

## THE INFLUENCE OF ACCESS TO CLEAN WATER AND PROPER SANITATION ON THE PREVALENCE OF STUNTING AMONG CHILDREN UNDER FIVE IN INDONESIA

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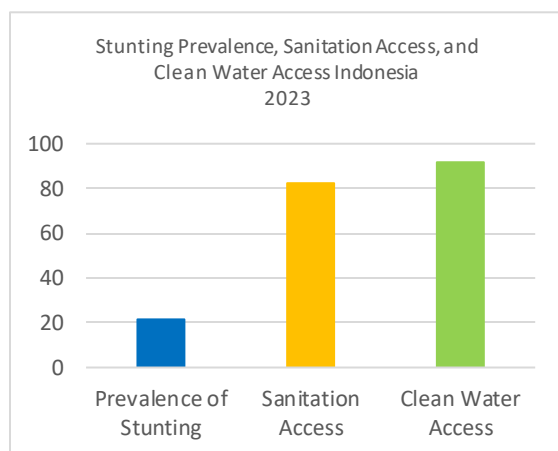
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### Abstract

The prevalence of stunting in children under five is still a serious challenge in public health development in Indonesia. This condition is not only related to nutrition, but also closely related to environmental aspects, such as the availability of clean water and proper sanitation. This study aims to analyze the effect of access to clean water and sanitation facilities on the prevalence of stunting among children under five at the provincial level in Indonesia. The data used is secondary data from the Indonesian Demographic and Health Survey (IDHS) in 2023 with a cross-sectional approach. The analytical method used was multiple linear regression to determine the simultaneous relationship between the two environmental variables on the level of stunting. The results showed that access to proper sanitation had a significant negative relationship with stunting prevalence, while access to clean water did not show a statistically significant effect. Nonetheless, in theory, both still play an important role in creating a healthy environment for child development. Therefore, improving infrastructure, sanitation and water quality assurance are crucial strategies in reducing the national stunting rate.

## INTRODUCTION

Stunting in children under five remains a significant public health problem in Indonesia. This condition is characterized by children's height growth that is below the standard for their age, reflecting chronic growth disorders due to long-term malnutrition, recurrent infections, and unfavorable environmental conditions such as inadequate sanitation and limited access to clean water (Kwami et al., 2019). Data from the Indonesian Nutrition Status Survey (SSGI) in 2023 showed that the national stunting prevalence reached 21.5%. Although this figure has decreased compared to previous years, it still exceeds the threshold recommended by the World Health Organization (WHO), which is 20%. Various factors influence the high stunting rate, including the quality and availability of basic services such as access to safe drinking water and adequate sanitation (Rizaldi et al., 2025).



*Source: Central Bureau of Statistics*

The distribution of clean water access in Indonesia is uneven, especially in rural and underdeveloped areas, where people still rely on water sources that do not meet health standards (Patunru, 2015). According to data from the Central Statistics Agency (BPS) and the Ministry of Public Works and Housing (PUPR) by 2023, around 91% of Indonesia's population will have access to safe drinking water, but the percentage of people who

have access to safe drinking water according to WHO standards is still lower. In addition, access to adequate sanitation facilities remains a challenge, although access achievements have improved in the past decade. There are still millions of people who do not have standard sanitation facilities, such as hand washing stations, healthy latrines and proper sewage systems.

These deficiencies in clean water and sanitation increase the risk of infections such as diarrhea and worms, which indirectly interfere with nutrient absorption and contribute to stunting in children (Cumming & Cairncross, 2016). This study aims to assess the impact of access to clean water and proper sanitation on the prevalence of under-five stunting in Indonesia by examining the cause-and-effect relationship between the two. In addition, this study will also assess the effectiveness of various government policies such as the Community-Based Water Supply and Sanitation Program (PAMSIMAS), the National Strategy for the Acceleration of Stunting Prevention, as well as integrated interventions carried out through cross-sectoral synergies by Bappenas and the Ministry of Health.

## LITERATURE REVIEW

### 1. Overview of Stunting in Indonesia

Stunting or failure to thrive in children under five due to chronic malnutrition is a serious public health problem in Indonesia. Based on the Indonesian Nutrition Status Survey (SSGI), the prevalence of stunting among children under five reached 24.4% in 2021 and decreased to 21.6% in 2022 (Ernawati et al., 2024). This decrease shows an improvement, but the figure is still above the maximum threshold set by WHO, which is 20%, and has not met the national target of 14% by 2024 (Azriani et al., 2024). Regions such as East Nusa Tenggara even reported prevalence above 35%, indicating significant interprovincial

disparities.

## **2. Factors Causing Stunting: A Multidimensional Perspective**

Stunting reflects chronic linear growth impairment caused by prolonged malnutrition, exposure to infections, and unhealthy environmental conditions (Mulyaningsih et al., 2021). As one of the main indicators of chronic childhood malnutrition, stunting is a national and global concern. Handling stunting requires an understanding of the various causal factors that are multidimensional in nature. One factor that has been highlighted in various studies is access to clean water and proper sanitation (Kwami et al., 2019).

## **3. The Role of Access to Clean Water and Proper Sanitation in Preventing Stunting**

Access to clean water and adequate sanitation facilities plays an important role in preventing infections and maintaining children's nutritional status. When children are frequently exposed to diseases such as diarrhea due to unsanitary environments, nutrient absorption is impaired, which in the long run contributes to stunting. In a study conducted by Children, it was found that 61.6% of households in the study area did not have access to proper sanitation, and only 31.2% had access to good drinking water (Yunitasari et al., 2022). This finding reinforces the notion that unequal access to water and sanitation facilities contributes to worsening the nutritional status of children under five in Indonesia.

