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The Effect of Hygiene Practices and Environmental Sanitation on Stunting Incidence: A Community-Based Public Health Approach

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Abstract**:** *Stunting remains a major public health challenge in Indonesia, with long-term consequences for cognitive development, educational attainment, and adult productivity. Beyond inadequate dietary intake, environmental determinants such as poor hygiene and inadequate sanitation significantly contribute to impaired linear growth. This study aims to analyze the effect of hygiene practices and environmental sanitation on stunting incidence using a community-based public health approach. A cross-sectional community-based analytical design was applied among children aged 6–59 months. Data were collected through structured caregiver interviews, direct observations of household sanitation facilities, anthropometric measurements using WHO growth standards, and reviews of community health records. Multivariate logistic regression analysis was conducted to determine adjusted odds ratios for WASH-related factors. The results indicate that lack of handwashing before feeding, unimproved latrine facilities, unsafe water sources, open defecation practices, and recent diarrheal episodes significantly increase the likelihood of stunting. These findings support the fecal–oral transmission and environmental enteric dysfunction pathways linking sanitation and growth failure. The study concludes that integrated community-based WASH interventions, combined with behavior change strategies and local health system strengthening, are essential to sustainably reduce stunting prevalence.*

Keywords : Community-based health, Environmental sanitation, Hygiene practices, Stunting, WASH interventions

INTRODUCTION

Stunting remains one of the most persistent public health challenges in low- and middle-income countries, including Indonesia. Defined as impaired linear growth resulting from chronic undernutrition, particularly during the first 1,000 days of life, stunting has far-reaching consequences that extend beyond childhood. Children who have experienced stunting face increased risks of impaired cognitive development, lower educational attainment, reduced economic productivity in adulthood, and a higher likelihood of developing non-communicable diseases later in life (Mulyani et al., 2025; Victora et al., 2021). The intergenerational nature of stunting further amplifies its societal impact, as undernourished girls were more likely to become stunted mothers who give birth to low birth weight infants, thereby perpetuating cycles of vulnerability. Consequently, stunting is not merely a nutritional issue but a multidimensional development problem that requires integrated interventions.

Although inadequate dietary intake and socioeconomic disadvantage are widely recognized determinants of stunting, growing evidence emphasizes the critical role of environmental conditions, particularly water, sanitation, and hygiene (WASH). Poor access to clean water, inadequate sanitation

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facilities, and suboptimal household hygiene practices increase exposure to enteric pathogens, leading to recurrent diarrheal infections and environmental enteric dysfunction (EED), a subclinical inflammatory condition of the small intestine that impairs nutrient absorption (Gizaw et al., 2022; Mulyaningsih et al., 2021). In Indonesia, children who livein communities without adequate WASH access face significantly higher risks of stunting compared to those residing in improved environments (Cahyawati & Riana, 2025; Mulyaningsih et al., 2021). These findings indicate that addressing stunting requires moving beyond nutrition-specific interventions toward broader environmental and behavioral determinants.

Empirical studies from Indonesia, Ethiopia, Pakistan, and other Asian contexts demonstrate the consistent associations between hygiene behavior, sanitation quality, and stunting risk. Handwashing practices, particularly before feeding, are strongly linked to growth outcomes. Evidence shows that failure to wash hands before feeding can increase the risk of stunting up to sixfold (Woldesenbet et al., 2023). Similarly, household ownership of improved latrines, regular handwashing with soap, and hygienic food preparation practices are significantly associated with reduced stunting prevalence (Heni et al., 2025; Manalu et al., 2023; Prasetyo & Susanna, 2025; Woldesenbet et al., 2023). These behavioral determinants reflect the importance of caregiver practices in interrupting fecal–oral transmission pathways that contribute to chronic infections.

