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Identification of Sanitation and Hygiene Risk Factors on the Incidence of Stunting in Indonesia: A Scoping Review

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Abstract
Stunting is a critical public health challenge in Indonesia, where over 30% of children under five are affected. This scoping review aims to identify sanitation and hygiene (WASH) risk factors associated with stunting prevalence in Indonesia over the past decade. Using the Joanna Briggs Institute methodology and PRISMA-ScR guidelines, relevant studies were systematically identified, analyzed, and synthesized. Findings reveal a strong link between stunting and inadequate WASH conditions, including limited access to clean water, poor sanitation infrastructure, and inconsistent hygiene practices like handwashing with soap. Key challenges include the prevalence of open defecation, improper waste management, and reliance on unimproved water sources, particularly in low-income households. These conditions contribute to chronic diarrhea and environmental contamination, exacerbating stunting risks. Women are pivotal in mitigating these risks through improved hygiene, nutrition, and parenting practices. To combat stunting effectively, targeted interventions should focus on expanding access to clean water, enhancing sanitation infrastructure, and fostering behavioral changes in hygiene practices. Community-based programs and policies emphasizing women's education and empowerment, alongside integrated WASH initiatives, are crucial for sustainable reductions in stunting prevalence and promoting child health in Indonesia.

Keywords: Hygiene, sanitation, stunting.

1. Introduction

Stunting is a significant public health issue worldwide (Leroy & Frongillo, 2019; Mezmur, Tefera, Roba, & Başdaş, 2024; Supadmi et al., 2024). According to the Global Health Observatory data from the World Health Organization (WHO), 22.3% of children under five experienced stunting in 2022 (Sihotang et al., 2023). Indonesia ranks fourth globally for the highest stunting prevalence, as reported by the Ministry of Health in 2018, with 30.8% of children under five years old—equivalent to more than eight million children—affected by stunting (Soekatri, Sandjaja, & Syauqy, 2020; Yuliastini, Sudiarti, & Sartika, 2020).

Stunting is impaired growth and development in children due to inadequate nutrition, recurrent infections, and lack of psychosocial stimulation (Adiwinoto,

Umijati, Graciela, Rahmadita, & Putra, 2024; Nurjazuli, Budiyono, Raharjo, & Wahyuningsih, 2023; Scheffler et al., 2020). A child is classified as stunted if their height is more than two standard deviations below the median of the WHO Child Growth Standards (de Onis & Branca, 2016; Quamme & Iversen, 2022). The effects of stunting are both short- and long-term (de Onis & Branca, 2016; Saleh, Syahrul, Hadju, Andriani, & Restika, 2021), including increased morbidity and mortality (Soliman et al., 2021), impaired physical growth (Dewey & Begum, 2011), reduced cognitive capacity (Amoadu et al., 2024), diminished learning ability (Woldehanna, Behrman, & Araya, 2017), a higher likelihood of infections and noncommunicable diseases in adulthood, and decreased productivity and economic potential (Dewey & Begum, 2011).

Sanitation and hygiene are critical in preventing diseases that contribute to stunting (Badriyah & Syafiq, 2017), such as enteric infections (Batool et al., 2023), malaria (Millward, 2017), respiratory infections, and inflammation-related appetite loss (Rah, Sukotjo, Badgaiyan, Cronin, & Torlesse, 2020). Poor sanitation and hygiene conditions, both at the household and community levels, are frequently found in areas with high stunting prevalence (Batool et al., 2023; Irawati, 2023; Kwami, Godfrey, Gavilan, Lakhanpaul, & Parikh, 2019). This underscores the urgent need to understand how these factors contribute to stunting, particularly in Indonesia, which bears a significant burden (Titaley, Ariawan, Hapsari, Muasyaroh, & Dibley, 2019).

Over the past decade, various studies have explored the relationship between sanitation, hygiene, and stunting in children and adults (Cumming & Cairncross, 2016; Das et al., 2021; Waller, Lakhanpaul, Godfrey, & Parikh, 2020). However, these studies often yield fragmented findings, highlighting the need for a comprehensive effort to synthesize and evaluate the associated risk factors. This information is crucial for supporting stunting prevention efforts through improvements in sanitation and hygiene.

