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Review
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The Influence of Environmental Sanitation on Incidence of Stunting: A Systematic Review

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ABSTRACT

Background: Stunting is a chronic health problem that has long-term impacts on child growth and development, especially in developing countries. Poor environmental sanitation is believed to be one of the main risk factors; however, this needs to be further examined based on empirical study findings. This study aims to analyze this issue systematically.
Subjects and Method: This is a systematic review using the PRISMA Flow Diagram. The PICO framework includes: Population (P): Children under five years of age; Intervention (I): Poor environmental sanitation; Comparison (C): Adequate environmental sanitation; Outcome (O): Stunting. Articles were retrieved from databases including PubMed, Scopus, ScienceDirect, and Google Scholar. Keywords used were "hygiene AND sanitation AND stunting AND under five AND cross-sectional." The quality of the studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal tool.
Results: A total of 9 articles from four studies were conducted in Asia, all of which from Indonesia, and five studies were conducted in Africa, all of which from the Ethiopia, indicated that access to proper sanitation, clean water, as well as appropriate feces disposal and handwashing practices, are strongly associated with a reduction in stunting incidence. The risk of stunting increases among children living in environments with unimproved latrines, untreated drinking water, and poor hygiene practices. Additional factors such as the child's age, mother's education level, and socioeconomic status also influence stunting outcomes.
Conclusion: Inadequate environmental sanitation plays a significant role in the occurrence of stunting. Preventive interventions should prioritize improving sanitation access, promoting hygiene behavior education, and implementing cross-sectoral approaches to sustainably reduce stunting prevalence.

Keywords: environment, sanitation, stunting, systematic review.

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BACKGROUND

Stunting remains a significant public health issue in Indonesia. Data show that the prevalence of stunting in Indonesia reached 30.8% in 2018, placing the country in the high category globally (Olo et al., 2020). The

2024 Indonesia Nutritional Status Survey (SSGI) shows a positive trend in the reduction of stunting, although the rate still exceeds the national target of 14% by the end of 2024 (Ministry of Health, 2024).

According to the World Health Organization (WHO), stunting is defined as a height-for-age measurement more than two standard deviations below the WHO Child Growth Standards median (WHO, 2020). This condition is not only a growth issue but also an indicator of prolonged nutritional deficiency, recurrent infections, and poor socioeconomic conditions. Stunting affects not only physical growth but also brain development, which can impair learning ability, reduce future productivity, and increase the risk of chronic diseases in adulthood (UNICEF, 2021).

One environmental factor contributing to the high rate of stunting is poor sanitation. Lack of access to proper sanitation facilities and the practice of open defecation increase the risk of exposure to fecal pathogens, which can lead to intestinal infections and chronic diarrhea in children. These conditions hinder nutrient absorption and negatively impact child growth (Rah et al., 2020).

Research indicates that children living in households with access to improved sanitation are 29% less likely to experience stunting compared to those in poor sanitation environments (Rah et al., 2020). In addition, access to clean water also plays a crucial role; families without access to clean water have twice the risk of having stunted children (Hurint et al., 2023).

Community-based interventions, such as the Community-Led Total Sanitation (CLTS) approach, have proven effective in improving community knowledge and behavior regarding sanitation, which in turn contributes to a reduction in stunting rates (Syam and Bungawati, 2024).

Given the importance of sanitation in preventing stunting, this study aims to analyze the impact of environmental sanitation on stunting incidence. This review will support the formulation of more effective policies and interventions in the effort to combat stunting (Olo et al., 2020).

SUBJECTS AND METHOD

1. Study Design

This systematic review was conducted using the PRISMA flow diagram. It followed the PICO format: Population= children under five years old; Intervention= poor environmental sanitation; Comparison= good environmental sanitation; Outcome= stunting. The databases used for the search were PubMed, Scopus, Science Direct, and Google Scholar, with the keywords “hygiene AND sanitation AND stunting AND under five AND cross-sectional”.

2. Steps of Systematic review

1) Formulating the research question in PICO format.
2) Searching for articles across various databases.
3) Performing critical appraisal.
4) Interpreting findings and drawing conclusions.

3. Inclusion Criteria

Inclusion criteria encompassed full-text articles in English, observational study designs, a research population of children under five years old, an intervention defined as exposure to poor sanitation, and stunting as the research outcome.

4. Exclusion Criteria

Inclusion criteria encompassed full-text articles in English, observational study designs, a research population of children under five years old, an intervention defined as exposure to poor sanitation, and stunting as the research outcome.

5. Operational Definition of Variables

Environmental sanitation was defined as the supervision of the physical environment of toddlers, consisting of clean water facilities, wastewater disposal facilities, waste disposal facilities (latrines), and garbage disposal facilities.