## **4. Long-term Impact of Stunting on Human Capital Quality**

The phenomenon of stunting not only impacts a child's height, but also affects cognitive development, future economic productivity, and increases the risk of chronic diseases in adulthood (Beal et al., 2018).

Therefore, stunting is not just an issue of physical growth, but concerns the long-term quality of human resources. One of the indirect determinants that contribute to stunting is environmental conditions, including access to clean water and proper sanitation (Tanjung et al., 2024).

## **5. Inequality in Access to Water and Sanitation between Regions in Indonesia**

In Indonesia, the phenomenon of high stunting rates shows a correlation with the low quality of sanitation and limited access to clean water. Based on a report from the International Journal of Environmental Research and Public Health (2022), national coverage of access to safe drinking water has reached 92%, and basic sanitation coverage is 86%. However, there are still significant disparities between the western and eastern regions of Indonesia, especially in rural areas and small islands where basic infrastructure is inadequate (Satriani et al., 2022). This disparity indicates that the national average does not reflect equitable development, and is potentially a risk factor that exacerbates the prevalence of stunting in disadvantaged areas.

## **6. Empirical Evidence: Studies Demonstrating the Link between Environment and Stunting**

An underlying issue that contributes to the high stunting rate in Indonesia is the low access to safe drinking water and proper sanitation facilities, especially in geographically and infrastructurally underdeveloped areas. This creates an unhealthy environment and increases children's exposure to infectious diseases. According to a study in the E3S Web of Conferences, 56% of malnutrition cases are directly related to lack of access to safe water and adequate sanitation. Children living in homes without proper sanitation were found to have a 0.645 times higher risk of

stunting compared to children living in homes with proper sanitation (Hasanah & Susanti, 2018).

Similar findings were also conveyed by (Fajriyati et al. 2021) in the *Journal of Health Promotion and Behavior*, which states that open defecation practices and poor household waste management are significantly associated with stunting. These two studies show that while nutritional factors remain important, environmental determinants such as clean water and proper sanitation cannot be ignored in the comprehensive handling of stunting.

## 7. Theoretical Approaches in Explaining Stunting

Theoretically, the problem of stunting can be explained through the Social Determinants of Health approach, which emphasizes that individual health status is strongly influenced by environmental conditions, including the availability of clean water and proper sanitation. Meanwhile, Bronfenbrenner's Ecological Theory views stunting as the result of interactions between children and their surrounding environment, which includes aspects such as basic infrastructure and community behavior.

Empirically, a number of studies support the link between environmental conditions and stunting prevalence. Findings in the *Journal of Public Health and Development* show that sanitation risks, such as sewerage, domestic waste management and exposure to dirty water, spatially influence stunting rates (Anismuslim et al., 2023). However, a study in the *International Journal of Environmental Research and Public Health* noted that while WASH (Water, Sanitation, and Hygiene) campaigns have been scaled up, implementation on the ground still shows significant gaps (Hanson et al., 2020).

Findings from BMC Nutrition also

show that children living around inadequate latrines have a 1.7 times greater risk of stunting than those living in neighborhoods with adequate sanitation (Woldesenbet et al., 2023). Other studies in *Svāsthya and Maternal & Child Nutrition* also confirm that poor sanitation and polluted water contribute significantly to stunting (Cumming & Cairncross, 2016).

## 8. Literature Gaps and Urgency of Integrative Research

While a number of studies have demonstrated the relationship between access to sanitation and clean water and stunting incidence, research gaps are still evident. To date, there are not many studies that integrate spatial analysis between the two main environmental determinants - access to clean water and proper sanitation - and stunting rates comprehensively at the national level. Most previous studies were sectoral, focused on one aspect of the environment only, or limited to a particular study area. The novelty of this study lies in the integrative approach to these two variables in a national scope, so as to provide a more complete picture of the combined influence of environmental factors on stunting among children under five in Indonesia (Heni, Ayu Idaningsih, Arni Wianti, 2025).

## 9. Research Contribution and Relevance to SDGs and Public Policy

In response to this gap, this study offers a novelty by integrating two key environmental variables-access to clean water and proper sanitation-into one analytical framework to evaluate their influence on under-five stunting rates in Indonesia. Unlike previous studies that tend to be sectoral and geographically limited, this study uses a national data-driven approach to generate a more comprehensive and representative understanding.

The contribution of this study lies in providing empirical evidence based on national macro data that supports

focused intervention policies on the provision of clean water and proper sanitation infrastructure as a strategy to reduce under-five stunting. This research is also relevant to support the achievement of Sustainable Development Goal (SDG) 6 on access to clean water and sanitation for all, as well as SDG 2 on ending hunger and all forms of malnutrition.

In addition, the findings from this study can serve as a reference in the formulation of cross-sectoral strategies between the Ministry of Health, Bappenas, and local governments. Empirical support for the urgency of this intervention is provided by findings in *Advances in Health Sciences Research* and *PLOS ONE*, which reveal that water quality and open defecation practices significantly increase the risk of stunting (Salsabila et al., 2023). Meanwhile, a study in the *International Journal of Health and Pharmaceutical* states that good sanitation is 16 times more likely to prevent stunting than poor sanitation (Bulan Nasution et al., 2022).

