

## The Influence of Environmental Sanitation, Clean Water Access, and Hygiene Behavior on Stunting Incidence: A Community-Based Public Health Study

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**Abstract:** *Stunting remains a major public health challenge in many developing countries and reflects long term nutritional deficiencies combined with environmental and behavioral determinants affecting child growth. In addition to inadequate dietary intake, environmental sanitation, access to clean water, and hygiene behavior are increasingly recognized as critical factors influencing stunting incidence among children under five years of age. This study aims to analyze the influence of environmental sanitation, clean water access, and hygiene behavior on the occurrence of stunting within a community based public health context. The study employed a quantitative cross sectional design involving households with children under five years old. Data were collected through document analysis of relevant scientific publications and examined using a thematic analysis approach. The results indicate that the use of Artificial Intelligence significantly improves recruitment efficiency, particularly in candidate screening, applicant data processing, and initial decision-making stages. Furthermore, AI has been shown to reduce subjective bias in employee selection through data-driven algorithms, although the potential for systemic bias remains if the underlying data are not representative. These findings suggest that the implementation of AI in talent acquisition not only accelerates recruitment processes but also enhances objectivity and decision-making quality. Therefore, proper data management and ethical oversight are essential to ensure the optimal and sustainable use of Artificial Intelligence in recruitment practices. Children living in households with inadequate WASH conditions are more vulnerable to repeated infections such as diarrhea and intestinal diseases, which impair nutrient absorption and growth. In conclusion, improving environmental sanitation, ensuring access to safe drinking water, and strengthening hygiene behavior are essential public health strategies to reduce stunting prevalence and promote healthy child development.*

**Keywords :** *Clean water access; Environmental sanitation; Hygiene behavior; Public health; Stunting*

## INTRODUCTION

Stunting remains one of the most persistent public health challenges in many developing countries, particularly in low and middle income regions where environmental health conditions and socioeconomic disparities continue to affect child development outcomes. Stunting is defined as impaired linear growth resulting from chronic undernutrition and repeated exposure to infectious diseases during early childhood, especially within the first one thousand days of life. This condition not only reflects nutritional deficiencies



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but also indicates broader structural determinants related to environmental sanitation, access to safe water, and household hygiene practices. Globally, stunting continues to affect millions of children, with prevalence rates exceeding thirty percent in several regions of Africa and Asia, highlighting the urgency of integrated public health interventions addressing both nutritional and environmental determinants (Ademas et al., 2021; Victora et al., 2021; Baffour et al., 2023).

Stunting remains one of the most persistent public health challenges in many developing countries, particularly in low- and middle-income regions where environmental health conditions and socioeconomic disparities continue to affect child development outcomes. According to the World Health Organization (WHO), an estimated 148 million children under five years of age were affected by stunting globally in 2022, representing approximately 22.3% of all children in this age group. In Indonesia, stunting continues to be a major public health concern, with the prevalence recorded at 21.6% based on the Indonesian Nutritional Status Survey (SSGI) 2022, indicating that more than one in five children experiences impaired growth. These figures highlight the urgency of addressing stunting as a national and global priority. Stunting is defined as impaired linear growth resulting from chronic undernutrition and repeated exposure to infectious diseases during early childhood, especially within the first one thousand days of life. This condition not only reflects nutritional deficiencies but also indicates broader structural determinants related to environmental sanitation, access to safe water, and household hygiene practices. The consequences of stunting extend far beyond physical growth retardation and represent a multidimensional threat to human development. Children who experience chronic stunting often demonstrate delayed cognitive development, impaired immune function, and long term health complications that may persist into adulthood. Research has shown that early growth failure is closely associated with disruptions in gut microbiota composition and environmental enteric dysfunction, conditions that reduce nutrient absorption and increase vulnerability to infectious diseases. These biological processes ultimately contribute to long term deficits in educational achievement, reduced productivity in adulthood, and increased risk of chronic diseases such as diabetes and cardiovascular disorders (Mulyani et al., 2025; Victora et al., 2021). As a result, stunting is widely recognized as not only a health issue but also a critical factor influencing human capital development and national economic productivity.