Stunting was defined as the proportion of children whose height-for-age z-score was below -2 standard deviations and -3 standard deviations, respectively, of the median height-for-age of the World Health Organization (WHO) Child Growth Standards.

6. Study Instruments

The quality of the studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal tool. The PRISMA diagram serves the primary function of transparently presenting the study selection process in a systematic review.

7. Data Analysis

The collected articles were screened with the help of PRISMA diagrams. The resume of the primary studi decribes with Table.

7. Ethic Clearance This study did not require ethical approval because it did not involve human subjects. It utilized primary data that had already been collected by previous researchers.

RESULTS

Study Selection

A PRISMA flow diagram of study inclusion is presented in Figure 1. The database search resulted in 724 records from the 4 sources. Three record was also generated from non-indexed publications and the relevant gray literature using web search engines. Initial screening based on the title and abstract using general criteria identified 45 records that were potentially eligible articles. A full-text review of the studies was then conducted, and the studies were assessed according to the inclusion criteria. Twenty-three articles were excluded due to various reasons such as irrelevant exposure, irrelevant outcomes, different study design, and different publication types. Finally, 9 articles satisfied the inclusion criteria and were included in the systematic review.

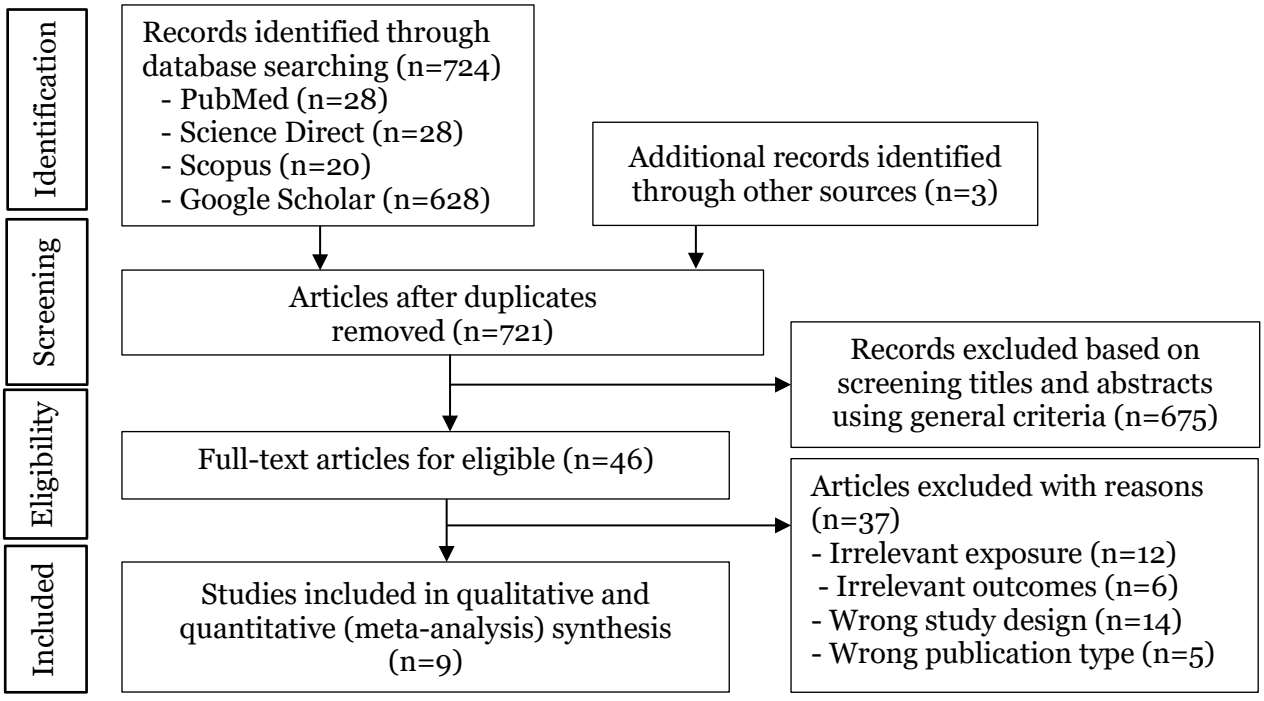

Figure 1. PRISMA 2020 flow diagram of the influence of environmental sanitation on the incidence of stunting

Included Studies

Table 1 describes the primary studies included in the meta-analysis. A total of nine article of included this study. Four studies were conducted in Asia, all of which from Indonesia. Five studies were conducted in Africa, all of which from the Ethiopia (Figure 2). A detailed description of the study characteristics, including the PICO, is summarized in Table 1. Critical appraisal uses the Joanna Briggs Institute (JBI) Critical Appraisal Tools for Use in JBI Systematic Reviews, Checklist for Analytical Cross-sectional Study (Table 2).