Environmental sanitation factors further reinforce the relationship between WASH and stunting. Open defecation, the presence of human feces in living environment, soil floors, drinking water contaminated with *Escherichia coli*, and poorly managed waste systems have been associated with 1.7 to four times higher odds of stunting (Cahyawati & Riana, 2025; Gizaw et al., 2022; Sahiledengle et al., 2022; Woldesenbet et al., 2023). These conditions facilitate repeated exposure to pathogens that trigger diarrheal disease and parasitic infections, increasing metabolic demands while reducing nutrient utilization. The biological pathway linking poor sanitation to impaired growth is increasingly explained through the concept of Environmental Enteric Dysfunction (EED), characterized by chronic intestinal inflammation, villous atrophy, and increased gut permeability. This condition reduces nutrient absorption, elevates energy requirements, disrupts growth hormone pathways, and ultimately impairs linear growth (Gizaw et al., 2022; Mulyani et al., 2025; Shatriadi et al., 2024; Victora et al., 2021). Thus, the WASH–stunting relationship is supported by both epidemiological evidence and pathophysiological mechanisms.

A summary of the WASH components underscores their critical roles in mitigating stunting risk. Access to safe water reduces diarrheal incidence and the likelihood of Environmental Enteric Dysfunction (EED), thereby decreasing undernutrition (Ademas et al., 2021; Gizaw et al., 2022; Heni et al., 2025; Rizaldi et al., 2025). Improved sanitation facilities and elimination of open defecation reduce exposure to fecal pathogens in domestic environment (Cahyawati & Riana, 2025; Gizaw et al., 2022; Woldesenbet et al., 2023). Handwashing with soap and safe food hygiene practices interrupt contamination pathways and protect children from recurrent infections (Dominguez-Salas et al., 2024; Manalu et al., 2023; Woldesenbet et al., 2023). These interconnected components illustrate that WASH is not a peripheral factor but a central determinant of child growth outcomes.

Despite substantial evidence linking WASH and stunting, important research gaps remain. First, much of the existing literature relies on cross-sectional designs that establish associations but do not adequately capture longitudinal or causal relationships. Comprehensive intervention studies that integrating integrate WASH improvements with nutrition-specific strategies remain limited, particularly within Indonesian community settings (Cahyawati & Riana, 2025; Mulyaningsih et al., 2021; Sahiledengle et al., 2022). Second, although the biological role of Environmental Enteric Dysfunction (EED) has been increasingly recognized, few community-based studies directly measure Environmental Enteric Dysfunction (EED) biomarkers and link them to environmental interventions, leaving a gap between

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mechanistic understanding and programmatic evaluation (Gizaw et al., 2022; Shatriadi et al., 2024; Victora et al., 2021). Third, evaluations of community-based WASH programs, including those implemented through integrated health posts (posyandu), midwives, and community health cares, remain limited in rigor, particularly regarding long-term outcomes such as height-for-age and cognitive development (Aryudaningrum et al., 2025; Heni et al., 2025; Sahiledengle et al., 2022; Sutrisnawati et al., 2025).

In Indonesia, multilevel determinants of stunting operate simultaneously at child, household, and community levels, suggesting that isolated interventions are unlikely to achieve sustained reductions (Mulyaningsih et al., 2021; Murwanto et al., 2025). Community-based actors, including midwives, health cadres, and family networks, play crucial roles in growth monitoring, nutrition education, WASH promotion, and early detection of growth faltering (Aryudaningrum et al., 2025; Heni et al., 2025; Sutrisnawati et al., 2025). However, the challenges such as social stigma, limited participation, communication barriers, and insufficient capacity, constrain the effectiveness of these initiatives. Without strong community engagement and empowerment, improvements in infrastructure alone may fail to translate into behavioral change and sustained health outcomes.

These gaps highlight the urgency of adopting a community-based public health approach that integrates nutrition interventions with WASH improvements, maternal education, and local service strengthening. Emerging evidence suggests that integrated strategies combining environmental sanitation, hygiene behavior change, and family engagement yield more sustainable reductions in stunting compared to single-component interventions (Aryudaningrum et al., 2025; Jalaludin et al., 2025; Murwanto et al., 2025; Shatriadi et al., 2024). Community empowerment enhances ownership, reinforces social norms around hygiene, and facilitates early identification of growth problems. Such integrated models align with public health frameworks emphasizing upstream determinants of health and participatory actions.