## METHODOLOGY

### 1. Nature of Data

This research uses quantitative and cross-sectional secondary data, focusing on Indonesia in 2023. The main source of data is the Central Bureau of Statistics (BPS). The data used in this study includes three main variables: Under-five stunting rate, percentage of households with access to clean water, and percentage of households with access to proper sanitation.

### 2. Sampling

#### a. Target Population

33 provinces in Indonesia that have complete data on stunting rates, access to clean water and proper sanitation.

#### b. Research Context

The context of this research is the field of human development, especially in the aspect of early childhood health, which is represented by the stunting rate of children under five as the main indicator.

### c. Unit of Analysis

The unit of analysis in this study is the province, with a total of 33 provinces for which complete data is available.

### d. Sample

The sample in this study was taken by total sampling, namely provinces in Indonesia that have complete data related to the variables studied. There are 33 provinces whose data are available at the Central Bureau of Statistics (BPS) for 2023.

### e. Data Collection

Data were obtained from the official BPS portal (<https://bps.go.id>), all collected for the year 2023 and processed in a cross-section tabulation format.

### f. Measurement Method

All variables were measured in percentages (%), in accordance with the operational definitions of BPS. Details of the operational definitions are presented in the following table:

| Variabel                          | Sym<br>bol | Operational<br>Definition                                  | Data<br>Source | Unit |
|-----------------------------------|------------|------------------------------------------------------------|----------------|------|
| Prevalence of under-five stunting | Y          | Percentage of under-fives who are stunted in each province | BPS 2023       | %    |

|                             |    |                                                                                                  |          |   |
|-----------------------------|----|--------------------------------------------------------------------------------------------------|----------|---|
| Access to clean water       | X1 | Percentage of households with access to drinking water sources that meet the proper requirements | BPS 2023 | % |
| Access to proper sanitation | X2 | Percentage of households with access to sanitation facilities that meet the proper criteria      | BPS 2023 | % |

#### g. Justification of Analysis Method Selection

The multiple linear regression method was used because all variables are quantitative and this study aims to determine the direction and strength of the relationship between basic services (access to clean water and proper sanitation) and the prevalence of stunting among children under five. Linear regression allows estimation of the effect of each independent variable simultaneously on the dependent variable, as well as testing its significance.

#### h. Data Analysis Technique

The data was processed using Multiple Linear Regression analysis, the analysis was carried out using Stata software. The regression model is formulated as follows:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

Keterangan:

- $Y$  : Prevalence of stunting among children under five (in percent)
- $X_1$  : Percentage of households with access to clean water
- $X_2$  : Percentage of households with access to proper sanitation
- $a$  : Constant
- $\beta_1, \beta_2$  : Regression coefficient
- $\varepsilon$  : Error term

Assumption test is done through:

- Multicollinearity test (VIF),
- Residual normality test,
- Heteroscedasticity test (Breusch-Pagan).

Significance Test:

- F test (simultaneous significance of the model)
- T test (significance of each independent variable).

Coefficient of Determination ( $R^2$ ) to measure how much variation in  $Y$  is explained by the model.

The model is considered valid if it meets the classical assumptions and all regression coefficients are significant at the 5% significance level ( $\alpha = 0.05$ ), and all regression assumptions are met. The results of this analysis are expected to provide an empirical picture of the relationship between access to basic services (clean water and sanitation) and the health conditions of children under five, especially in the context of stunting prevalence.

## RESULT AND DISCUSSION

## RESULT

| <i>Regression Statistics</i> |             |
|------------------------------|-------------|
| Multiple R                   | 0.487791806 |
| R Square                     | 0.237940846 |
| Adjusted R Square            | 0.15910714  |
| Standard Error               | 5.539890938 |
| Observations                 | 33          |

|            | <i>d</i><br><i>f</i> | <i>SS</i>   | <i>MS</i> | <i>F</i>    | <i>Significance F</i> |
|------------|----------------------|-------------|-----------|-------------|-----------------------|
| Regression | 2                    | 223.7672048 | 111.8836  | 3.555061232 | 0.041155986           |
| Residual   | 30                   | 944.1491589 | 31.47164  |             |                       |
| Total      | 32                   | 1167.916364 |           |             |                       |

|                  | <i>Coefficient</i> | <i>Standard Error</i> | <i>t Stat</i> | <i>P-value</i> | <i>Lower 95%</i> | <i>Upper 95%</i> |
|------------------|--------------------|-----------------------|---------------|----------------|------------------|------------------|
| Intercept        | 41.07390823        | 11.51399557           | 3.567303      | 0.001234518    | 17.55919221      | 64.58862426      |
| Akses Sanitasi   | -0.312518282       | 0.131216276           | -2.3817       | 0.023776237*   | -0.580497669     | -0.044538895     |
| Akses Air Bersih | 0.080937876        | 0.160823598           | 0.503271      | 0.618448995    | -0.247507729     | 0.409383481      |

Based on the results of multiple linear regression analysis, it is known that the model built has a coefficient of determination (R-squared) value of 0.1916. This means that the independent variables, namely access to proper sanitation and access to clean water, together are able to explain about 19.16% of the variation that occurs in the prevalence of stunting. The F-test results show a significance value of 0.0412 ( $p < 0.05$ ), which means that this regression model is statistically significant at the 95% confidence level. Thus, both independent variables simultaneously affect the prevalence of

stunting in the analyzed areas.

Partially, the access to proper sanitation variable shows a negative and significant effect on stunting prevalence with a coefficient value of -0.3125 and a p value of 0.0238 ( $p < 0.05$ ). This indicates that every 1% increase in the coverage of access to proper sanitation will reduce the prevalence of stunting by 0.31%, assuming other variables remain constant. This result is consistent with theory and previous findings that poor sanitation increases the risk of infection and nutritional disorders in children under five, which in turn impacts on child growth.