This study aims to identify sanitation and hygiene risk factors contributing to the prevalence of stunting in Indonesia. Using a scoping review approach, the research will compile and analyze findings from studies conducted over the past ten years. The outcomes are expected to provide a clear understanding of the relationship between sanitation, hygiene, and stunting, serving as a foundation for formulating more effective policies to reduce stunting prevalence in Indonesia.

2. Method

This study employs a scoping review methodology to systematically identify and map sanitation and hygiene risk factors associated with stunting prevalence in Indonesia over the past decade. A scoping review followed a framework guided by Arskey and O'Malley and further developed by Levac et al. and Joanna Briggs

Institute methodology for scoping reviews. We conducted the following five major steps: (1) identifying the research questions, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results. The selection procedures for the studies were performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) guidelines.

Table 1. Steps and Tools Used in the Scoping Review Methodology

Steps	Description	Tools/Guidelines Used
Identifying the Research Questions	Formulating the main research question: "What are the risk factors of sanitation and hygiene on the incidence of stunting in Indonesia during the last ten years?"	
Identifying Relevant Studies	Conducting a literature search using two databases (CINAHL and Scopus) with Boolean operators: “stunting” AND “sanitation” OR “hygiene”.	CINAHL, Scopus
Study Selection	Two-stage review process: (1) Title and abstract screening, (2) Full-text evaluation by two independent reviewers. Discrepancies resolved through discussion.	Zotero, PRISMA-ScR Guidelines
Charting the Data	Extracting and organizing data on population, concept, context, methodologies, and key findings using a data extraction tool.	Draft charting table developed by reviewers for consistency assessment.
Collating, Summarizing, and Reporting the Results	Summarizing data into narrative descriptions and tabular forms to demonstrate identified outcomes.	Narrative and tabular representation

3. Results and Discussion

A total of 1.169 articles were identified through the database searches. 956 citations of English language articles between 2014 to 2023 were exported to Zotero reference manager and 200 duplicates were removed. Seventeen titles and abstracts matched the inclusion criteria, but three of them were not further processed because the full-text was missing. In the last process of study selection, reviewers decided fourteen studies to be reviewed and analyzed (Figure 1).

All selected studies were published between 2016 and 2023 (Table 1). Most of the included studies—twelve out of the fourteen—were quantitative research using data analysis, observational, cross-sectional, and case-control design methods. Other

articles were qualitative and mixed-method with an explanatory sequential design study.