The novelty of this study lied in its integrative examination of hygiene practices and environmental sanitation as determinants of stunting within a community-based public health framework. Unlike previous studies that analyze WASH components or nutritional factors separately, this research adopts a comprehensive approach that connects environmental conditions, behavioral practices, and community engagement mechanisms. By situating the analysis at the community level and emphasizing participatory health promotion structures, the study addresses the gap between epidemiological association and programmatic implementation. It contributes to the literature by providing empirical evidence on how hygiene and sanitation practices interact with community-based health systems to influence stunting outcomes.

Accordingly, this study aims to analyze the effect of hygiene practices and environmental sanitation on stunting incidence using a community-based public health approach. Through this objective, the research seeks to generate evidence that informs integrated intervention strategies capable of addressing both biological and environmental determinants of child growth. By bridging WASH components, community participation, and health system strengthening, the study aspires to support sustainable reductions in stunting and advance child health equity in Indonesia.

METODOLOGI

This study employed a community-based analytical observational design with a cross-sectional approach to examine the effect of hygiene practices and environmental sanitation on stunting incidence. The research was conducted in selected villages with varying levels of WASH access to capture contextual

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differences at the community level. The study population consisted of children aged 6–59 months and their primary caregivers. A multistage cluster sampling technique was applied to select households proportionally from each community. The primary outcome variable was stunting status, determined by using height-for-age Z-scores (HAZ) based on WHO Child Growth Standards, where HAZ < -2 SD was classified as stunted. Independent variables included household hygiene practices (handwashing with soap before feeding and after defecation, safe food preparation, child feces disposal), environmental sanitation indicators (access to improved water sources, latrine ownership, open defecation practices, floor type, waste management), and selected covariates such as maternal education, household income, and child morbidity history. Data collection techniques included structured interviews using validated questionnaires, direct household observation checklists to assess sanitation conditions, anthropometric measurements conducted by trained health workers, and review of community health records from local integrated health posts (posyandu).

Data analysis was conducted in several stages. First, descriptive statistics were used to summarize the distribution of stunting prevalence, hygiene behavior, and sanitation characteristics. Second, bivariate analysis using chi-square tests and independent t-tests examined associations between each WASH variable and stunting status. Third, multivariate logistic regression analysis was performed to estimate adjusted odds ratios (AOR) and identify the independent effects of hygiene and sanitation variables on stunting while controlling for socioeconomic and demographic covariates. To assess the community-based dimension, multilevel modeling was applied where appropriate to account for clustering effects at the village level. Statistical significance was set at $p < 0.05$ with 95% confidence intervals. The findings were interpreted to determine whether improved hygiene practices and environmental sanitation significantly reduced the likelihood of stunting within a community-based public health framework.

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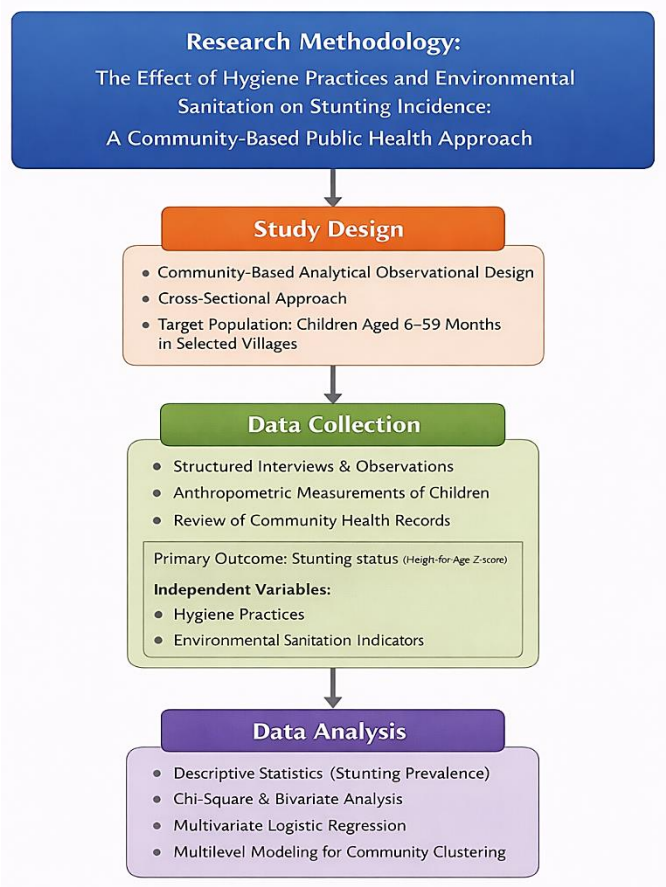

Figure 1. Diagram Conceptual Research

RESULTS AND DISCUSSION

To describe the characteristics of the study population and the distribution of hygiene and sanitation variables, descriptive statistical analysis was conducted among 320 children aged 6–59 months in selected communities.