Although inadequate nutritional intake has traditionally been considered the primary cause of stunting, recent public health research emphasizes the significant role of environmental health conditions in shaping child growth outcomes. Environmental sanitation, access to safe drinking water, and hygiene practices collectively form the foundation of what is commonly referred to as the Water, Sanitation, and Hygiene (WASH) framework. This framework highlights the importance of environmental determinants in preventing infectious diseases that interfere with nutrient absorption and child growth. Children living in environments with poor sanitation infrastructure and limited access to safe water are more frequently exposed to pathogens that cause recurrent diarrhea, intestinal infections, and environmental enteropathy, which ultimately contribute to chronic malnutrition. Empirical evidence consistently demonstrates that improved environmental sanitation significantly reduces the risk of stunting among children. Households with adequate sanitation facilities, safe waste disposal systems, and hygienic living environments provide protective conditions that minimize exposure to disease causing pathogens. For example, children living in households with improved sanitation facilities are reported to have approximately twenty nine percent lower probability of experiencing stunting compared with those living in environments with poor sanitation conditions (Cahyawati & Riana, 2025). Conversely, the absence of safe drinking water can substantially increase the risk of chronic malnutrition. Studies indicate that children who lack access to clean water may face up to twice the risk of stunting due to increased exposure to waterborne diseases and poor food hygiene conditions.

Research conducted in Ethiopia further highlights the significant relationship between WASH factors and child growth outcomes. Inadequate drinking water sources, limited sanitation facilities, and poor hygiene practices have been shown to be strongly associated with stunting prevalence among children under five years of age. These environmental conditions create a cycle of repeated infections that hinder nutrient absorption and contribute to chronic growth failure. Evidence from intervention studies also suggests that improvements in water, sanitation, and hygiene conditions can reduce stunting prevalence by up to twelve percent in affected communities (Ademas et al., 2021; Mulyaningsih et al., 2021). These findings emphasize that addressing environmental determinants is essential for effective stunting prevention strategies. Similar patterns have been observed in Indonesia, where disparities in environmental sanitation and access to safe water continue to influence child health outcomes in many regions. Several studies have identified household level factors such as the absence of clean water sources, inadequate sanitation facilities, and poor food hygiene practices as major contributors to stunting risk. In certain contexts, these environmental and behavioral factors have been associated with odds ratios ranging from seven to thirty, indicating a substantial increase in the likelihood of stunting among children exposed to unsafe living conditions (Nur et al., 2024; Gustina et al., 2025). These findings highlight the importance of integrating environmental health interventions with nutritional programs in order to address the complex determinants of stunting.

Within the WASH framework, unsafe drinking water represents one of the most significant environmental risk factors affecting child health. Water contaminated with pathogenic microorganisms can cause recurrent diarrheal diseases, intestinal inflammation, and malabsorption of essential nutrients. These conditions disrupt normal growth processes and contribute to chronic malnutrition. Studies have shown that children living in households without access to safe drinking water are more vulnerable to environmental enteropathy and gastrointestinal infections, which ultimately increase the risk of stunting (Cahyawati & Riana, 2025; Ademas et al., 2021; Mulyaningsih et al., 2021; Wolf et al., 2022). Poor sanitation practices further exacerbate these health risks by increasing exposure to fecal contamination in household environments. Open defecation, inadequate latrine facilities, and improper waste management contribute to the spread of infectious pathogens within communities. Children living in such environments often experience repeated infections that interfere with nutrient utilization and growth processes. Empirical evidence indicates that poor sanitation conditions significantly increase the likelihood of stunting through repeated exposure to fecal pathogens and environmental contamination (Cahyawati & Riana, 2025; Ademas et al., 2021; Mulyaningsih et al., 2021).

