprised families with toddlers aged 6–59 months. A sample of 100 families was selected using a purposive sampling technique. Data were collected through structured questionnaires, mother interviews, sanitation observations, and height measurements for height-for-age using WHO standards to assess stunting incidence. Data analysis used univariate analysis, the Chi-Square Test for bivariate analysis, and logistic regression to examine variable interactions. Results showed that 38% of toddlers experienced stunting, 45% of families had poor environmental sanitation, and 42% of pregnant women had inadequate nutritional intake. There was a significant correlation between environmental sanitation and the incidence of stunting ($p=0.001$) and between pregnant women's nutritional intake and stunting ($p=0.003$). The logistic regression analysis showed that toddlers exposed to poor sanitation and inadequate nutritional intake during pregnancy had a 3.2 times higher risk of stunting than those exposed to only one factor. Stunting is a multifactorial problem influenced by poor sanitation and inadequate maternal nutritional intake during pregnancy. Therefore, efforts to prevent stunting need to be integrated through improving environmental sanitation and enhancing the nutritional quality of pregnant women.

INTRODUCTION

Stunting is a form of chronic malnutrition characterized by a child's height below the standard for the age due to prolonged malnutrition and/or repeated infections (W.H.O., 2021). In Indonesia, stunting remains a national concern. Based on data from the 2022 Indonesian Nutritional Status Study (*Survei Status Gizi Indonesia*, SSGI), the national stunting prevalence was 21.6%, far above the WHO threshold of 20%, and remains a significant challenge for child health development efforts. Stunting not only impairs physical growth but also reduces cognitive development, weakens the immune system, and lowers children's potential productivity in adulthood (Black, Victora and Walker, 2013).

Theoretically and empirically, the causes of stunting are multifactorial. Previous studies have shown that nutritional factors during pregnancy and environmental sanitation conditions play a significant role in determining the risk of stunting in children. Maternal dietary intake, particularly adequate energy and micronutrient intake, is key to supporting optimal fetal growth and preventing low birth weight (Rahmannia, Nurjazuli and Astuti, 2021). In addition, poor environmental sanitation, including the lack of

safe latrines, clean water, and adequate hygiene, increases the risk of infectious diseases, such as diarrhea, which can interfere with children's nutrient absorption (Fink, Günther and Hill, 2019).

A study by Sulistyoningsih *et al.* (2020) examined the effect of maternal nutritional intake on stunting risk and found a significant association between maternal energy adequacy and child nutritional status. In addition, research by Yanti *et al.* (2021) found that environmental sanitation quality was strongly associated with stunting incidence. However, most of these studies only analyze these factors separately. The survey by Dewi and Pramestuty (2020), for example, highlighted sanitation but did not consider the nutritional status of pregnant women. Similarly, prior research on maternal nutrition often ignored the environmental factors. Interventions to address stunting are insufficient if they target only one factor, given the complex interplay among social, behavioral, and physical environmental determinants. Therefore, an approach that simultaneously integrates environmental sanitation and maternal nutritional intake is crucial for examining their interaction in stunting incidence. This paper is based on the Social Ecology Theory (McLeroy *et al.*, 1988), which holds that an individual's health status is influenced by interactions between individual factors (e.g., maternal nutrition) and environmental factors (e.g., sanitation). In addition, this investigation uses the Developmental Origins of Health and Disease (DOHaD) framework, which posits that pregnancy is a critical period for establishing the risk of future chronic diseases. Malnutrition during pregnancy can have long-term effects, including stunting, due to impaired intrauterine growth (Hanson and Gluckman, 2014). From a sanitation perspective, the F-diagram theory by the WHO (2015) illustrates the transmission pathways of fecal matter to humans via contaminated hands, water, flies, and food, which can trigger gastrointestinal infections and worsen children's nutritional status. By integrating these theories, the research is expected to more comprehensively explain the roots of stunting and provide a basis for designing more effective nutrition and sanitation interventions.