Table 1. Distribution of Stunting Status and WASH Variables (n = 320)

Variable	Category	n	%
Stunting Status	Stunted	98	30.6
	Non-stunted	222	69.4
Handwashing Before Feeding	Yes	185	57.8
	No	135	42.2
Latrine Ownership	Improved Latrine	210	65.6
	No/Unimproved	110	34.4

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Access to Safe Water	Improved Source	228	71.3
	Unimproved Source	92	28.7
Open Defecation Practice	No	240	75.0
	Yes	80	25.0
Child Diarrhea (Past 2 Weeks)	Yes	76	23.8
	No	244	76.2

Table 1 showed that the prevalence of stunting among children aged 6–59 months was 30.6%, that indicating a moderate public health burden in the study communities. Although 71.3% of households reported access to improved water sources and 65.6% owned improved latrines, a considerable proportion of households still practiced inadequate hygiene behaviors. Notably, 42.2% of caregivers did not consistently wash hands before feeding, and 25% of households reported open defecation practices. The presence of diarrhea in 23.8% of children within the past two weeks suggests ongoing exposure to enteric pathogens. These findings highlight persistent environmental and behavioral risks that may contribute to impaired linear growth.

To assess the independent effects of hygiene practices and environmental sanitation on stunting, multivariate logistic regression analysis was conducted while controlling for maternal education and household income.

Table 2. Multivariate Logistic Regression Analysis of Determinants of Stunting

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
No Handwashing Before Feeding	2.84	1.65–4.89	0.000**
No Improved Latrine	2.21	1.28–3.81	0.004**
Unimproved Water Source	1.97	1.10–3.53	0.021*
Open Defecation Practice	2.56	1.41–4.64	0.002**
Recent Diarrhea Episode	2.73	1.53–4.87	0.001**
Low Maternal Education	1.88	1.05–3.36	0.033*

Table 2 demonstrated that poor hygiene and sanitation practices were significantly associated with increased odds of stunting. Children whose caregivers did not practice handwashing before feeding were 2.84 times more likely to be stunted compared to those with proper hygiene practices. Lack of improved latrine facilities and open defecation practices were also strong predictors, increasing the likelihood of stunting by more than two-fold. Access to unimproved water sources and recent diarrheal episodes significantly elevated stunting risk, supporting the fecal–oral transmission pathway and environmental enteric dysfunction hypothesis. Even after adjusting for maternal education, WASH-related factors remained statistically significant, indicating that environmental sanitation and hygiene behaviors independently contribute to stunting risk. These findings reinforce the importance of integrated, community-based WASH interventions in reducing stunting incidence.

Discussion

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This study aimed to analyze the effect of hygiene practices and environmental sanitation on stunting incidence within a community-based public health framework. The empirical findings demonstrated that inadequate handwashing, lack of improved latrine facilities, unsafe water sources, open defecation practices, and recent diarrheal episodes are significantly associated with increased odds of stunting among children aged 6–59 months. Even after controlling for maternal education and household socioeconomic factors, WASH-related variables remained strong predictors of impaired linear growth. These findings reinforce a growing body of evidence indicating that hygiene and sanitation are not peripheral determinants of child growth, but central components in the prevention of chronic undernutrition.

The association between poor hygiene practices and stunting observed in this study is consistent with national and international evidence. Caregivers who did not practice handwashing before feeding had nearly three times higher odds of having stunted children. This finding aligns with national review evidence in Indonesia demonstrating strong associations between stunting and inadequate handwashing with soap, poor sanitation facilities, and limited access to clean water (Heni et al., 2025). Similar magnitudes of association have been documented in Ethiopia, where children whose mothers did not wash hands before feeding faced 1.7 to 6 times higher odds of stunting (Woldesenbet et al., 2023; Gizaw et al., 2022). These consistent findings across settings indicated that hygiene behavior at the household level plays a crucial role in interrupting fecal–oral transmission pathways that contribute to chronic growth impairment.