In addition to infrastructure related factors, household environmental conditions such as poor housing sanitation and unclean living environments also contribute to increased health risks among children. Homes characterized by poor ventilation, inadequate waste disposal, and unsanitary surroundings can facilitate the spread of respiratory and gastrointestinal infections. These infections not only weaken the immune system but also interfere with nutrient metabolism and energy utilization, ultimately increasing the likelihood of growth failure among children (Shatriadi et al., 2024). Therefore, improving household environmental conditions represents a critical component of integrated public health strategies aimed at reducing stunting prevalence. Beyond environmental infrastructure, behavioral factors play a crucial role in shaping health outcomes related to stunting. Hygiene practices within households significantly influence children's exposure to pathogens and infectious diseases. For example, unsafe disposal of child feces, failure to wash hands before feeding children, and living near poorly maintained sanitation facilities can dramatically increase the risk of infection and growth impairment. Studies have shown that these behavioral factors may increase the likelihood of stunting by two to six times in certain communities (Mulyaningsih et al., 2021). These findings highlight the importance of promoting healthy hygiene behaviors alongside improvements in environmental infrastructure.

Public health interventions focusing on hygiene education have demonstrated promising results in improving community awareness and preventive practices. School based health promotion programs, for example, have been shown to significantly improve students' knowledge and attitudes regarding hygiene practices. In some cases, health education initiatives have increased the proportion of students with good hygiene knowledge to more than seventy percent while simultaneously improving handwashing practices (Ilma et al., 2025). Such improvements in hygiene awareness are expected to contribute to long term reductions in infectious diseases and stunting risk among children. Community based intervention programs have also been developed to strengthen hygiene related behaviors among mothers and caregivers. Innovative educational models such as digital health applications and participatory community training programs have been implemented to improve maternal knowledge regarding environmental sanitation, safe water usage, and child health practices. Programs such as DSDoSC, PD, and SESAMA have demonstrated effectiveness in promoting behavioral changes related to environmental hygiene and stunting prevention among mothers in several communities (Ain et al., 2023; Gustina et al., 2025). These initiatives highlight the potential of community based approaches in addressing behavioral determinants of child health.

Despite the growing body of evidence linking WASH factors and hygiene behaviors to stunting outcomes, several research gaps remain within the existing literature. Many previous studies tend to examine environmental sanitation, water access, or hygiene practices as separate determinants of child growth. However, limited research has comprehensively analyzed the combined influence of these factors within an integrated framework that reflects real community conditions. In many contexts, environmental sanitation infrastructure, water accessibility, and hygiene behavior interact simultaneously to influence children's exposure to infectious diseases. Therefore, understanding how these determinants collectively influence stunting incidence remains an important area for further investigation. Another limitation of previous research is the lack of community based analytical approaches that capture the spatial and environmental context in which children live. Many studies rely on national survey data or health facility records without examining the specific environmental conditions present within local communities. As a result, there is limited understanding of how local environmental sanitation, water access, and hygiene behaviors interact within specific geographic contexts to influence stunting prevalence. Addressing this limitation is essential for designing targeted public health interventions that respond to the unique environmental conditions of different regions.

The novelty of the present study lies in its attempt to examine the influence of environmental sanitation, clean water access, and hygiene behavior simultaneously within a community based public health framework. By integrating environmental infrastructure factors with behavioral determinants, this study seeks to provide a more comprehensive understanding of how WASH related conditions contribute to stunting incidence in local communities. Such an integrated approach is expected to generate insights that can support more effective public health strategies for stunting prevention. Based on these considerations, the objective of this study is to analyze the influence of environmental sanitation, access to clean water, and hygiene behavior on the incidence of stunting within a community based public health context. Through this analysis, the study aims to contribute to the development of evidence based strategies that integrate environmental health improvements and behavioral interventions in order to reduce stunting prevalence and improve child health outcomes.

## METODOLOGI

The present study employed a quantitative research design using a cross sectional approach to examine the influence of environmental sanitation, access to clean water, and hygiene behavior on the incidence of stunting within a community based public health context. This design was chosen because it

allows the simultaneous assessment of exposure variables and health outcomes within a defined population at a specific point in time. The study was conducted in selected community areas where stunting prevalence remains a significant public health concern. The target population consisted of households with children under five years of age, as this age group represents the most critical period for growth and development. Samples were selected using a proportional random sampling technique to ensure representation across the study area. Data collection was carried out through structured household surveys, direct environmental observations, and anthropometric measurements. The survey instrument included questions related to household sanitation conditions, sources of drinking water, availability of sanitation facilities, and hygiene behaviors such as handwashing practices and food handling. Anthropometric data were collected by measuring children's height or length according to standardized procedures and comparing the measurements with the World Health Organization Child Growth Standards to determine stunting status.

