

Inadequate Household Environmental Sanitation Is a Significant Determinant of Stunting Among Toddlers

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ABSTRACT

Stunting is a serious public health problem in Indonesia and reflects chronic malnutrition as well as poor environmental conditions, particularly inadequate sanitation. In the working area of Mejuwet Health Center, Bojonegoro Regency, the prevalence of stunting in 2023 remained above the WHO threshold for high prevalence. This study aimed to analyze the relationship between environmental sanitation conditions and the incidence of stunting among toddlers aged 24–59 months in the area. This research employed a quantitative method with an observational analytic approach and a cross-sectional design. The independent variables consisted of environmental sanitation indicators, while the dependent variable was stunting incidence. The sample included 180 toddlers divided into two groups: 90 cases (stunted toddlers) and 90 controls (non-stunted toddlers). Data were collected through questionnaires, direct observation, and secondary data from the health center. Statistical analysis was conducted using chi-square tests and logistic regression. The Chi-square results demonstrated significant associations between stunting and all environmental sanitation indicators: ownership of healthy latrines ($p=0.000$), availability of clean water facilities ($p=0.001$), solid waste disposal facilities ($p=0.000$), and wastewater disposal facilities ($p=0.007$). Overall environmental sanitation conditions were significantly associated with stunting ($p=0.005$). The most dominant variables influencing stunting were healthy latrine ownership and solid waste disposal facilities. In conclusion, all environmental sanitation indicators show significant relationships with stunting among toddlers. Integrated water, sanitation, and hygiene (WASH) interventions involving improvements in basic infrastructure and promotion of hygienic behavior are necessary to reduce stunting prevalence and create a healthy environment that supports optimal child growth and development.

Keywords: stunting; environmental sanitation; toddlers

INTRODUCTION

Stunting is a chronic nutritional problem characterized by a child's height-for-age falling below the established growth standard and reflects long-term growth impairment due to inadequate nutrient intake and unhealthy environmental influences [1]. In Indonesia, stunting has become a national priority because of its high prevalence and its long-term impact on the quality of human resources [2]. One of the major factors increasingly recognized as contributing to stunting is poor environmental sanitation [3]. Inadequate environmental sanitation, including limited access to clean water, improper domestic waste management systems, and open defecation practices, significantly contributes to chronic diarrheal diseases in children, which subsequently affect nutrient absorption and linear growth [4].

In the context of the Mejuwet Health Center working area, Sumberrejo District, Bojonegoro Regency, sanitation conditions remain an important public health issue, particularly affecting toddlers. According to local health data, the stunting prevalence in 2023 in Sumberrejo District exceeded 20%, surpassing the WHO threshold for high prevalence. This condition raises serious concerns because stunting not only affects physical growth but also impairs cognitive development and future productivity [5].

Environmental factors related to sanitation—such as clean water facilities (drinking water quality), healthy latrine ownership, wastewater management systems, and solid waste disposal facilities—play a crucial role in determining child health status [6]. Studies indicate that children living in poor sanitation environments have approximately twice the risk of experiencing stunting compared to those living in adequate sanitation environments [7]. Additionally, low implementation of clean and healthy living behaviors in the community further worsens environmental sanitation conditions [8]. Limited maternal knowledge regarding sanitation practices and child health increases repeated exposure to infectious agents, which weakens nutrient absorption [9]. This situation is aggravated by inadequate household waste management and limited availability of proper public sanitation facilities [10].

Theoretically, stunting is closely related to sanitation through repeated infection pathways, particularly gastrointestinal infections that impair nutrient absorption [11]. Over time, recurrent infections lead to chronic malnutrition and ultimately hinder linear growth [12]. Therefore, environmental sanitation interventions can be an effective strategy to significantly reduce stunting prevalence [13]. A national literature review reported that poor environmental sanitation conditions, including unsafe water and inadequate fecal disposal systems, are associated with stunting among toddlers in Indonesia [14]. Previous research has consistently demonstrated correlations between sanitation and stunting, indicating that toddlers living in households with access to safe water and adequate sanitation have substantially lower stunting prevalence compared to those without such access [9]. A study conducted in Kendal Regency in 2023 found that access to improved latrines, waste disposal facilities, and handwashing habits were significantly associated with stunting among toddlers [9]. Other local survey data also show that stunting patterns remain influenced by sanitation-related variables such as drinking water sources and household environmental cleanliness [15]. Furthermore, sanitation improvement interventions have been shown to reduce stunting prevalence by up to 15% within two years [3].