The main problem in this study was the high rate of stunting in toddlers, which stems from a combination of inadequate environmental sanitation and poor maternal nutritional intake. While these two factors had been previously studied separately, few studies explicitly examined their interaction in increasing the risk of stunting. This research gap underpins the scientific contribution and originality of this article. This study differs from previous studies in that it analyzes the interactive effect between two key variables, rather than just a direct (bivariate) relationship. In addition, a population in this investigation from a region characterized by a high risk of stunting, namely rural areas with limited access to sanitation and maternal nutrition education, adds contextual value to the study results. The novelty of this study lies in the interaction analysis model used, which explains how the combination of two key factors exerts a more substantial influence on stunting risk than either factor alone. This investigation will provide new insights into designing comprehensive and targeted interventions. This study aims to: 1. Analyze the relationship

between environmental sanitation and the incidence of stunting in toddlers 2. Analyze the relationship between the nutritional intake of pregnant women and the incidence of stunting in toddlers 3. Analyze the interaction between environmental sanitation and pregnant women's nutritional intake on the risk of stunting in toddlers. This research is also expected to make practical contributions to national programs, such as Integrated Stunting Prevention, that require household- and community-based approaches.

METHOD

The study used an analytical observational design with a cross-sectional approach and was conducted in the working area of the Lamongan Public Health Center (PHC) in Rancangkencono Village. The study population comprised families with toddlers aged 6–59 months. A sample of 100 families was selected using a purposive sampling technique. The inclusion criteria were families with toddlers aged 6–59 months, a mother who had lived with the child since birth, and a willingness to be a respondent. The independent variables were environmental sanitation and pregnant women's nutritional intake; the dependent variable was stunting incidence. Data were collected through structured questionnaires, mother interviews, sanitation observations, and height measurements for height-for-age using WHO standards to assess stunting incidence. Data analysis used univariate analysis, the Chi-Square Test for bivariate analysis, and logistic regression to examine variable interactions. Significant interaction was determined if the $p < 0.05$ and the interaction coefficient was significant.

RESULT

Table 1 shows that among 100 toddlers, half are boys (52%) and almost half are girls (48%). Most mothers have a high school education (60%), and almost half have graduated from University. In addition, half of the families have low income (55%), and nearly half have middle- to high-income.

Table 1. The Characteristics of Respondents (n = 100)

The Characteristics of Respondents	Frequency (n)	Percentage (%)
Toddler's Sex		
Boy	52	52
Girl	48	48
Maternal Education		
High School	60	60
University	40	40
Family Income		
Low	55	55
Middle - High	45	45

Based on the results in Table 2, half of the respondents lived in an environment with good sanitation (55%). In contrast, almost half (45%) lived in poor environmental sanitation.

Table 2. Frequency Distribution of Environmental Sanitation

Environmental Sanitation	Frequency (n)	Percentage (%)
Poor	45	45
Good	55	55
Total	100	100

Based on the results of Table 3, half of the respondents had adequate pregnant women's nutritional intake (55%). On the other hand, almost half (42%) were found to be inadequate.

Table 3. Frequency Distribution of Nutritional Intake of Pregnant Women

Nutritional Intake of Pregnant Women	Frequency (n)	Percentage (%)
Inadequate	42	42
Adequate	58	58
Total	100	100

According to Table 4, 38% of toddlers had stunting. This figure remained relatively high, indicating that stunting risk factors require concern. Meanwhile, most toddlers (62%) had a normal nutritional status.

Table 4. Frequency Distribution of Nutritional Status in Toddlers

Nutritional Status	Frequency (n)	Percentage (%)
Stunting	38	38
Normal	62	62
Total	100	100

Toddlers from families with poor sanitation were more likely to experience stunting (25%) than those with good sanitation (13%). In contrast, those with good sanitation were more likely to have a normal nutritional status (42%) than those with poor sanitation (20%). The Chi-square test results showed a significant relationship between environmental sanitation and stunting incidence ($p=0.001$) (Table 5).

Table 5. The Correlation between Environmental Sanitation and Stunting Incidence in Toddlers

Environmental Sanitation	Stunting n (%)	Normal n (%)	Total	<i>p</i>
Poor	25 (25)	20 (20)	45 (45)	0.001
Good	13 (13)	42 (42)	55 (55)	
Total	38 (38)	62 (62)	100 (100)	

Toddlers born to mothers with inadequate nutritional intake during pregnancy were more likely to have stunting (25%) than those with adequate nutritional intake (13%). Meanwhile, those with adequate nutritional intake were more likely to have toddlers with normal nutritional status (58%) than those with inadequate nutritional intake (42%). The chi-square test showed a significant association between pregnant women's nutritional intake and stunting incidence ($p=0.003$) (Table 6).