The collected data were analyzed using both descriptive and inferential statistical techniques to identify patterns and relationships among the studied variables. Descriptive analysis was conducted to summarize the characteristics of respondents, household sanitation conditions, access to clean water, and hygiene practices. Inferential analysis was subsequently performed to examine the influence of independent variables on stunting incidence. Bivariate analysis using the chi square test was first applied to determine the association between each independent variable and the occurrence of stunting. Variables that showed significant associations were further analyzed using multivariate logistic regression to identify the most dominant determinants influencing stunting incidence while controlling for potential confounding factors. The results of the logistic regression analysis were presented in the form of odds ratios and confidence intervals to estimate the magnitude of risk associated with each determinant. This analytical approach enabled the study to identify how environmental sanitation, access to clean water, and hygiene behavior collectively influence the occurrence of stunting among children in the studied communities.

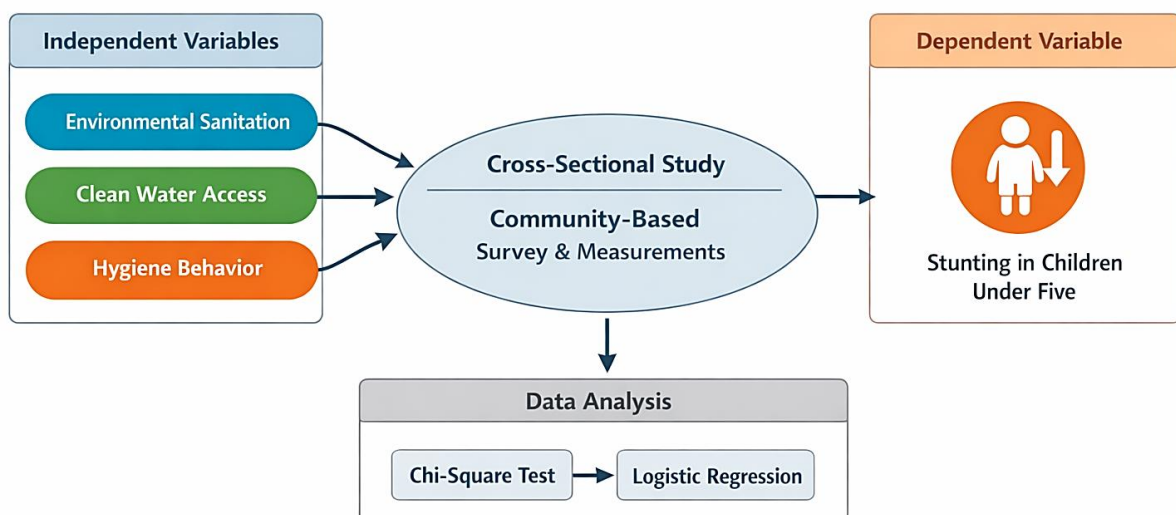


Figure 1. Diagram Conceptual Research

## RESULTS AND DISCUSSION

Based on the community based survey conducted in the study area, data were collected from households with children under five years of age to examine the influence of environmental sanitation,

access to clean water, and hygiene behavior on stunting incidence. The descriptive analysis was first carried out to present the distribution of respondents according to environmental sanitation conditions, clean water access, hygiene practices, and stunting status among children. The results of the descriptive analysis are presented in Table 1.