Meanwhile, the clean water access variable has a positive coefficient of 0.0809, but is not statistically significant ( $p = 0.6184$ ). Although theoretically access to clean water has an important role in reducing stunting, the results of this analysis show that this variable has no significant effect in the model. This may be due to the close relationship between access to clean water and access to sanitation ( $r = 0.6102$ ), so the influence of access to clean water may have been represented by the sanitation variable in the model.

## DISCUSSION

The finding that access to improved sanitation significantly reduces stunting is in line with previous studies and environmental epidemiology theory. Poor sanitation increases the risk of exposure to pathogens that cause gastrointestinal infections (such as diarrhea and worm infections), which impair nutrient absorption and exacerbate chronic malnutrition in children.

Previous studies in The Lancet Global Health have also shown that sanitation is a strong predictor of stunting in developing countries. UNICEF and WHO studies also show that poor sanitation practices (such as open defecation) are strongly

correlated with high rates of stunting.

However, the insignificant effect of access to clean water in this model suggests that clean water alone is not enough, or it is possible that measuring access to clean water at the aggregate level (province) does not adequately represent the quality and consistency of the water supply used by households. It may be that the water is considered “safe” by technical definition (e.g. from a well or PAM), but is not free from contamination or is used unhygienically. It is important to note that water quality and how it is used (not just access) must be considered in policy interventions.

### Access to Proper Sanitation

The regression results show that access to proper sanitation has a significant negative effect on stunting prevalence (coefficient -0.3125;  $p = 0.024$ ), meaning that the higher the coverage of proper sanitation, the lower the stunting rate. This finding is in line with many international studies. For example, (Rah et al., 2020) reported that children living in homes with proper sanitation had 29% lower odds of stunting (OR=0.68, 95% CI 0.48-0.96) than those without. Meta-analyses in several developing countries even confirmed that inadequate sanitation was consistently significantly associated with stunting in the majority of studies (72% of studies) (Mudadu Silva et al., 2023). In Indonesia, a national study (IFLS) found that lack of access to good sanitation increased the risk of stunting by 27% (OR=1.27, 95% CI 1.10-1.46) (Mulyaningsih et al., 2021).

The biological mechanism is related to the increase in infectious diseases in children due to poor sanitation. Poor sanitation can lead to transmission of enteric diseases such as diarrhea, cholera, dysentery or intestinal worm infections, which cumulatively impair nutrient absorption and bone growth in children. For

example, poor sanitation triggers recurrent infections (diarrhea and intestinal worms) so that nutrients are not absorbed optimally. The provision of proper toilet facilities and waste disposal is critical to breaking this cycle of transmission: the provision of clean water and sanitation has been shown to “play an important role in reducing stunting because it is closely related to the prevention of infectious diseases”. Field conditions in Indonesia support these findings: there are still around 19 million people practicing open defecation in 2020 (Yolanda et al., 2022), thus improving sanitation is a key intervention. The government also targets 90% coverage of improved sanitation in the RPJMN 2020-2024. Thus, the evidence from in-depth data and literature confirms that improved sanitation is key to reducing stunting in Indonesia (Rah et al., 2020).

### Clean Water Access

In contrast, access to clean water in this regression model has no significant effect on stunting (coefficient 0.0809;  $p = 0.618$ ). This means that there is no clear statistical correlation between clean water coverage and stunting prevalence. This finding was also observed in previous studies. (Rah et al., 2020) reported that household drinking water source was not significantly associated with child stunting. Similarly, the IFLS multilevel analysis found that not having access to clean water increased the odds of stunting by 36% (OR=1.36, 95% CI 0.98-1.89) but was not statistically significant.

The reasons for the insignificance of clean water access are likely to be multi-causal. Firstly, the coverage of clean water access in Indonesia is already very high - IFLS data shows more than 96% of households have access to at least a “clean” water source. With this very small variability, the effect of clean water is difficult to detect in the analysis. Secondly, the definition of

“clean water access” often only looks at the presence of a source (e.g. a protected well or piped water), but does not guarantee the quality of the water consumed. Many studies emphasize that even if a clean water channel is present, the water may still be contaminated with microbes or other contaminants if it is not further treated. For example, (Nizaruddin & Ilham, 2022) suggests that water quality be maintained by encouraging the practice of treating drinking water (e.g. boiling) before consumption. In other words, access to water sources is not enough - the need for water quality assurance is crucial.

In addition, other environmental factors can be more dominant in transmitting stunting. Poor environmental sanitation can contaminate water sources, so even without good management, households are still exposed to pathogens. In other words, families with access to clean water can still experience stunting if the surrounding environment is dirty. Therefore, while the provision of safe drinking water remains important, the findings of this regression indicate that improving sanitation (waste management) and daily hygiene behaviors are likely to have a more direct influence on improving children's nutritional status than simply improving water access alone (Mudadu Silva et al., 2023).

In a policy context, these results support global guidance that WASH (Water, Sanitation and Hygiene) interventions need to focus on environmental sanitation and hygiene. UNICEF and WHO also emphasize that “clean water, good sanitation and proper hygiene practices are critical to reducing stunting” and that sanitation improvements often show more consistent results in reducing stunting. Therefore, efforts to accelerate stunting reduction in Indonesia should focus on improving environmental sanitation (e.g. elimination of open defecation, construction of improved latrines,

CLTS interventions) along with improving drinking water safety (water quality and processing) (Nizaruddin & Ilham, 2022). That way, the synergistic effect of preventing childhood infections can be optimized and the potential for reducing stunting rates is greater.