The role of sanitation infrastructure is equally evident. Children who are living in households without improved latrines or practicing open defecation have twice as much stunting. . This result mirrors findings from Indonesia showing that the combination of unimproved drinking water and inadequate sanitation facilities increases the odds of stunting more than threefold among children aged 0–23 months (Torlesse et al., 2016). Additional local studies in Jember and Ogan Ilir similarly demonstrated that unhealthy household sanitation environments were significantly associated with higher stunting prevalence (Ainy et al., 2021; Purba et al., 2020). At the multilevel level, analysis of the Indonesian Family Life Survey (IFLS) indicated that children who were residing in communities lacking WASH access face significantly higher stunting risks even after adjusting for nutritional intake and socioeconomic variables (Mulyaningsih et al., 2021). The present findings extend this evidence by demonstrating that WASH factors remain independently significant within a community-based analytical framework.

Access to safe drinking water also emerged as a significant determinant of child growth. Households relying on unimproved water sources showed nearly twice the odds of stunting compared to those with improved water access. Regional and Asian-level reviews confirm that unsafe water, inadequate sanitation, and poor hygiene practices are consistently correlated with higher stunting prevalence (Rizaldi et al., 2025). Evidence suggests that water treatment and safe storage practices can reduce not only stunting but also anemia and repeated infections among young children (Meiyetriani & Utomo, 2025; Gizaw et al., 2022; Batool et al., 2023). These findings support the concept t of WASH improvements that reduce pathogen exposure and recurrent infection cycles, which compromise nutrient utilization.

The biological plausibility of these associations is well established. Repeated exposure to fecal pathogens through contaminated water, soil, food, or hands leads to chronic diarrhea and parasitic infections. Persistent enteric infection contributes to environmental enteric dysfunction (EED), characterized by chronic intestinal inflammation, villous atrophy, and increased intestinal permeability. The Environmental Enteric Dysfunction (EED) impairs nutrient absorption, increases metabolic demands, and disrupts growth hormone regulation, ultimately leading to linear growth failure (Gizaw et al., 2022; Victora et al., 2021). The significant association between recent diarrheal episodes and stunting in this study further supports this pathophysiological pathway. Diarrhea represents both an immediate cause of nutrient loss and a marker of repeated pathogen exposure, reinforcing the importance of environmental prevention strategies.

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The evidence thus clearly demonstrates that hygiene and sanitation factors are strongly associated with stunting. However, the effectiveness of WASH interventions depends heavily on implementation quality and community engagement. Large-scale randomized trials in Zimbabwe and the Democratic Republic of Congo found that basic household-level WASH interventions alone were insufficient to significantly reduce stunting without broader environmental transformation and sustained behavioral change (Humphrey et al., 2018; Quattrochi et al., 2025). These findings suggest that incremental improvements in infrastructure may not translate into meaningful growth outcomes if environmental contamination remains widespread at the community level.

Conversely, evidence from Community-Led Total Sanitation (CLTS) programs in Mali indicated that comprehensive sanitation improvements and open defecation elimination at the community scale can significantly improve child height outcomes, particularly when interventions are initiated before two years of age (Pickering et al., 2015). This suggests showed that scale, intensity, and timing of interventions were critical determinants of effectiveness. The present study's findings, which emphasize the independent effects of sanitation practices even after controlling for socioeconomic variables, reinforce the need for community-wide behavioral transformation rather than isolated household-level improvements.

Studies in Ethiopia and Indonesia further underscored that behavioral change among caregivers, including handwashing, safe water treatment, and hygienic disposal of child feces, must accompany infrastructure upgrades to achieve sustained growth improvements (Ademas et al., 2021; Kwami et al., 2019; Mulyaningsih et al., 2021; Woldesenbet et al., 2023). Behavioral practices are shaped by social norms, cultural beliefs, and local leadership, highlighting the relevance of community-based approaches. In Indonesia, integrated strategies that combine nutrition education, WASH promotion, economic empowerment, and engagement of community health cadres and midwives had been recommended as more effective than clinic-based approaches alone (Heni et al., 2025; Kusumawardani et al., 2020).