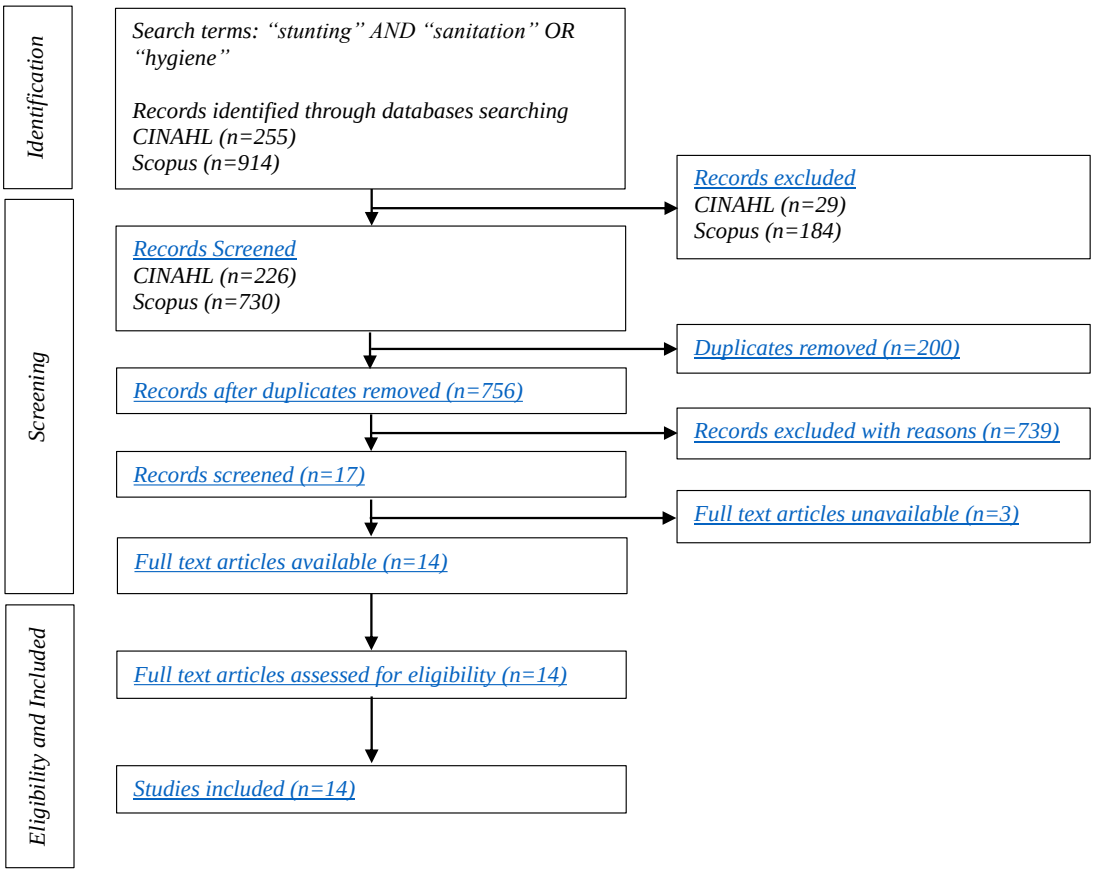

Figure 1. Article Selection Flow

Table 2. The Summary of Included Studies

Author (Year)	Aims	Methods	Sample	Outcomes
Ilham, Rahayuwati, Witdiawati, Pramukti, & Ramdhanie (2023)	To ascertain the relationship between the WASH practices at the stunting locus and demographic data.	A cross-sectional study	463 village residents in Sukamulya Village, Rancaekek District, and Bandung Regency, West Java Province.	49.2% respondents had poor WASH practices. Significantly, there was relationship between education and WASH practices (p=0.002).
Anismuslim, Pramoedyo, Andarini, (2023)	To investigate and map the impact of	An observational study	3.000 village residents in Malang	There was positive association

	spatially associated sanitation risk on the prevalence of stunting toddlers.		Regency, East Java Province.	between sanitation risk index with toddler stunting prevalence (R^2=0.41).
Kamila & Salami (2022)	To evaluate the correlation between clean water and sanitation accesses with stunting incidence.	A cross-sectional study	75 household residents in Bandung Regency, West Java Province.	Stunting incidence did not significantly correlate with availability to clean water and sanitary facilities.
Arini, Ernawati, Hayudanti, & Alristina (2022)	To identify the impact of hygiene sanitation during COVID-19 pandemic towards stunting prevalence.	A case control study	3.886 families in Surabaya City, East Java Province.	Significantly, clean water source, hand-washing habits, sewer access, healthy latrine, and waste management affected the prevalence of stunting (p=0.001; p=0.000; p=0.007; p=0.001; and p=0.001 respectively).
Yenita, Thamrin, Amin, & Agrina (2021)	To determine effect of stunting risk factors towards the incidence of stunting.	A mixed method with an explanatory sequential design study	People living in the Kampar Watershed, West Sumatera Province.	Significantly, home sanitation affected the stunting incidence (p=0,049).
Cameron et al. (2021)	To evaluate the correlation between poor household and community water and sanitation	A data analysis study	Over 6.000 children in the IFLS.	There was impact of household access to improved sanitation, household open