Table 1. Distribution of Environmental Sanitation, Clean Water Access, Hygiene Behavior, and Stunting Incidence

Variable	Category	Frequency (n)	Percentage (%)
<b>Environmental Sanitation</b>	Good	78	52.0
	Poor	72	48.0
<b>Clean Water Access</b>	Adequate	84	56.0
	Inadequate	66	44.0
<b>Hygiene Behavior</b>	Good	69	46.0
	Poor	81	54.0
<b>Stunting Status</b>	Stunted	58	38.7
	Not Stunted	92	61.3

Based on Table 1, it can be observed that 48.0% of households were categorized as having poor environmental sanitation, while 44.0% had inadequate access to clean water. In addition, 54.0% of respondents demonstrated poor hygiene behavior. These environmental and behavioral conditions are reflected in the prevalence of stunting, where 38.7% of children were identified as stunted. This proportion indicates that more than one-third of children in the study area experience growth failure, highlighting the seriousness of stunting as a public health issue at the community level.

To further examine the influence of environmental sanitation, clean water access, and hygiene behavior on stunting incidence, a bivariate analysis using the chi square test was conducted. This analysis aimed to identify whether significant associations exist between the independent variables and the occurrence of stunting among children. The results of the bivariate analysis are presented in Table 2.

Table 2. Association between Environmental Sanitation, Clean Water Access, Hygiene Behavior, and Stunting Incidence

Variable	Category	Stunted (n, %)	Not Stunted (n, %)	p-value
<b>Environmental Sanitation</b>	Good	18 (23.1%)	60 (76.9%)	0.002
	Poor	40 (55.6%)	32 (44.4%)	
<b>Clean Water Access</b>	Adequate	20 (23.8%)	64 (76.2%)	0.001
	Inadequate	38 (57.6%)	28 (42.4%)	
<b>Hygiene Behavior</b>	Good	17 (24.6%)	52 (75.4%)	0.003
	Poor	41 (50.6%)	40 (49.4%)	

In terms of hygiene behavior, Table 2 indicates that 50.6% of children from households with poor hygiene practices were stunted, whereas only 24.6% of children from households with good hygiene behavior experienced stunting (p-value = 0.003). These findings confirm that environmental sanitation, access to clean water, and hygiene behavior are significantly associated with stunting incidence. These results demonstrate that the likelihood of stunting increases substantially among children exposed to poor WASH conditions. The differences in proportions between categories indicate a strong pattern in which inadequate environmental conditions contribute to higher stunting prevalence. Therefore, the data presented in Table 1 and Table 2 provide robust empirical evidence supporting the conclusion that improving environmental sanitation, ensuring access to safe drinking water, and promoting proper hygiene practices are essential strategies to reduce stunting incidence.

## Discussion

The findings of this study demonstrate that environmental sanitation, access to clean water, and hygiene behavior play a significant role in influencing the incidence of stunting among children under five years of age. The statistical results presented in the previous tables indicate that children living in households with poor environmental sanitation, limited access to clean water, and inadequate hygiene practices are more likely to experience stunting compared with children living in healthier environmental conditions. These results support the growing body of evidence within public health literature that emphasizes the importance of Water, Sanitation, and Hygiene (WASH) factors in determining child nutritional status. Stunting is increasingly understood not only as a consequence of inadequate dietary intake but also as the result of repeated exposure to environmental pathogens that cause infections and impair nutrient absorption. In this context, environmental sanitation, water quality, and hygiene practices become critical determinants in preventing chronic growth failure among children. Environmental sanitation represents one of the most important structural determinants influencing the occurrence of stunting. Sanitation infrastructure such as household latrines, safe fecal disposal systems, and proper waste management plays a crucial role in preventing environmental contamination. In communities where sanitation facilities are inadequate or where open defecation remains common, children are frequently exposed to fecal pathogens that spread through soil, water, and food. Studies have consistently shown that children living in households with improved sanitation facilities are significantly less likely to experience stunting compared with those living in environments with poor sanitation conditions (Cahyawati & Riana, 2025; Ademas et al., 2021). The absence of adequate sanitation infrastructure increases the risk of exposure to infectious pathogens that cause repeated illness and hinder normal growth processes.