Figure 2. Map of the study area of the influence of environmental sanitation on the incidence of stunting

Table 2. Risk of bias assessed by the Joanna Briggs Institute (JBI) Critical Appraisal Tools for Use in JBI Systematic Reviews, Checklist for Analytical Cross-sectional Study

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	%Yes
Prasetyo and Susanna (2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Cameron et al. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Rah et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Ademas et al. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Toma et al. (2023)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Soboksa et al. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Kwami et al. (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Torlesse et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100
Woldesenbet et al. (2023)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100

Q1: Were the criteria for inclusion in the sample clearly defined?; Q2: Were the study subjects and the setting described in detail?; Q3: Was the exposure measured in a valid and reliable way?; Q4: Were objective, standard criteria used for measurement of the condition?; 5: Were confounding factors identified?; Q6: Were strategies to deal with confounding factors stated?; Q7: Were the outcomes measured in a valid and reliable way?; and Q8: Was appropriate statistical analysis used?

Table 1. Summary results of primary studies of the influence of environmental sanitation on the incidence of stunting

Name (Year)	Country	Study Design; Journal Name	Findings	Strengths	Weakness
Prasetyo and Susanna (2025)	Indonesia	- Desain: Cross-sectional - Internation al Journal of Advance-ment in Life Sciences Research	- Private latrine ownership (p = 0.004; OR = 5.068) and child age 49-60 months (p = 0.011; OR = 1.528) were the most influential factors contributing to stunting. - Handwashing practices, water quality, socioeco-nomic status, and family smoking behavior were sig-nificantly associated in bivariate analysis.	- Uses bivariate and multivariate analysis (logistic regression). - Includes various individual and family factors. - Based on relevant and recent field data from 2024.	- Cross-sectional design cannot prove causality - Sample taken using consecutive sampling, which has the potential for representative bias. - Several important variables like gene-tics and long-term environmental factors were not analyzed. - Reliance on self-reported data for smoking behavior.
Cameron et al. (2021)	Indonesia	- Desain: Cross-sectional - Economics and Human Biology	Good sanitation access at birth (0-2 years) reduced stunting risk by 4-5%. Communities practicing open defecation (BABS) reduced stunting risk by 12-15%.	- Representative national panel data. - Strong controls, multivariate analysis, and environmental confounding factors were analyzed.	- Did not measure specific hygiene practices like hand-washing. - Limited control over environmental confounding factors despite strong controls.
Rah et al. (2020)	Indonesia	- Desain: Cross-sectional - Maternal & Child Nutrition	Access to improved sanitation facilities reduced the likelihood of stunting by 20%. A link was found between sanitation and anemia.	- Uses representative survey data from a UNICEF-EU program. - Strong controls for many confounding factors.	- Observational study, so it cannot conclude causal relationships. - Important data, such as maternal nutritional status, was not available.
Ademas et al. (2021)	Ethiopia	- Desain: Community -based Cross-sectional Study - Italian Journal of Pediatrics	- Stunting prevalence: 35.6%. - Associated factors: illiterate parents, single mothers, large family, short mothers, unimproved water/ sanitation/ hygiene, recent diarrhea, specific feeding methods, no deworming, and ANC visits.	- Community-based with direct observation for WASH variables. - Multivariable analysis used.	- Cross-sectional design (no causality) - Potential for recall bias.
Toma et al. (2023)	Ethiopia	- Community -based	- Prevalence of stunting was 59.97%	- Uses robust	- Cross-sectional design cannot

Name (Year)	Country	Study Design; Journal Name	Findings	Strengths	Weakness
		Cross-sectional - BMC Nutrition	and wasting 9.1%. - Wasting risk factors: large family size, low economic status, poor knowledge, diarrhea, not exclusively breast-feeding, birth inter-val 24 months. - Stunting risk factors: older child age, not exclusively breastfeeding, birth interval 24 months, low dietary diversity score, not a PSNP participant, and low food security.	multivariate logis-tic regression analysis. - First-hand data collected from the field. - Covers many social-economic and environmental determinants.	establish causality - Potential for recall bias in mothers' reports regarding feeding practices and child illnesses.
Soboksa et al. (2021)	Ethiopia	- Desain: Cross-Sectional based community - Environmen tal Challenges	- 80% of CLTS kebeles and 58.7% of non-CLTS kebeles practiced safe child feces disposal - Positive associated factors: middle/rich wealth status, living with a diarrhea-prone child, having a toilet without handwashing facility. - Negative associated factors: unimproved latrine form, elevated drinking water container location.	- Uses secondary data-from a comprehen-sive household survey (756 households) - Identifies relevant socio-economic and-infrastructural factors.	Cross-sectional design does not prove causality. - Risk of social desirability bias in reporting. - Limitations of secondary data (incomplete variables).
Kwami et al. (2019)	Ethiopia	- Desain: Cross-sectional Study - Inter-national Journal of Environmen tal Research and Public Health	- A significant asso-ciation was found between stunting and drinking water source, mother and child handwashing practices, and child's sex - WASH factors explained 7% of the variation in stunting.	- Large sample size (3200 households, 2400 children). - Contextual data from four repre-sentative regions of Ethiopia. - Uses an integrated approach (WASH and nutrition). - Valid anthropometric tools and WHO standards used.	- Did not include baseline data. - Potential for report-ing bias in behavior. - Socio-economic, emission, and education factors were not analyzed in depth. - Collinearity between socio-economic and other variables was not fully controlled.