	services and childhood stunting.			defecates, household access to improved water source, and community open defecation free rate towards childhood stunting.
Ainy, Susanto, & Susumaningrum (2021)	To ascertain the association between family and stunting's environmental sanitation among under five children.	A cross-sectional study	393 families in Jember District, East Java Province.	Significantly, there was association between environmental sanitation and stunting among under five children ($p<0.001$).
Saputri, Anggraeni, Sujadmi, & Sopamena (2020)	To identify the women's role stunting alleviation interventions.	A qualitative study	Women in productive, reproductive, and social manner.	Women in productive, reproductive, and social manner had a very strategic and decisive roles towards environmental sanitation and the occurrence of stunting.
Rah et al. (2020)	To investigate the relationship between improved sanitation and stunting in 6-35 months of age children.	A data analysis study	1.450 children in Jayawijaya District (Papua Province), Klaten District (Central Java Province), Sikka District (East Nusa	Compared to children living in a household with inadequate sanitation, children in improved sanitation households had

			Tenggara Province).	a 29% lower risk of stunting.
Hasanah et al. (2020)	To evaluate the WASH and individual factors on the stunting prevalence.	A case control study	150 children in Ambon City, Maluku Province.	WASH was a risk factor for stunting.
Fithra & Siska (2020)	To determine the effect of environmental sanitation towards nutritional status in stunting condition.	A cross-sectional study	90 residents in Pidie District, Aceh Province.	There was associated between environmental sanitation mapping with the nutritional status of under five children.
Ahmadi, Sulistyorini, Azizah, & Oktarizal (2020)	To investigate the correlation between handwashing habits and toilet availability with the stunting incidence of young children.	A cross-sectional study	82 children in Tanjung Pinang City, Riau Islands Province.	Significantly, there was correlation between stunting with handwashing habits and the availability of toilet (p=0.013 and p=0.016 respectively).
Irianti, Prasetyoputra, Dharmayanti, Azhar, & Hidayangsih (2019)	To ascertain environmental factors that identify stunting among under five children.	A data analysis study	2.571 children in the IFLS5.	Inadequate rubbish collection and an unimproved source of drinking water were associated with a higher risk of child stunting.
Torlesse, Cronin, Sebayang, & Nandy (2016)	To assess the stunting-associated factors indicating a prominent role of WASH	A cross-sectional study	1.366 children in Jayawijaya District (Papua Province), Klaten District	Significantly, there was interaction between household sanitary facility and household

	sector in stunting alleviation.	(Central Java Province), Sikka District (East Nusa Tenggara Province).	water treatment (p=0.007). The adjusted odds of child stunting were more than three times greater if children lived in families who drank untreated water and used an unimproved latrine (p<0,001).

Note: WASH: water, sanitation, and hygiene; the IFLS: the Indonesian Family Life Survey

Sumatera, Riau, Java, Nusa Tenggara, Maluku, and Papua were among the Indonesian islands where researchers gathered data for their investigations. Data were collected by completing surveys, conducting interviews, and observing toddlers, under-five children, schoolers, and adults living there.

Table 3. Themes grouping

Parameters	Outcomes
Water source	Quantity
	Quality (Escherichia coli, Total Coliform, pH, temperature, dissolved oxygen, turbidity)
	Continuity
Sanitation	Sewer
	Puddle
	Solid waste
	Wastewater
Hygiene	Clean and healthy lifestyle
	Hand washing with soap
Women's roles	Reproductive
	Productive
	Social

In this scoping review, we identified four themes based on the data extraction from fourteen selected studies in Tables 1 and 2. These topics include (1) the risk factors of water source on the incidence of stunting, (2) the risk factors of sanitation on the incidence of stunting, (3) the risk factors of hygiene on the incidence of stunting, and (4) women's role in the incidwomen's stunting and environmental sanitation."

3.1 The Risk Factors of Water Source on the Incidence of Stunting

The provision of clean water in Indonesia is constitutionally guaranteed under Article 33 of the 1945 Constitution, which asserts that "land, water, and natural resources shall be controlled by the state and utilized for the optimal welfare of the people" (The Constitution of The State of the Republic of Indonesia, 1945). Consequently, central, and regional governments are responsible for ensuring access to clean water as a fundamental public service (Masnun, Noviyanti, Santoso, Wedhatami, & Abiyoga, 2024).