The findings of this study therefore support a nuanced interpretation of the hygiene–sanitation–stunting relationship. What is already clear from the accumulated evidence is that inadequate WASH conditions consistently increase the risk of stunting across diverse contexts. Poor sanitation and hygiene expose children to chronic infections that disrupt growth pathways, and these effects persist even after adjusting for nutritional and socioeconomic factors. However, the magnitude of impact and the success of interventions depend on the breadth of environmental improvements and the strength of community engagement.

The community-based public health approach adopted in this study is particularly relevant in Indonesia, where multilevel determinants of stunting operate simultaneously at individual, household, and community levels. Isolated infrastructure provision without community ownership may fail to shift entrenched hygiene behaviors. Conversely, empowering community health workers, strengthening local monitoring systems such as posyandu, and fostering family engagement can enhance adherence to hygiene practices and sustain sanitation improvements. Community participation increases accountability, reinforces social norms against open defecation, and promotes collective responsibility for child health.

Importantly, the findings also highlight the interdependence between hygiene practices and environmental sanitation. Handwashing without improved water access may be inconsistent, and latrine ownership without behavioral commitment may not eliminate environmental contamination. Therefore, integrated WASH strategies that address water quality, sanitation infrastructure, and hygiene behavior simultaneously are more likely to yield meaningful reductions in stunting risk. The independent significance of each WASH component in the regression model suggests that partial interventions addressing only one factor may not sufficiently disrupt the fecal–oral transmission cycle.

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In conclusion, the discussion confirms that the influence of hygiene and sanitation on stunting is well supported by both epidemiological evidence and biological mechanisms. Poor WASH conditions consistently elevate the risk of impaired linear growth, particularly among children exposed to chronic fecal contamination and recurrent diarrhea. Community-based approaches offer a promising pathway to translate infrastructure improvements into sustained behavioral change, yet their effectiveness depends on implementation quality, early intervention timing, and integration with nutrition-specific strategies. The present findings contribute to the growing consensus that reducing stunting requires not only improved dietary intake but also transformative improvements in environmental sanitation and hygiene practices at the community level.

CONCLUSIONS

This study concluded that hygiene practices and environmental sanitation exert a significant and independent influence on stunting incidence within a community-based public health context. Children who were living in households characterized by inadequate handwashing behavior, unimproved latrine facilities, unsafe water sources, open defecation practices, and recent diarrheal episodes face substantially higher risks of impaired linear growth. These findings confirmed that exposure to fecal–oral pathogens and recurrent infections remains a critical pathway linking poor WASH conditions to chronic undernutrition. The results further indicated that improvements in infrastructure alone are insufficient unless accompanied by sustained behavioral change and active community engagement. Therefore, reducing stunting requires an integrated approach that combines safe water access, improved sanitation, consistent hygiene practices, and strengthened community-based health systems. By addressing environmental determinants alongside nutritional interventions, community-based WASH strategies can play a decisive role in achieving sustainable reductions in stunting prevalence.

REFERENCES

Ademas, A., Adane, M., Keleb, A., Berihun, G., & Tesfaw, G. (2021). Water, sanitation, and hygiene as a priority intervention for stunting in under-five children in northwest Ethiopia: A community-based cross-sectional study. *Italian Journal of Pediatrics, 47*. https://doi.org/10.1186/s13052-021-01128-y

Ainy, F., Susanto, T., & Susumaningrum, L. (2021). The relationship between environmental sanitation of family and stunting among underfive children: A cross-sectional study in the public health center of Jember, Indonesia. *Nursing Practice Today*. https://doi.org/10.18502/npt.v8i3.5932

Aryudaningrum, N., Hidayat, A., & Kurniawati, H. (2025). Midwives' roles in community-based stunting prevention: A qualitative study in primary health services. *Gaster*. https://doi.org/10.30787/gaster.v23i2.1932