Specifically in the Mejuwet Health Center working area, the high prevalence of stunting among toddlers is suspected to be associated with inadequate environmental sanitation conditions. Empirical data examining the specific relationship between sanitation indicators—such as healthy latrine ownership, access to safe drinking water, household waste management, and stunting incidence—remain limited. To date, no comprehensive study has specifically analyzed environmental sanitation factors contributing to stunting in this area. In this context, analyzing sanitation-related factors is important not only to determine their contribution to stunting but also to serve as a basis for evidence-based and context-specific intervention planning [16]. A deeper understanding of local sanitation conditions can strengthen environmental health surveillance systems and support more targeted public health policy formulation [17].

The main research question was: Is there a significant relationship between environmental sanitation conditions and stunting incidence among toddlers in the Mejuwet Health Center working area in 2024? The study aimed to analyze environmental sanitation factors associated with stunting in this region.

METHODS

This study employed a quantitative design with an observational analytic approach and a cross-sectional research design, measuring independent and dependent variables simultaneously at a single point in time to determine the relationship between environmental sanitation

factors and stunting incidence. The study was conducted in the Mejuwet Health Center working area, Sumberrejo District, Bojonegoro Regency, from August to December 2024. The population consisted of all toddlers aged 24–59 months in the Mejuwet Health Center working area in 2024. The sample comprised all toddlers aged 24–59 months who were stunted (case group) and non-stunted (control group). Total sampling was used for cases, while controls were selected using a 1:1 ratio with random sampling. The case sample included 90 toddlers, and the control sample also included 90 toddlers, resulting in a total of 180 respondents.

The independent variables (environmental sanitation factors) included: clean water facilities, ownership and adequacy of healthy latrines, wastewater disposal facilities and solid waste disposal facilities. The dependent variable was stunting status among toddlers. Confounding variables included maternal age and education, family income, child immunization status, and child nutritional intake. Data collection was conducted after obtaining official permission from the Mejuwet Health Center (No. 440/210/412.202.19/2024). Respondents were informed about the study objectives and provided informed consent prior to completing the questionnaire. Primary data were collected using structured questionnaires to obtain information on environmental sanitation conditions and respondent characteristics, as well as direct observation to assess sanitation facilities. Secondary data were obtained from health center records regarding child nutritional status and stunting reports.

Data processing included editing (checking completeness and consistency), coding (assigning numerical and alphabetical codes), tabulating (organizing data into rows and columns), and data entry into SPSS version 26. Bivariate analysis was performed using the Chi-square test to examine associations between sanitation variables and stunting. Multivariate analysis using logistic regression was conducted to identify the most dominant variables while controlling for confounders.

RESULTS

Table 1 demonstrate that all examined environmental sanitation variables are statistically significantly associated with the incidence of stunting among toddlers in the Mejuwet Health Center working area. Based on the chi-square analysis, each sanitation indicator shows a p-value below the predetermined significance level of 0.05, indicating that the null hypothesis of no association can be rejected for all variables. These findings confirm that variations in household environmental sanitation conditions are meaningfully related to differences in stunting status among children aged 24–59 months.

Specifically, healthy latrine ownership shows a highly significant association with stunting ($p=0.000$). This extremely low p-value indicates a very strong statistical relationship between the absence of adequate latrine facilities and increased stunting incidence. Households lacking improved and hygienic latrines are more likely to expose children to fecal contamination in the domestic environment, thereby increasing the risk of recurrent enteric infections that interfere with nutrient absorption and linear growth. The magnitude of statistical significance suggests that latrine ownership is one of the most critical sanitation components influencing child growth outcomes in this setting.

Access to clean water facilities is also significantly associated with stunting ($p=0.001$). This result indicates that inadequate access to safe and reliable water sources is linked to a higher probability of stunting. Clean water is essential not only for drinking but also for food preparation, personal hygiene, and environmental cleanliness. When households lack safe water, children are more vulnerable to waterborne diseases and chronic gastrointestinal disturbances, which may cumulatively impair nutritional status. The statistically significant association underscores the importance of ensuring safe water availability as part of stunting prevention strategies.

Similarly, the availability of solid waste disposal facilities demonstrates a highly significant relationship with stunting ($p=0.000$). The very small p-value indicates that improper waste management is strongly correlated with increased stunting risk. Poorly managed household waste can create unsanitary surroundings, attract disease vectors such as flies and rodents, and facilitate the spread of infectious agents. Continuous exposure to such environmental hazards may contribute to repeated infections and inflammation, both of which are known to negatively affect child growth. The strength of this association suggests that solid waste management is a key environmental determinant in this population.