Access to clean water significantly contributes to public health and improved living standards (Armah et al., 2018; Hutton & Chase, 2017). Reliable drinking, cooking, and sanitation water sources can reduce water-related diseases and overall morbidity. However, as of 2018, only 62.75% of the lowest-income households had access to sustainable drinking water sources. Additionally, studies indicate that clean water sources, such as dug wells, are often situated close to final waste disposals, violating the recommended minimum distance of ten meters (Anismuslim et al., 2023; Yenita et al., 2021).

The association between access to clean water and stunting prevalence is well-documented. Research by Kamila & Salami (2022) reported that only 4.1% to 42.7% of participants in their study had access to piped drinking water. Furthermore, 90.91% of the 33 clean water sources examined failed to meet sanitation and hygiene standards, with several indicators, including pH and turbidity, exceeding acceptable limits. Most samples contained contaminants such as Total Coliform and Escherichia coli, with agricultural areas exhibiting higher turbidity and coliform contamination levels.

While Rah et al. (2020) found no direct correlation between drinking water sources and stunting, other studies revealed contrasting findings. Logistic regression analysis by Arini et al. (2022) demonstrated that clean water access significantly affected stunting incidence ($p = 0.001$), showing that children with clean water were less likely to experience stunting. Similarly, Soeracmad (2019) estimated that improved drinking water access could prevent 21.58% of stunting cases in rural areas. Cameron et al. (2021) also highlighted a statistically significant relationship between improved household water access and Height-for-Age z-scores.

Moreover, Yenita et al. (2021) observed that among 141 children with stunting, those consuming contaminated water frequently suffered from diarrhea. Prolonged diarrhea, caused by fecal contamination, led to intestinal mucosa damage, impairing nutrient absorption, and ultimately resulting in malnutrition. These findings underscore the critical role of clean water sources in preventing stunting and improving child health outcomes.

3.2 The Risk Factors of Sanitation on the Incidence of Stunting

This scoping review highlights a significant correlation between stunting and poor household as well as environmental sanitation (Ahmadi et al., 2020; Ainy et al., 2021; Arini et al., 2022; Cameron et al., 2021; Torlesse et al., 2016; Yenita et al., 2021). Children under five from households with substandard environmental cleanliness were 0.254 times more likely to experience stunting (Ainy et al., 2021). Furthermore, 73.8% of 141 stunted children lived in homes with sanitation systems that did not meet regulatory standards (Yenita et al., 2021). Similarly, another study confirmed that children residing in areas lacking waste management systems, healthy latrines, and proper sewage infrastructure were at greater risk of stunting (Arini et al., 2022).

A study conducted in Malang Regency by Anismuslim et al. (2023) found a positive, though statistically insignificant, correlation between the sanitation risk index and the prevalence of stunting. The study suggested that higher sanitation risk index values increased the likelihood of stunting, with wastewater, solid waste, and stagnant water identified as the most critical factors. Participants predominantly used inadequate wastewater systems characterized by clogged and unhygienic open drains due to the absence of proper treatment facilities.

Poor solid waste management practices—such as burning, open dumping, and disposal into rivers or vacant land—posed a significant pollution risk (Anismuslim et al., 2023). These practices increased the proliferation of fly vectors in garbage piles, potentially escalating the spread of pathogens that cause diarrhea, intestinal worms, and other digestive infections. Such conditions further exacerbate growth abnormalities, including stunting, as flies carry harmful bacteria from contaminated areas to human food sources (Gaugler, 2016). Chronic infections resulting from these conditions, such as recurrent diarrhea, can severely hinder children's physical development (Cumming & Cairncross, 2016; Headey & Palloni, 2019; Kwami et al., 2019).