Table 6. The Relationship between Nutritional Intake of Pregnant Women and the Incidence of Stunting in Toddlers

Nutritional Intake	Stunting n (%)	Normal n (%)	Total	<i>p</i>
Inadequate	25 (25)	17 (17)	42 (42)	0.003
Adequate	13 (13)	45 (45)	58 (58)	
Total	38 (38)	62 (62)	100 (100)	

Logistic regression analysis results showed that toddlers exposed to both factors, poor environmental sanitation and inadequate nutrition during pregnancy, had a 3.2 times higher risk of stunting (OR = 3.2; 95% CI: 1.8–5.6) compared to those exposed to only one factor (Table 7).

Table 7. The Analysis of the Interaction of Environmental Sanitation and Nutritional Intake on Stunting Incidence in Toddlers

Variables	OR	95% CI	<i>p</i>
Poor Sanitation	2.1	1.2 – 3.9	0.008
Inadequate Nutrition of Pregnant Women	2.5	1.4 – 4.6	0.004
Interaction of Poor Sanitation and Inadequate Nutrition of Pregnant Women	3.2	1.8 – 5.6	0.001

DISCUSSION

Based on Table 1, the majority of respondents had a high school education (60%) and low family income (55%). Low socioeconomic status can affect a family's ability to provide adequate sanitation and nutrition for pregnant women. Black *et al.* (2013) discovered that poverty and low maternal education were closely associated with the risk of malnutrition and stunting due to limited access to nutritious food, health services, and sanitation facilities. Furthermore, Nikmah *et al.* (2025) found that increasing pregnant women's knowledge through sanitation education can improve clean, healthy living behaviors, especially among groups with lower levels of education.

This study showed that the incidence of stunting was higher among toddlers living in environments with poor sanitation (25%) than among those with good sanitation (13%), with a significant correlation ($p=0.001$) (Table 5). Inadequate sanitation increases the risk of infectious diseases such as diarrhea, worm infestation, and gastrointestinal infections, which can interfere with nutrient absorption in children. The WHO (2019) states that poor sanitation contributes to environmental enteric dysfunction (EED), a chronic intestinal disorder that impairs nutrient absorption and contributes to stunting. Torlesse *et al.* (2016) also reported that children living in homes without sanitary latrines had a higher risk of stunting than children living in environments with good sanitation. This study finding is also consistent with prior research. It showed that environmental sanitation education for pregnant women could reduce the risk of stunting by improving family hygiene practices (Nikmah *et al.*, 2025).

This paper also found that toddlers born to mothers with inadequate nutritional intake during pregnancy had a higher prevalence of stunting (25%) than those born to mothers with adequate nutritional intake (13%), with $p=0.003$ (Table 6). Inadequate maternal nutritional intake during pregnancy, particularly energy, protein, iron, and micronutrients, can inhibit fetal growth and increase the risk of low birth weight (LBW), a significant risk factor for stunting. Bhutta (2013) discovered that nutritional interventions during pregnancy are crucial for preventing fetal growth disorders and stunting in toddlers. Barker (2012), using the Developmental Origins of Health and Disease (DOHaD) concept, also uncovered that maternal nutritional status during pregnancy influences the child's long-term health and growth. In line with this,

Nikmah *et al.* (2025) emphasized that balanced nutrition education for pregnant women is crucial for preventing stunting during pregnancy.

Furthermore, logistic regression results in this investigation exhibited that the combination of poor sanitation and inadequate maternal nutritional intake during pregnancy increased the risk of stunting by 3.2 times (OR = 3.2; 95% CI: 1.8–5.6; $p=0.001$) (Table 7). This finding suggests that stunting is a multifactorial problem influenced by interactions between environmental and biological factors. Dewey and Begum (2011) found that nutritional interventions alone were insufficient if not accompanied by improvements in sanitation and the environment. This finding is also supported by Nikmah *et al.* (2025), who demonstrated that an integrated environmental sanitation education approach with maternal nutrition education was more effective in reducing the risk of stunting than either intervention alone.