Wastewater disposal facilities are also significantly associated with stunting ($p=0.007$). Although the p-value is higher than those of latrine ownership and solid waste disposal, it remains well below the 0.05 threshold, confirming a statistically meaningful relationship. Inadequate drainage and improper disposal of domestic wastewater may lead to environmental contamination, stagnant water accumulation, and increased exposure to pathogens. These conditions can indirectly influence child health and nutritional status, thereby contributing to stunting.

Finally, when environmental sanitation is analyzed as a composite variable, the overall association with stunting remains statistically significant ($p=0.005$). This finding indicates that the combined effect of multiple sanitation deficiencies substantially increases the likelihood of stunting. In other words, the poorer the overall sanitation condition of a household, the greater the probability that a child living in that environment will experience impaired linear growth. Among all variables, healthy latrine ownership and solid waste disposal facilities show the smallest p-values ($p=0.000$), suggesting that these two factors are the most dominant sanitation-related determinants of stunting in this study population.

DISCUSSION

There was a highly significant association between healthy latrine ownership and the incidence of stunting. This finding indicates that children living in households without access to improved and hygienic latrine facilities are at substantially greater risk of experiencing stunting compared with children residing in households that possess adequate latrines. The strength of the statistical significance suggests that latrine ownership is not merely a complementary environmental factor, but rather a central determinant of child growth outcomes within the studied population. These results are consistent with the findings, who reported that the availability of healthy latrines constitutes one of the key sanitation variables significantly associated with stunting [18]. Similarly, research conducted in Aturan Mumpo, Bengkulu Tengah Regency, demonstrated a significant correlation between healthy latrine ownership and stunting incidence [19]. Collectively, these findings reinforce the understanding that access to proper sanitation facilities is a fundamental component of a healthy household environment and plays a critical role in preventing recurrent gastrointestinal infections.

From a biological and environmental perspective, the underlying mechanism is plausible and well established. Households lacking healthy latrines often practice open defecation or rely on unsafe and unimproved facilities, resulting in environmental contamination with human fecal matter. Such contamination facilitates the transmission of pathogenic microorganisms [20], including bacteria, viruses, and helminths, which can cause gastrointestinal infections, diarrhea, and chronic low-grade enteric infections. These conditions interfere with nutrient absorption, reduce appetite, and increase metabolic demands due to immune system activation, thereby impairing linear growth in children [21]. Over time, repeated enteric infections may contribute to chronic inflammation and environmental enteric dysfunction, further compromising growth potential. A literature review has also

Table 1. Chi-square test results demonstrating significant associations between environmental sanitation factors and stunting

Hypothesis testing	p-value
Association between stunting and healthy latrine ownership	0.000
Association between stunting and clean water facilities	0.001
Association between stunting and solid waste disposal facilities	0.000
Association between stunting and wastewater disposal facilities	0.007
Association between stunting and overall environmental sanitation	0.005

identified access to improved latrines and proper fecal waste management as key determinants in stunting prevention efforts [14]. Therefore, strengthening household latrine coverage and ensuring hygienic fecal disposal systems are essential strategies in reducing stunting prevalence.

The variable of clean water availability also demonstrated a statistically significant association with stunting incidence. This finding supports the hypothesis that, beyond fecal sanitation, access to safe and reliable water supplies is critically important for maintaining adequate child nutritional status. Munthe et al. (2024) reported that poor-quality access to clean water is potentially one of the contributing factors to the persistently high stunting rates in Indonesia [22]. A study examining drinking water hygiene practices in Singorojo I, Kendal Regency, further indicated that inadequate water treatment practices—such as failing to boil water or storing water in uncovered containers—were associated with stunting [9]. Although the p-value in that study approached but did not reach conventional statistical significance, the direction of association aligns with the broader conceptual framework linking unsafe water to impaired child growth.

Unsafe water sources serve as vehicles for infectious agents responsible for diarrheal diseases, helminth infections, and other waterborne illnesses, which indirectly compromise nutritional status [23]. When households lack easily accessible clean water, children are more vulnerable to consuming contaminated drinking water, practicing inadequate hand hygiene, and living in suboptimal hygienic conditions. These circumstances increase the likelihood of recurrent mild infections or chronic gastrointestinal disturbances that inhibit optimal linear growth [24]. Consequently, the significant association between clean water availability and stunting underscores the importance of safe water provision as a core public health intervention component within stunting reduction programs.