Open defecation was also shown to influence stunting rates significantly. Through non-parametric regression analysis, Cameron et al. (2021) demonstrated that communities practicing open defecation had higher stunting rates. Conversely, as open defecation practices decreased, children's cognitive scores improved, particularly those aged 7 and older. This finding aligns with Ahmadi et al. (2020), who reported that 95.8% of stunted children lacked access to hygienic toilets. Poorly constructed latrines often directly discharged fecal contaminants into surrounding soil and water sources, contributing to persistent diarrhea and subsequent stunting.

Moreover, untreated drinking water and unimproved latrines were strongly associated with stunting in Indonesia (Torlesse et al., 2016). Households consuming

untreated water and using unimproved toilets had an over threefold increase in the odds of their children experiencing stunting. These findings underscore the critical need for improved sanitation infrastructure and hygiene practices to mitigate stunting risks.

3.3 The Risk Factors of Hygiene on the Incidence of Stunting

Hygiene is defined as the consistent or inconsistent practice of maintaining personal cleanliness, encompassing activities such as handwashing with soap, bathing, avoiding actions like sneezing or coughing on others, cleaning contaminated surfaces, proper waste disposal, and using appropriate personal protective equipment (Arini et al., 2022; Kamila & Salami, 2022). Studies indicate that a majority of children under two years of age diagnosed with stunting belong to the high-risk hygiene category (Hasanah et al., 2020).

Research by (Kamila & Salami, 2022) highlights a potential relationship between poor hygiene practices and an increased risk of stunting and waterborne illnesses. Children who occasionally washed their hands with soap were found to have a 1.1 times higher risk of waterborne infections and a 1.4 times higher risk of stunting compared to those who practiced handwashing consistently. These findings are corroborated by Arini et al. (2022) and Torlesse et al. (2016), who reported a significant association between handwashing with soap and reduced stunting risk. Regular handwashing with soap reduces the likelihood of diarrhea, negatively affecting nutrient absorption. Further, Ahmadi et al. (2020) demonstrated that 80% of children aged 24–59 months who consistently practiced handwashing with soap exhibited normal growth patterns.

3.4 The Role of Women in Stunting Incidence and Environmental Sanitation

Women play a pivotal role in mitigating stunting risks through improved sanitation practices, as highlighted by Saputri et al. (2020). Women's contributions can be categorized into productive, reproductive, and societal. Productive women are typically employed outside the home, reproductive women focus on household responsibilities, and societal roles involve participating in community training and seminars on stunting prevention.

Reproductive roles are particularly significant in stunting prevention, involving parenting, providing psychosocial stimulation for children, maintaining the home's cleanliness, preparing nutritious meals, and utilizing healthcare services (Saputri et al., 2020). To enhance their effectiveness, women must acquire knowledge and awareness about optimal feeding practices, the importance of hygiene and sanitation, effective parenting techniques, and the utilization of healthcare resources. Moreover,

understanding the value of psychosocial stimulation is crucial for preventing stunting in children.

4. Conclusion

The results of this scoping review reflect that stunting in Indonesia is closely linked to water, sanitation, and hygiene (WASH) factors, as well as the pivotal role of women in mitigating these risks. Access to clean water, proper sanitation infrastructure, and consistent hygiene practices like handwashing with soap significantly reduce stunting prevalence. However, poor management of waste, open defecation, and using unimproved water sources remain prevalent challenges, especially in low-income households. Additionally, inadequate hygiene practices and chronic diarrhea due to contaminated environments further exacerbate the risk of stunting. Women contribute significantly to stunting prevention through their roles in families and communities by promoting better hygiene, nutrition, and parenting practices.

To address these challenges, efforts should focus on expanding access to clean water, improving waste and sanitation infrastructure, and promoting behavioral changes toward consistent hygiene practices. Educational programs targeting women as key change agents should emphasize the importance of optimal nutrition, cleanliness, and healthcare services. Policy interventions should prioritize community-based sanitation programs, eliminating open defecation, and establishing comprehensive WASH systems to ensure sustainable improvements in child health outcomes.

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