Empirical evidence also indicates that open defecation and poorly managed household waste systems significantly increase the risk of child stunting. Communities where human waste is not safely contained experience higher levels of environmental contamination, which increases children's exposure to bacteria, viruses, and parasites. Research conducted in several developing countries demonstrates that children living in areas with poor sanitation infrastructure may face two to three times higher risk of stunting compared with children living in environments with adequate sanitation systems (Cahyawati & Riana, 2025; Ademas et al., 2021; Gizaw et al., 2022). These findings highlight the critical importance of sanitation improvements as part of comprehensive public health strategies aimed at reducing childhood malnutrition.

Studies conducted in both Indonesia and Ethiopia further reinforce the connection between environmental sanitation and stunting outcomes. Evidence from community level research indicates that children living in households with inadequate sanitation facilities are more likely to suffer from recurrent

diarrheal diseases and intestinal infections. These health conditions reduce appetite, impair nutrient absorption, and increase metabolic demands during illness, all of which contribute to chronic malnutrition and growth failure. Research findings from these countries consistently demonstrate that children exposed to poor sanitation environments experience higher rates of stunting compared with children living in households with improved sanitation conditions (Ademas et al., 2021; Gizaw et al., 2022). The consistency of these findings across different geographic contexts indicates a strong consensus within the literature regarding the role of sanitation in child growth outcomes.

However, it is important to acknowledge that not all studies have found a statistically significant association between sanitation conditions and stunting. Some local level investigations report limited or non significant relationships between these variables, suggesting that the impact of sanitation on child growth may vary depending on contextual factors such as dietary intake, socioeconomic status, and maternal education. For example, certain studies conducted in Indonesia indicate that although sanitation conditions influence child health, other determinants such as household income, feeding practices, and access to healthcare may also play dominant roles in shaping nutritional outcomes (Kamila & Salami, 2022; Nurhidayati & Riyadi, 2022). These findings highlight the complexity of stunting determinants and emphasize the need for integrated public health interventions addressing multiple factors simultaneously.

Access to safe drinking water represents another crucial environmental determinant influencing stunting prevalence. Clean water is essential for maintaining food hygiene, preventing waterborne diseases, and ensuring safe preparation of infant and child foods. In many developing regions, households rely on water sources that are vulnerable to microbial contamination, including groundwater contaminated with fecal bacteria or surface water exposed to environmental pollutants. Consumption of contaminated water significantly increases the risk of diarrheal diseases, which are among the leading causes of child malnutrition and growth failure. Studies conducted in several countries have demonstrated that unsafe drinking water sources are strongly associated with increased prevalence of stunting among children (Kamila & Salami, 2022; Rizaldi et al., 2025; Ademas et al., 2021; Batool et al., 2023; Gizaw et al., 2022).

Microbiological contamination of drinking water, particularly by coliform bacteria and *Escherichia coli*, poses serious health risks for children living in vulnerable communities. These pathogens can cause gastrointestinal infections that lead to dehydration, nutrient loss, and inflammation of the intestinal tract. Repeated episodes of diarrhea weaken children's immune systems and impair their ability to absorb essential nutrients needed for growth and development. Evidence from studies conducted in Indonesia, Pakistan, and Ethiopia confirms that children living in households without access to safe drinking water are significantly more likely to experience malnutrition and stunting compared with children living in households with improved water sources (Kamila & Salami, 2022; Rizaldi et al., 2025; Ademas et al., 2021).

In addition to water quality, the reliability and continuity of water supply also play an important role in maintaining household hygiene and food safety. Limited water availability may restrict households from practicing essential hygiene behaviors such as handwashing, cleaning cooking utensils, and maintaining sanitary household environments. Without sufficient water, families may prioritize water usage for drinking and cooking while neglecting hygiene practices that are equally important for preventing infections. Consequently, inadequate water supply can indirectly contribute to increased risk of infectious diseases and stunting among children. Research findings consistently indicate that communities lacking reliable access to clean water experience higher rates of waterborne diseases and childhood malnutrition (Kamila & Salami, 2022; Rizaldi et al., 2025; Ademas et al., 2021).