Name (Year)	Country	Study Design; Journal Name	Findings	Strengths	Weakness
Torlesse et al. (2016)	Indonesia	- Desain: Cross-sectional survey of 1366 children aged 0-23 months in 3 districts (MYCNSIA 2011 baseline data) - BMC Public Health	- The combination of unimproved sanitation and untreated drinking water increased stunting risk by 3.47 times. Children from poor families, males, and older children (12-23 months) had a higher risk.	- Uses representative data from several regions. - Multivariate approach considering important interactions between variables (sanitation and water treatment).	- Cross-sectional study (cannot prove causality). - Some important variables were not analyzed.
Woldesenbet et al. (2023)	Ethiopia	- Desain: Community based cross-sectional study - BMC Nutrition	- Stunting prevalence was 33.5%. - Stunting was associated with child's age, uneducated mothers, unimproved toilets, unsafe child feces disposal, and mothers not washing hands before feeding children	- Community-based study with a high response rate (92.2%). - Random sampling, leading to more generalizable results	- Did not cover factors related to food availability and accessibility. - Cross-sectional design cannot prove causality.

DISCUSSION

Several studies, such as Torlesse et al. (2016) and Kwami et al. (2019), found a significant association between stunting and a combination of unimproved latrines and untreated drinking water. Similarly, Woldesenbet et al. (2023) reported that living near unimproved toilets and unsafe child feces disposal were risk factors for stunting. This indicates that not only the availability of sanitation facilities but also their quality and safe use are crucial. Furthermore, personal hygiene practices like mothers' handwashing before feeding children were also strongly associated with stunting.

Socioeconomic factors also emerged as important determinants. Lower wealth quintiles, lower maternal education, and larger family sizes were frequently identified as risk factors for stunting and wasting. Interestingly, the study by Soboksa et al. (2021) showed that middle/rich wealth status and living with a diarrhea-prone child had a higher likelihood of practicing safe child feces disposal. This might indicate a higher awareness or capability in these groups, or a "shock effect" from the experience of child illness.

The studies in this table, predominantly cross-sectional in design, consistently find an association between poor sanitation and hygiene and the prevalence of stunting in young children. This finding aligns with global evidence affirming that exposure to unhygienic environments and enteric pathogens via the fecal-oral transmission pathway is a significant contributor to environmental enteric dysfunction (EED), which in turn inhibits nutrient absorption and leads to stunting (Checkley et al., 2017; Humphrey, 2009).

The study by Torlesse et al. (2016) specifically highlights the interaction between unimproved latrines and untreated drinking water as a strong risk factor for stunting. This concept of interaction is supported by other research emphasizing the importance of an integrated WASH approach, rather than focusing solely on one component. For instance, a systematic review by Cumming and Cairncross (2016) concluded that comprehensive WASH interventions, encompassing clean water, adequate sanitation, and hygiene promotion, showed a greater impact on nutritional outcomes compared to single interventions. This suggests that sanitation improvement efforts must be accompanied by improved water quality and hygiene practices for maximum effectiveness.

Most of these studies employ a cross-sectional design. The primary strength of this design is its ability to collect data from a large and representative sample of the population at a single point in time, allowing for the identification of prevalence and associations between variables. These studies often utilize robust bivariate and multivariate analyses to control for confounding factors and identify significant predictors. Some even used national or community-based survey data, enhancing the generalizability of the findings.

However, the main limitation of cross-sectional designs is their inability to establish cause-and-effect relationships or causality. This means that while there is a strong association between WASH and stunting, we cannot definitively state that poor WASH causes stunting based solely on these studies. Other common limitations include the potential for reporting bias or recall bias, especially for questions related to hygiene practices or illness history. Some studies also acknowledge that they did not cover all important variables that might influence stunting, such as genetic factors, birth weight/length, or more in-depth nutritional aspects. Furthermore, reliance on secondary data or non-random sampling can also limit the representativeness and generalizability of findings. Nevertheless, the findings from these studies are valuable for formulating hypotheses and informing public health policies and interventions.

AUTHOR CONTRIBUTION

Conceptualization, methodology, data curation, formal analysis, project administration, and article writing up: Sunik Cahyawati. Visualization and Review, editing article writing up: Eka Riana

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Not applicable.

CONFLICT OF INTEREST

None.

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