The results also revealed a highly significant association between solid waste disposal facilities and stunting incidence. This finding indicates that inadequate household waste management constitutes an additional environmental risk factor for stunting. Households without proper waste disposal systems may contribute to environmental pollution, accumulation of refuse, and the proliferation of disease vectors such as flies, rodents, and mosquitoes, as well as unpleasant odors and other contaminants [25]. Such environmental conditions increase the risk of exposure to infectious pathogens and compromise overall household hygiene. The present findings are supported by research conducted by Juanda et al. (2022), which identified a significant relationship between household waste management practices and stunting incidence [26]. Furthermore, the fourth pillar of Community-Based Total Sanitation (STBM), which emphasizes proper household waste management, has been shown to be significantly associated with stunting risk. Poor waste management can contribute to repeated infections and subclinical inflammatory responses that negatively affect child growth. Therefore, stunting prevention efforts must extend beyond latrine provision and clean water access to include comprehensive environmental cleanliness and waste management practices. Even when latrine and water facilities are adequate, a household environment contaminated by unmanaged waste may still pose a substantial risk for impaired growth.

In addition, wastewater disposal facilities were significantly associated with stunting incidence. This finding suggests that, beyond fecal and solid waste management, proper domestic wastewater management also plays an important role in reducing stunting risk. Households lacking adequate drainage systems often discharge wastewater directly into the surrounding environment, leading to environmental contamination and deterioration of local water quality [27]. Contaminated surface water and stagnant wastewater may serve as breeding grounds for pathogens and vectors, thereby increasing community exposure to infectious diseases. Olo et al. (2021) similarly reported that substandard wastewater drainage facilities were correlated with stunting incidence [28]. These findings emphasize that sanitation must be addressed comprehensively, encompassing healthy latrines, safe water access, solid waste management, and wastewater disposal systems in an integrated manner [29].

Overall, environmental sanitation conditions demonstrated a statistically significant association with stunting incidence. This result indicates that the cumulative effect of multiple sanitation deficiencies substantially increases the likelihood of stunting among children. In practical terms, the poorer the household's environmental sanitation conditions, the greater the probability that children within that household will experience impaired linear growth. This finding reaffirms that poor environmental sanitation is a critical determinant of stunting [14]. Supporting evidence from Anggraini et al. (2020) reported that environmental sanitation factors contributed to stunting among toddlers in the Air Bangis Health Center area, Pasaman Barat Regency [30]. Similarly, Natasha et al. (2025) found significant associations between clean water facilities, waste management facilities, healthy latrines, wastewater disposal systems, and stunting incidence among toddlers [31]. Among the five variables examined in the present study, healthy latrine ownership and solid waste disposal facilities exhibited the smallest p-values, indicating that these two factors appear to be the most dominant sanitation-related determinants of stunting. Thus, the findings strengthen the argument that household and environmental sanitation interventions constitute an essential component of comprehensive stunting prevention strategies.

Nevertheless, several limitations must be acknowledged. First, because the analysis employed the chi-square test, which is associative in nature, the relationships identified are correlational and do not establish direct causality. Second, although sanitation variables demonstrated significant associations, other contextual factors—such as socioeconomic status, maternal education, nutritional intake, history of infectious diseases, and access to health services—must be considered as potential confounders. Research by Putri et al. (2023) demonstrated that both maternal and child-related factors, alongside sanitation conditions, influence stunting outcomes. Maternal nutritional status was identified as an important determinant, while for children, insufficient intake of breast milk and inadequate complementary feeding were significant contributors. When mothers experience poor nutritional status, children may receive insufficient breast milk, and inadequate complementary feeding practices further hinder optimal growth and development, ultimately leading to stunting [32]. Therefore, stunting reduction strategies that focus solely on sanitation improvements are unlikely to achieve optimal outcomes without simultaneously addressing nutritional, maternal, and broader socioeconomic determinants.

CONCLUSION

All environmental sanitation indicators—healthy latrine ownership, clean water access, solid waste disposal facilities, and wastewater disposal facilities—were significantly associated with stunting among toddlers in the Mejuwet Health Center working area. Healthy latrine ownership and solid waste disposal facilities were the most dominant factors. Comprehensive WASH-based interventions combined with multisectoral collaboration and household-level hygiene behavior improvements are essential to reduce stunting prevalence and promote healthy child growth and development.

Ethical consideration, competing interest and source of funding

- This study was conducted in accordance with established research ethics principles, and ethical approval was obtained from the appropriate institutional review board prior to data collection.
- There is no conflict of interest related to this publication.
- Source of funding is authors.

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