## **Policy Implications and National Interventions**

The findings in this study provide strong empirical support that investment in the sanitation sector has a real and significant impact on reducing the prevalence of stunting in Indonesia. In the context of national policy, there are a number of strategic programs that have been designed and implemented to address this challenge. Two of the most relevant are the Community-Based Water Supply and Sanitation Program (PAMSIMAS) and the National Strategy for the Acceleration of Stunting Prevention (Stranas Stunting).

### **1. PAMSIMAS Program**

PAMSIMAS is a national priority program that began in 2008 as part of the Government of Indonesia's efforts to expand access to safe drinking water and proper sanitation in rural and peri-urban areas. The program adopts a community-based development approach, where the community is not only the beneficiary, but also actively involved in the planning, implementation, and maintenance of water supply and sanitation facilities.

By the end of 2023, PAMSIMAS has reached more than 27,000 villages across Indonesia. This coverage includes the provision of gravity-based drinking water facilities, shallow or deep groundwater drilling, construction of public toilets, to the promotion of behavior change such as handwashing with soap and

stopping open defecation practices. In the performance evaluation, PAMSIMAS was proven to not only improve physical access to water and sanitation, but also strengthen local institutional capacity and long-term program sustainability.

The impact on stunting is indirect but crucial. With the availability of proper sanitation and adequate clean water, the risk of environment-based diseases such as diarrhea and intestinal infections decreases, resulting in improved nutritional status of children. This is in line with the sensitive intervention framework for stunting reduction, which focuses on the underlying causes of stunting.

## **2. National Strategy for the Acceleration of Stunting Prevention (Stranas Stunting)**

Stranas Stunting is a national framework launched in 2018 and coordinated by Bappenas (National Development Planning Agency). The strategy builds on the principle of cross-sector convergence and emphasizes interventions during the first 1,000 days of life (HPK)-the golden period for child growth and development. Stranas distinguishes between two types of interventions:

- Specific interventions, which are directly related to the biological causes of stunting (such as exclusive breastfeeding, immunizations, nutritional supplements).
- Sensitive interventions, targeting structural and environmental determinants, including access to clean water, proper sanitation, health services, maternal education, and food security.

In the context of sanitation and drinking water, Stranas recognizes

that children living in environments with poor sanitation and limited access to clean water are at high risk of chronic gastrointestinal infections and impaired nutrient absorption. Therefore, efforts to improve sanitation and the provision of safe drinking water are prioritized in regional and village action plans, especially in priority stunting locations that have been determined by the government. Stranas Stunting encourages each priority district/city to:

- Develop an Integrated Intervention Activity Plan.
- Encourage local budget allocations that support WASH services.
- Integrating national programs such as PAMSIMAS into the village development system.
- Involving the Ministry of Health, Ministry of Villages, Ministry of PUPR, and Bappenas in a collaborative ecosystem.

More than a strategy document, Stranas Stunting is an integrated operational framework that places sanitation as a key instrument of human development. In an interim evaluation report by Bappenas (2022), provinces and districts that significantly reduced stunting had high levels of convergence of sanitation and nutrition programs at the village level.

## **CONCLUSION**

This study found that access to improved sanitation has a significant effect on reducing the prevalence of stunting among children under five in Indonesia, while access to clean water did not show a statistically significant effect. This finding indicates that environmental conditions, particularly sanitation, play a crucial role in

breaking the chain of infectious diseases that contribute to stunting. Access to clean water, while important in theory, does not always have a real impact if its quality and practical use are not guaranteed. These results suggest that policy interventions should prioritize building and increasing coverage of proper sanitation facilities, especially in areas with high stunting rates. National programs such as PAMSIMAS and Stranas Stunting need to focus more on environmental sanitation aspects and cross-sectoral integration. In addition, it is important to review the clean water access indicator to measure not only the availability of sources, but also the quality and safety of water consumption by households. A holistic approach that combines sanitation, water quality, and hygiene behavior education is key to accelerating the sustainable reduction of stunting in Indonesia.

## REFERENCE

- Addae, H. Y., Sulemana, M., Yakubu, T., Atosona, A., Tahiru, R., & Azupogo, F. (2024). Low birth weight, household socio-economic status, water and sanitation are associated with stunting and wasting among children aged 6–23 months: Results from a national survey in Ghana. *PLoS ONE*, 19(3 March). <https://doi.org/10.1371/journal.pone.0297698>
- 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(1), 1–11. <https://doi.org/10.1186/s13052-021-01128-y>
- Aji Primantoro, L. P. sari. (2024). Kebijakan Penanggulangan Penurunan Angka Stunting Di Indonesia. *Berajah Journal*, 4(2), 393–408.
- Amirul Dini, Elyasari, & Arsulfa. (2023). Temuan dari Survei Sosial Ekonomi Indonesia dan Survei Status Gizi Indonesia pada Faktor yang Mempengaruhi Prevalensi Stunting. *HIJP (Health Information: Jurnal Penelitian)*, 15(2), 1–13. <https://doi.org/10.36990/hijp.v15i2.902>
- Anismuslim, M., Pramoedyo, H., Andarini, S., & Sudarto. (2023). The effect of sanitation risk on toddler stunting incident with geographically weighted regression approach in Malang Regency, Indonesia. *Journal of Public Health and Development*, 1(1), 90–105. <https://doi.org/10.55131/jphd/2023/210107>
- Asmirin, Hasyim, H., Novrikasari, & Faisya, F. (2021). *Doi: 10.36729 abstrak. 6(Determinan, Stunting, Balita (24-59 Bulan))*, 16–33.
- Azriani, D., Masita, Qinthara, N. S., Yulita, I. N., Agustian, D., Zuhairini, Y., & Dhamayanti, M. (2024). Risk factors associated with stunting incidence in under five children in Southeast Asia: a scoping review. *Journal of Health, Population, and Nutrition*, 43(1), 174. <https://doi.org/10.1186/s41043-024-00656-7>
- Batool, M., Saleem, J., Zakar, R., Butt, M. S., 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(1), 1–7. <https://doi.org/10.1186/s12889-023-17135-z>
- Beal, T., Tumilowicz, A., Sutrisna, A., Izwardy, D., & Neufeld, L. M. (2018). A review of child stunting determinants in Indonesia. *Maternal and Child Nutrition*, 14(4), 1–10.