The results of this study emphasize the importance of an integrated approach to stunting prevention through: 1. Environmental sanitation education for pregnant women, 2. Increasing knowledge about balanced nutrition, 3. Strengthening the role of health workers and cadres, 4. Community-based family support. Bhutta (2013) and Black (2013) suggest that community-based interventions that combine nutritional and environmental improvements are an effective strategy for reducing stunting prevalence. Sanitation education that actively involves pregnant women has clearly demonstrated increased family health awareness and practices, thereby contributing to sustainable stunting prevention (Nikmah *et al.*, 2025).

CONCLUSION

Stunting is a multifactorial problem influenced by poor sanitation and inadequate maternal nutritional intake during pregnancy. Therefore, efforts to prevent stunting need to be integrated through improving environmental sanitation and enhancing the nutritional quality of pregnant women.

REFERENCES

- Barker, D.J. (2012) “Developmental origins of chronic disease,” *Public Health*, 126(3), pp. 185–189.
- Bhutta, Z.A. (2013) “Evidence-based interventions for improvement of maternal and child nutrition,” *The Lancet*, 382(9890), pp. 452–477.
- Black, R.E., Victora, C.G. and Walker, S.P. (2013) “Maternal and child undernutrition and overweight in low-income and middle-income countries,” *The Lancet*, 382(9890), pp. 427–451. Available at: [https://doi.org/10.1016/S0140-6736\(13\)60937-X](https://doi.org/10.1016/S0140-6736(13)60937-X).
- Dewey, K.G. and Begum, K. (2011) *Long-term consequences of stunting in early life*. Maternal & Child Nutrition.
- Dewi, R.K. and Pramestuty, R. (2020) “Hubungan kualitas sanitasi lingkungan dan kejadian stunting pada balita,” *Jurnal*, K(1) (1(2), pp. 178–185. Available at: <https://doi.org/10.15294/kemas.v15i2.23180>.

- Fink, G., Günther, I. and Hill, K. (2019) “The effect of water and sanitation on child health: Evidence from the demographic and health surveys,” *International Journal of Epidemiology*, 40(5), pp. 1196–1204. Available at: <https://doi.org/10.1093/ije/dyr102>.
- Hanson, M.A. and Gluckman, P.D. (2014) “Early developmental conditioning of later health and disease: Physiology or pathophysiology?,” *Physiological Reviews*, 94(4), pp. 1027–1076. Available at: <https://doi.org/10.1152/physrev.00029.2013>.
- McLeroy, K.R. *et al.* (1988) “An ecological perspective on health promotion programs,” *Health Education Quarterly*, 15(4), pp. 351–377. Available at: <https://doi.org/10.1177/109019818801500401>.
- Nikmah, K. *et al.* (2025) “Environmental Sanitation Education for Pregnant Women as an Effort to Prevent Stunting in Children in Lamongan.”
- Rahmanna, S., Nurjazuli and Astuti, D. (2021) “Hubungan asupan energi ibu hamil dengan kejadian stunting pada anak usia 6–24 bulan,” *Jurnal Gizi dan Kesehatan*, 13(1), pp. 10–16. Available at: <https://doi.org/10.14710/jgk.13.1.10-16>.
- Sulistyoningsih, R.R., Susilowati, S. and Setyowati, E. (2020) “Asupan gizi makro ibu hamil sebagai faktor risiko stunting pada balita,” *Jurnal Gizi Indonesia*, 8(1), pp. 45–50. Available at: <https://doi.org/10.14710/jgi.8.1.45-50>.
- W.H.O. (2021) “Child growth standards and the identification of severe acute malnutrition in infants and children. World Health Organization.” Available at: <https://www.who.int/publications/i/item/9789241598163>.
- Yanti, F., Hadi, H. and Puspasari, I. (2021) “Pengaruh sanitasi lingkungan terhadap kejadian stunting pada anak balita,” *Jurnal Media Gizi Indonesia*, 16(1), pp. 47–53. Available at: <https://doi.org/10.20473/mgi.v16i1.2021.47-53>.