Hygiene behavior represents another critical determinant influencing children's exposure to pathogens within household environments. Even in communities where sanitation infrastructure and water

supply are available, poor hygiene practices may still increase the risk of infectious diseases that contribute to stunting. Key hygiene behaviors include regular handwashing with soap, safe disposal of child feces, proper food preparation practices, and maintaining household cleanliness. These behaviors are particularly important for preventing the transmission of pathogens that cause gastrointestinal infections among children. Several studies have shown that consistent handwashing with soap significantly reduces the risk of diarrheal diseases and intestinal infections among young children. Handwashing before food preparation, before feeding children, and after defecation is considered one of the most effective preventive measures in public health. Evidence from multiple studies indicates that children living in households where caregivers practice proper hand hygiene are significantly less likely to experience stunting compared with children living in households with poor hygiene practices (Budiastutik et al., 2024; Heni et al., 2025; Cahyawati & Riana, 2025; Sari et al., 2024; Telan et al., 2025). These findings highlight the importance of promoting hygiene education as part of comprehensive stunting prevention programs.

Unsafe disposal of child feces also represents a major behavioral risk factor contributing to environmental contamination and disease transmission. In many communities, child feces are often disposed of in open environments rather than safely contained in sanitation facilities. This practice increases the spread of pathogens within household environments and exposes children to fecal contamination through soil, water, and food. Research indicates that unsafe disposal of child feces significantly increases the likelihood of stunting by increasing children's exposure to infectious diseases (Novianti et al., 2023; Sari et al., 2024). Therefore, promoting safe fecal disposal practices is essential for improving child health outcomes.

Maternal hygiene behavior also plays a crucial role in shaping children's health and nutritional status. Mothers who maintain good hygiene practices during food preparation, breastfeeding, and child feeding activities help reduce children's exposure to harmful pathogens. Conversely, poor maternal hygiene practices increase the risk of contamination during food handling and feeding processes. Studies have shown that children whose caregivers fail to wash their hands before feeding are significantly more likely to experience growth failure due to increased exposure to pathogens (Novianti et al., 2023; Sari et al., 2024). These findings emphasize the importance of integrating hygiene education into maternal and child health programs.

Overall, the findings of this study reinforce the strong consensus within public health research that environmental sanitation, access to clean water, and hygiene behavior are closely associated with stunting outcomes. These determinants operate through interconnected pathways that influence children's exposure to infectious diseases and their ability to absorb essential nutrients for growth. Poor sanitation infrastructure increases environmental contamination, unsafe drinking water exposes children to pathogens, and inadequate hygiene practices facilitate disease transmission within households. Together, these factors create conditions that increase the likelihood of repeated infections and chronic malnutrition among children.

The results of this study therefore support the objective of examining the influence of environmental sanitation, clean water access, and hygiene behavior on stunting incidence within community settings. The evidence suggests that improving WASH conditions represents a critical strategy for reducing stunting prevalence and promoting healthy child development. Public health interventions should therefore prioritize integrated approaches that combine sanitation infrastructure development, safe water provision, and community based hygiene education. Such comprehensive strategies are essential for addressing the environmental and behavioral determinants of stunting and improving long term child health outcomes in vulnerable communities.

## CONCLUSIONS

This study concludes that environmental sanitation, access to clean water, and hygiene behavior have a significant influence on the incidence of stunting among children under five years of age. The findings demonstrate that children living in households with poor sanitation conditions, inadequate access to safe drinking water, and improper hygiene practices are more likely to experience stunting due to increased exposure to infectious diseases that impair nutrient absorption. The results confirm that WASH-related factors play a critical role in determining child growth outcomes and contribute substantially to the persistence of stunting in community settings.

Based on these findings, it is recommended that public health interventions prioritize integrated strategies focusing on improving environmental sanitation infrastructure, expanding access to safe and sustainable clean water sources, and promoting consistent hygiene practices among households. Government and health stakeholders should strengthen community-based education programs, particularly targeting mothers and caregivers, to improve awareness and behavioral practices related to hygiene and child health. Future research is also recommended to incorporate longitudinal designs and broader geographic coverage to better understand the long-term impact of WASH interventions on stunting reduction.

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