<https://doi.org/10.1111/mcn.12617>

Bulan Nasution, S., Endang Sofia S, Adi Rahmat, & Murni Sari. (2022). The Relationship Of Sanitation And Refill Water Quality With Stunting Events In The Work Area of Community Health Centers Titi Papan in Medan Deli District. *International Journal of Health and Pharmaceutical (IJHP)*, 2(1), 162–167.  
<https://doi.org/10.51601/ijhp.v2i1.26>

Cumming, O., & Cairncross, S. (2016). Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. *Maternal and Child Nutrition*, 12, 91–105.  
<https://doi.org/10.1111/mcn.12258>

Dariswan, D. T. N., & Nurika, G. (2024). Implementation of WASH (Water, Sanitation, and Hygiene) with Stunting Incidents in Puger District, Bondowoso Regency. *JURNAL KESEHATAN LINGKUNGAN: Jurnal Dan Aplikasi Teknik Kesehatan Lingkungan*, 21(1), 161–168.  
<https://doi.org/10.31964/jkl.v21i1.824>

Dearden, K. A., Schott, W., Crookston, B. T., Humphries, D. L., Penny, M. E., & Behrman, J. R. (2017). Children with access to improved sanitation but not improved water are at lower risk of stunting compared to children without access: a cohort study in Ethiopia, India, Peru, and Vietnam. *BMC Public Health*, 17(1), 1–19.  
<https://doi.org/10.1186/s12889-017-4033-1>

Dwi Wahyuni, S., Husnina, Z., Sulistyorini, L., & Azizah, R. (2024). Analysis of Sanitation and Diarrhea Factors with The Incidence of Stunting in Indonesia. *JURNAL KESEHATAN LINGKUNGAN: Jurnal Dan Aplikasi Teknik*

*Kesehatan Lingkungan*, 21(2), 303–316.  
<https://doi.org/10.31964/jkl.v21i2.664>

Ernawati, R., Nurjanah, M., & Wahyuni, T. (2024). The Correlation of Environmental Sanitation with Stunting Incidents in School-Age Children. *Indonesian Journal of Global Health Research*, 6(2), 553–564.

Fajriyati, A., Rany, N., Yunita, J., Dewi, O., & Leonita, E. (2021). The Relationship of Community-Based Total Sanitation with Stunting Incidences in Toddlers. *Journal of Health Promotion and Behavior*, 6(3), 224–232.  
<https://doi.org/10.26911/thejhp.2021.06.03.06>

Hanson, C., Allen, E., Fullmer, M., O'brien, R., Dearden, K., Garn, J., Rachmi, C. N., Glenn, J., West, J., Crookston, B., & Hall, P. (2020). A national communication campaign in Indonesia is associated with improved WASH-related knowledge and behaviors in Indonesian mothers. *International Journal of Environmental Research and Public Health*, 17(10), 1–10.  
<https://doi.org/10.3390/ijerph17103727>

Hasanah, I., & Susanti, H. (2018). Does water and sanitation effects on children's physical development? Evidence from Indonesia Family life Survey (IFLS) 2014. *E3S Web of Conferences*, 74.  
<https://doi.org/10.1051/e3sconf/20187409007>

Hendrayanti, S., & Sari, C. T. (2023). Potential Of Land and Building Transfer Tax ( BPHTB). *International Journal of Economics, Business and Accounting Research (IJEBAR)*, 7(4), 1365–1375.