Batool, M., Saleem, J., Zakar, R., Butt, M., Iqbal, S., Haider, S., & Fischer, F. (2023). Relationship of stunting with water, sanitation, and hygiene (WASH) practices among children under the age of five: A cross-sectional study in Southern Punjab, Pakistan. *BMC Public Health, 23*. https://doi.org/10.1186/s12889-023-17135-z

Journal of Public Health Indonesian
Volume.2 Issue.6, (March, 2026) Pages 1-12
E-ISSN: 3048-1139
DOI : https://doi.org/10.62872/7fer8r69
https://nawalaeducation.com/index.php/JHH

Cahyawati, S., & Riana, E. (2025). The influence of environmental sanitation on incidence of stunting: A systematic review. *Journal of Maternal and Child Health*. https://doi.org/10.26911/thejmch.2025.10.03.03

Dominguez-Salas, P., Waddington, H., Grace, D., Bosire, C., Moodley, A., Kulkarni, B., Dasi, T., Banjara, S., Kumar, R., Fahmida, U., Htet, M., Sudibya, A., Faye, B., Tine, R., Heffernan, C., Saxena, D., Dreibelbis, R., & Häsler, B. (2024). Understanding the role of household hygiene practices and foodborne disease risks in child stunting: A UKRI GCRF Action Against Stunting Hub protocol paper. *BMJ Paediatrics Open, 8*. https://doi.org/10.1136/bmjpo-2022-001695

Gizaw, Z., Yalew, A., Bitew, B., Lee, J., & Bisesi, M. (2022). Stunting among children aged 24–59 months and associations with sanitation, enteric infections, and environmental enteric dysfunction in rural northwest Ethiopia. *Scientific Reports, 12*. https://doi.org/10.1038/s41598-022-23981-5

Heni, H., Idaningsih, A., Wianti, A., & Setyawati, A. (2025). Identification of sanitation and hygiene risk factors on the incidence of stunting in Indonesia: A scoping review. *Multidiscience: Journal of Multidisciplinary Science*. https://doi.org/10.59631/multidiscience.v2i1.302

Humphrey, J., Mbuya, M., Ntozini, R., Moulton, L., Stoltzfus, R., Tavengwa, N., Mutasa, K., Majo, F., Mutasa, B., Mangwadu, G., Chasokela, C., Chigumira, A., Chasekwa, B., Smith, L., Tielsch, J., Jones, A., Manges, A., Maluccio, J., & Prendergast, A. (2018). Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: A cluster-randomised trial. *The Lancet Global Health, 7*, e132–e147. https://doi.org/10.1016/s2214-109x(18)30374-7

Jalaludin, M., Fauzi, M., Sidiartha, G., John, C., Aviella, S., Novery, E., Permatasari, A., & Muhardi, L. (2025). Addressing stunting in children under five: Insights and opportunities from Nepal, Bangladesh, and Vietnam—A review of literature. *Children, 12*. https://doi.org/10.3390/children12050641

Kusumawardani, L., Rasdiyanah, R., Rachmawati, U., Jauhar, M., & Rohana, I. (2020). Community-based stunting intervention strategies: Literature review. *8*, 259–268. https://doi.org/10.20527/dk.v8i2.8555

Kwami, C., Godfrey, S., Gavilan, H., Lakhanpaul, M., & Parikh, P. (2019). Water, sanitation, and hygiene: Linkages with stunting in rural Ethiopia. *International Journal of Environmental Research and Public Health, 16*. https://doi.org/10.3390/ijerph16203793

Manalu, S., Syaputri, D., S, B., Tanjung, N., Tanjung, R., & Damanik, A. (2023). The effect of clean water facilities and household food sanitation hygiene on stunting in toddlers. *Contagion: Scientific Periodical Journal of Public Health and Coastal Health*. https://doi.org/10.30829/contagion.v5i3.17239

Meiyetriani, E., & Utomo, B. (2025). Improved sanitation and co-occurrence of anemia and stunting in Indonesian children: A retrospective cohort study. *Narra J, 5*. https://doi.org/10.52225/narra.v5i1.2070

Journal of Public Health Indonesian
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https://nawalaeducation.com/index.php/JHH