Heni, Ayu Idaningsih, Arni Wianti, A. S. (2025). *Journal of Multidisciplinary*

- Science*. 2(1), 94–109. <https://doi.org/10.59631/multidiscience.v2i1.302>
- Hurint, M. T. N., Bintari, H., Yuliani, Y., Kurniasari, Y., Rahayu, H. K., & Aji, A. S. (2023). Sanitation and Family Environmental Health Status and Its Association With Stunting in Kulon Progo, Indonesia. *Journal of Global Nutrition*, 3(2), 267–278. <https://doi.org/10.53823/jgn.v3i2.65>
- Irianti, S., Prasetyoputra, P., Dharmayanti, I., Azhar, K., & Hidayangsih, P. S. (2019). The role of drinking water source, sanitation, and solid waste management in reducing childhood stunting in Indonesia. *IOP Conference Series: Earth and Environmental Science*, 344(1). <https://doi.org/10.1088/1755-1315/344/1/012009>
- Kementrian Kesehatan. (2016). *Profil Kesehatan*.
- Kuddus, M. A., Sunny, A. R., Sazzad, S. A., Hossain, M., Rahman, M., Mithun, M. H., Hasan, S. E., Ahmed, K. J., Zandonadi, R. P., Han, H., Ariza-Montes, A., Vega-Muñoz, A., & Raposo, A. (2022). Sense and Manner of WASH and Their Coalition With Disease and Nutritional Status of Under-five Children in Rural Bangladesh: A Cross-Sectional Study. *Frontiers in Public Health*, 10(May), 1–12. <https://doi.org/10.3389/fpubh.2022.890293>
- Kwami, C. S., 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(20). <https://doi.org/10.3390/ijerph16203793>
- Mudadu Silva, J. R., Vieira, L. L., Murta Abreu, A. R., de Souza Fernandes, E., Moreira, T. R., Dias da Costa, G., & Mitre Cotta, R. M. (2023). Water, sanitation, and hygiene vulnerability in child stunting in developing countries: a systematic review with meta-analysis. *Public Health*, 219(May), 117–123. <https://doi.org/10.1016/j.puhe.2023.03.024>
- Mulyaningsih, T., Mohanty, I., Widyaningsih, V., Gebremedhin, T. A., Miranti, R., & Wiyono, V. H. (2021). Beyond personal factors: Multilevel determinants of childhood stunting in Indonesia. *PLoS ONE*, 16(11 November), 1–19. <https://doi.org/10.1371/journal.pone.0260265>
- Munthe, S. N., Silalahi, R. M., Pertiwi, K. C., Permanasari, V. Y., & Andriani, H. (2024). Kajian Literatur: Pengaruh Konsumsi Air Bersih Terhadap Stunting Pada Anak yang Berasal dari Keluarga Berpendapatan Rendah. *MAHESA: Malahayati Health Student Journal*, 4(2), 566–580. <https://doi.org/10.33024/mahesa.v4i2.13301>
- Nasyidah, M., Fajar, N. A., & Najmah, N. (2023). Tinjauan Faktor Air dan Sanitasi dengan Kejadian Stunting pada Balita. *Jurnal Kesehatan Komunitas*, 8(3), 597–606. <https://doi.org/10.25311/keskom.vo18.iss3.1338>
- Ningsih, D. F., Ikhtiar, M., & Baharuddin, A. (2021). Community-Led Total Sanitation (CTLS) to Prevent Stunting among Toddlers in Indonesia. *Journal of Aafiyah Health Research (JAHR) 2021*, 2(2), 22–32. <https://doi.org/10.52103/jahr.v2i2.706http://pascaumi.ac.id/index.php/jahr/index>
- Nizaruddin, N., & Ilham, M. I. (2022). The Effect of Sanitation on Stunting Prevalence in Indonesia. *Populasi*,

- 30(2),  
<https://doi.org/10.22146/jp.80186>
- Novianti, S., Huriyati, E., & Padmawati, R. S. (2023). Safe Drinking Water, Sanitation and Mother's Hygiene Practice as Stunting Risk Factors: A Case Control Study in a Rural Area of Ciawi Sub-district, Tasikmalaya District, West Java, Indonesia. *Ethiopian Journal of Health Sciences*, 33(6), 935–944. <https://doi.org/10.4314/ejhs.v33i6.3>
- Nurhidayati, V. A., & Riyadi, H. (2022). Quality of Water Sources, Sanitation, and Hygiene in Households with Stunted Children in Rural and Urban Areas in West Java. *Amerta Nutrition*, 6(1SP), 13–18. <https://doi.org/10.20473/amnt.v6i1sp.2022.13-18>
- Otsuka, Y., Agestika, L., Widyarani, Sintawardani, N., & Yamauchi, T. (2019). Risk factors for undernutrition and diarrhea prevalence in an urban slum in Indonesia: Focus on water, sanitation, and hygiene. *American Journal of Tropical Medicine and Hygiene*, 100(3), 727–732. <https://doi.org/10.4269/ajtmh.18-0063>
- Paramasatya, A., & Wulandari, R. A. (2023). Korelasi Akses Sanitasi Dan Akses Air Minum Dengan Kejadian Stunting Pada Balita Di Wilayah Kabupaten Serang Tahun 2022 Correlation of Access To Sanitation and Access To Drinking Water Stunting Incidence in Toddlers in the Region of Serang District in 202. *JAMBURA Journal Of Health Science and Research*, 463(December 2022), 695–706.
- Patunru, A. A. (2015). Access to safe drinking water and sanitation in Indonesia. *Asia and the Pacific Policy Studies*, 2(2), 234–244. <https://doi.org/10.1002/app5.81>
- Rah, J. H., Sukotjo, S., Badgaiyan, N., Cronin, A. A., & Torlesse, H. (2020). Improved sanitation is associated with reduced child stunting amongst Indonesian children under 3 years of age. *Maternal and Child Nutrition*, 16(S2), 1–8. <https://doi.org/10.1111/mcn.12741>
- Raharini, H., & Yuniarti, E. (2023). Relationship Between Water Quality and Stunting in Indonesia: Literature Review. *Jurnal Penelitian Pendidikan IPA*, 9(9), 664–670. <https://doi.org/10.29303/jppipa.v9i9.4513>
- Rahayuwati, L., Ibrahim, K., Hendrawati, S., Sari, C. W. M., Yani, D. I., Pertiwi, A. S. P., & Fauziyyah, R. N. P. (2022). Pencegahan Stunting melalui Air Bersih, Sanitasi, dan Nutrisi. *Warta LPM*, 25(3), 356–365. <https://doi.org/10.23917/warta.v25i3.1031>
- Rizaldi, M. A., Ali, K., Mega, S., Rara, H., Sri, B., & Panjaitan, R. (2025). Water , Sanitation and Hygiene ( WASH ) and its Association with Stunting in Developing Countries in Asia : A Systematic Review. 2(2).
- Sahiledengle, B., Petrucka, P., Kumie, A., Mwanri, L., Beressa, G., Atlaw, D., Tekalegn, Y., Zenbaba, D., Desta, F., & Agho, K. E. (2022). Association between water, sanitation and hygiene (WASH) and child undernutrition in Ethiopia: a hierarchical approach. *BMC Public Health*, 22(1), 1–20. <https://doi.org/10.1186/s12889-022-14309-z>
- Salsabila, A. M. R. A., Suhartono, & Nurjazuli. (2023). *Relationship Between Environmental Sanitation and Stunting Incidents in Toddlers in Work Area of Kendal II Public Health Center* (Issue ICoHPS). Atlantis Press International BV. [https://doi.org/10.2991/978-94-6463-324-5\\_53](https://doi.org/10.2991/978-94-6463-324-5_53)

- Sangalang, S. O., Lemence, A. L. G., Ottong, Z. J., Valencia, J. C., Olaguera, M., Canja, R. J. F., Mariano, S. M. F., Prado, N. O., Ocaña, R. M. Z., Singson, P. A. A., Cumagun, M. L., Liao, J., Anglo, M. V. J. C., Borgemeister, C., & Kistemann, T. (2022). School water, sanitation, and hygiene (WaSH) intervention to improve malnutrition, dehydration, health literacy, and handwashing: a cluster-randomised controlled trial in Metro Manila, Philippines. *BMC Public Health*, 22(1), 1–17. <https://doi.org/10.1186/s12889-022-14398-w>
- Satriani, S., Ilma, I. S., & Daniel, D. (2022). Trends of Water, Sanitation, and Hygiene (WASH) Research in Indonesia: A Systematic Review. *International Journal of Environmental Research and Public Health*, 19(3). <https://doi.org/10.3390/ijerph19031617>
- Soe, T. K., Laohasiriwong, W., Sornlorm, K., & Mahato, R. K. (2023). Safely managed sanitation practice and childhood stunting among under five years old children in Myanmar. *PLoS ONE*, 18(11 November), 1–14. <https://doi.org/10.1371/journal.pone.0290600>
- Soekatri, M. Y. E., Sandjaja, S., & Syauqy, A. (2020). Stunting was associated with reported morbidity, parental education and socioeconomic status in 0.5–12-year-old Indonesian children. *International Journal of Environmental Research and Public Health*, 17(17), 1–9. <https://doi.org/10.3390/ijerph17176204>
- Takele, K., Zewotir, T., & Ndanguza, D. (2019). Understanding correlates of child stunting in Ethiopia using generalized linear mixed models. *BMC Public Health*, 19(1), 1–8. <https://doi.org/10.1186/s12889-019-6984-x>
- Tanjung, R., Lestrina, D., & Sinaga, J. (2024). Spatial analysis of environmental sanitation and stunting incidents. *International Journal of Public Health Science (IJPHS)*, 13(4), 1968. <https://doi.org/10.11591/ijphs.v13i4.23442>
- Tirpude, S. C., & Warthe, V. (2025). *European Journal of Cardiovascular Medicine (EJCM) Association of Water, Sanitation, and Hygiene (WASH) Practices on Stunting in Children Aged 6 Months to Five Years at a Tertiary Health Care Centre*. 03, 8–11.
- Torlesse, H., Cronin, A. A., Sebayang, S. K., & 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(1), 1–11. <https://doi.org/10.1186/s12889-016-3339-8>
- Wiyono, S., Burhani, A., Harjatmo, T. P., Astuti, T., Zulfianto, N. A., . T., & Putri, M. S. (2018). The role sanitation to stunting children age 6-35 months, Purwojati subdistrict, Banyumas district, Central Java, Indonesia. *International Journal Of Community Medicine And Public Health*, 6(1), 82. <https://doi.org/10.18203/2394-6040.ijcmph20185231>
- 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(1), 1–9. <https://doi.org/10.1186/s40795-023-00677-1>

- Yolanda, K., B, S. K., & Hapsari, A. (2022). Literature Review: Predisposing, Enabling and Reinforcing Factors that Influence Community Open Defecation Behavior in Indonesia. In *Proceedings of the International Conference on Sports Science and Health (ICSSH 2022)*. Atlantis Press International BV. <https://doi.org/10.2991/978-94-6463-072-5>
- Yunitasari, E., Lee, B. O., Krisnana, I., Lugina, R., Solikhah, F.K., & Aditya, R. S. (2022). Determining the Factors That Influence Stunting during Pandemic in Rural Indonesia: A Mixed Method. *Children*, 9(8), 1–16. <https://doi.org/10.3390/children9081189>
- Yunitawati, D., Laksono, A. D., Khairunnisa, M., Purwoko, S., & Muis, E. W. (2025). *Education Role in Stunting Under Two Years among Poor Communities in Indonesia*. 20(1). <https://doi.org/10.14710/jpki.20.1.30-36>
- Zahtamal, Z., Restila, R., Sundari, S., & Palupi, R. (2024). the Influence of Environmental Sanitation on Stunting. *Jurnal Kesehatan Lingkungan*, 16(1), 59–67. <https://doi.org/10.20473/jkl.v16i1.2024.59-67>