Mulyani, A., Khairinisa, M., Khatib, A., & Chaerunisaa, A. (2025). Understanding stunting: Impact, causes, and strategy to accelerate stunting reduction—A narrative review. *Nutrients, 17*. https://doi.org/10.3390/nu17091493

Mulyaningsih, T., Mohanty, I., Widyaningsih, V., Gebremedhin, T., Miranti, R., & Wiyono, V. (2021). Beyond personal factors: Multilevel determinants of childhood stunting in Indonesia. *PLoS ONE, 16*. https://doi.org/10.1371/journal.pone.0260265

Murwanto, B., Santosa, I., Ginting, D., & Sutarto, S. (2025). The role of environmental factors in stunting in rural areas. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*. https://doi.org/10.30604/jika.v10i1.2939

Pickering, A., Djebbari, H., López, C., Coulibaly, M., & Alzúa, M. (2015). Effect of a community-led sanitation intervention on child diarrhoea and child growth in rural Mali: A cluster-randomised controlled trial. *The Lancet Global Health, 3*, e701–e711. https://doi.org/10.1016/s2214-109x(15)00144-8

Prasetyo, A., & Susanna, D. (2025). Hygiene and sanitation towards the incidence of stunting in children under five years old in Bidara Cina Village, East Jakarta in 2024. *International Journal of Advancement in Life Sciences Research*. https://doi.org/10.31632/ijalsr.2025.v08i02.010

Purba, I., Sunarsih, E., Trisnaini, I., & Sitorus, R. (2020). Environmental sanitation and incidence of stunting in children aged 12–59 months in Ogan Ilir Regency. *12*, 189–199. https://doi.org/10.20473/jkl.v12i3.2020.189-199

Quattrochi, J., Croke, K., Dohou, C., Ghib, L., Lokaya, Y., Coville, A., & Mvukiyehe, E. (2025). Effects of a community-driven water, sanitation, and hygiene intervention on diarrhea, child growth, and local institutions: A cluster-randomized controlled trial in rural Democratic Republic of Congo. *PLOS Medicine, 22*. https://doi.org/10.1371/journal.pmed.1004524

Rizaldi, M., Ali, K., Rara, S., & Panjaitan, B. (2025). Water, sanitation and hygiene (WASH) and its association with stunting in developing countries in Asia: A systematic review. *Svāsthya: Trends in General Medicine and Public Health*. https://doi.org/10.70347/svsthya.v2i2.81

Sahiledengle, B., Petrucka, P., Kumie, A., Mwanri, L., Beressa, G., Atlaw, D., Tekalegn, Y., Zenbaba, D., Desta, F., & Agho, K. (2022). Association between water, sanitation and hygiene (WASH) and child undernutrition in Ethiopia: A hierarchical approach. *BMC Public Health, 22*. https://doi.org/10.1186/s12889-022-14309-z

Shatriadi, H., Putra, C., Said, F., & Rashid, N. (2024). Healthy environment for optimal growth and development: Preventing stunting early. *Jurnal Inspirasi Kesehatan*. https://doi.org/10.52523/jika.v2i2.127

Torlesse, H., Cronin, A., Sebayang, S., & Nandy, R. (2016). Determinants of stunting in Indonesian children: Evidence from a cross-sectional survey indicate a prominent role for the water, sanitation and hygiene sector in stunting reduction. *BMC Public Health, 16*. https://doi.org/10.1186/s12889-016-3339-8

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https://nawalaeducation.com/index.php/JHH

Victora, C., Christian, P., Vidaletti, L., Gatica-Domínguez, G., Menon, P., & Black, R. (2021). Revisiting maternal and child undernutrition in low-income and middle-income countries: Variable progress towards an unfinished agenda. *Lancet, 397*, 1388–1399. https://doi.org/10.1016/s0140-6736(21)00394-9

Woldesenbet, B., Tolcha, A., & Tsegaye, B. (2023). Water, hygiene and sanitation practices are associated with stunting among children of age 24–59 months in Lemo district, South Ethiopia, in 2021: Community-based cross-sectional study. *BMC Nutrition, 9*. https://doi.org/10.1186/s40795-023-00677-1