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# The Relationship between Environmental Sanitation and the Incidence of Stunting in Toddlers

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**ABSTRACT**

Stunting remains a significant nutritional issue among children under five in various regions of Indonesia, including Beka Village, Marawola District, Sigi Regency. Stunting is influenced by several indirect factors, including environmental sanitation, clean water, healthy latrines, wastewater management (Household Wastewater Drainage System), waste management, and hygienic practices. This study aims to examine the relationship between environmental sanitation and stunting incidence among toddlers in Beka Village. This analytical research employs a case-control study design. The study variables include clean water sanitation, healthy latrines, Household Wastewater Drainage System, waste management, and stunting. Data were collected through questionnaires and KMS books, utilizing both primary and secondary sources. Univariate and bivariate analyses were performed using the chi-square test. The study population consisted of all 128 toddlers with stunting, with a sample size of 50 toddlers, including 25 cases and 25 controls. The results indicate a significant relationship between clean water availability (p = 0.020), healthy latrines (p = 0.010), Household Wastewater Drainage System (p = 0.020), and waste management (p = 0.046) with stunting incidence. In conclusion, this study finds a significant association between environmental sanitation factors and the occurrence of stunting in toddlers in Beka Village, Marawola District, Sigi Regency.

**Keywords:** Environmental, Sanitation, Stunting, Toddlers

## INTRODUCTION

Stunting is a chronic nutritional problem that seriously affects the growth and development of children worldwide. The *World Health Organisation* (WHO) notes that by 2020, around 149 million children under five will be stunted globally, with the majority of cases in Asia and Africa (WHO, 2021). In Indonesia, despite a decrease in prevalence, the stunting rate is still above the 20% threshold set by WHO as a public health standard. Based on the 2022 Indonesian Nutrition Status Survey (SSGI), the national stunting prevalence reached 21.6% (Indonesian Ministry of Health, 2022). This condition not only hinders physical growth, but also impacts cognitive development, human resource competitiveness, and economic productivity in the long run (Danaei et al., 2016).

Overcoming stunting is a national priority that requires an integrated multi-sectoral approach. (Vice President Secretariat, 2018). One important sector that contributes to stunting prevention is the environment and basic sanitation. Poor environmental sanitation has been shown to contribute to the incidence of stunting through the mechanisms of recurrent infections and impaired nutrient absorption. Factors such as access to clean water, availability of healthy latrines, sewerage systems, and household waste management play an important role in creating a favourable environment for children to grow. (UNICEF Indonesia, 2012). Not meeting these sanitation standards can lead to exposure to pathogens that cause diarrhoea, acute respiratory infections and helminthiasis, all of which contribute to impaired nutrition and growth (Basyariyah et al., 2022; Fibrianti et al., 2021). Recent studies have shown that children living in homes with poor sanitation are twice as likely to be stunted as children living in healthy neighbourhoods. (Ningsih et al., 2021; Zahtamal et al., 2024). Therefore, sanitation interventions should be an integral part of stunting prevention strategies, especially in areas with limited basic infrastructure. Data from the Health Profile of Central Sulawesi in 2023, shows that the coverage of access to proper sanitation and safe drinking water in several

districts is still below the national target(Central Sulawesi Health Office, 2023).

One of the regions that still faces major challenges in handling stunting is Sigi District, Central Sulawesi Province. Based on SSGI 2022 data, the prevalence of stunting in Sigi District reached 28.7%, higher than the national average (Indonesian Ministry of Health, 2022). Beka Village, located in Marawola Sub-district, is one of the priority villages for handling stunting because it has a high number of stunting patients. This area has geographical conditions that are difficult to reach and limited sanitation facilities, such as clean water and inadequate sewage systems. These limitations make the community vulnerable to exposure to an unhealthy environment, which in turn contributes to the high stunting cases in the area. Local characteristics such as access to water from the mountains without treatment, irregular waste disposal, and lack of environmental health education are real challenges that need special attention. Therefore, it is important to examine the specific environmental sanitation factors in this region.

While there have been several studies examining the relationship between sanitation and stunting in Indonesia, most were conducted at a generalised national or regional scale (Rahman et al., 2023). There are limited local studies that utilise a technical indicator-based approach to sanitation and direct measurement in the community, particularly in Sigi District. Previous studies tend not to explain in detail the relationship between specific indicators such as water quality, latrine type, Household Wastewater Drainage System feasibility, and household waste management systems with the incidence of stunting (Fibrianti et al., 2021; Mayasari et al., 2022). Therefore, there is still a knowledge gap on how environmental sanitation measurably contributes to stunting in the context of remote and underdeveloped villages. This research is needed to produce evidence-based policy recommendations and interventions that are appropriate and relevant to local community and environmental conditions.

Based on this background, this study aims to analyse the relationship between environmental sanitation conditions including access to clean water, ownership of healthy latrines, the presence of Household Wastewater Drainage System, and household waste management with the incidence of stunting in children under five in Beka Village, Marawola Sub-district, Sigi Regency. The results of this study are expected to provide a basis for strengthening sanitation interventions in community-based stunting prevention programmes, especially in areas with limited access to basic infrastructure.

## METHODS

This type of research is an observational analytic with a *case control study* design that aims to determine the relationship between environmental sanitation and the incidence of stunting in toddlers. This design was carried out by identifying case groups (stunted toddlers) and control groups (non-stunted toddlers), then continued with retrospective tracking to determine the history of environmental sanitation conditions owned by each respondent. This study was conducted on 17-31 July 2023 in Beka Village, Marawola Sub-district, Sigi Regency, Central Sulawesi Province. The population in this study were all toddlers who were stunted based on 2022 data, totalling 58 toddlers. The sample was 50 toddlers consisting of 25 cases and 25 controls. The sampling technique was carried out by purposive sampling with inclusion criteria, namely: toddlers aged 24-59 months, living in the Beka Village area for at least the last 1 year, and willing to become respondents. Exclusion criteria were children under five with congenital abnormalities that could affect growth and nutritional status. Proportional technique was used in dividing the sample size based on the distribution of hamlets. Environmental sanitation as the independent variable in this study was measured based on four technical indicators, namely: (1) availability of clean water, (2) ownership of healthy latrines, (3) household waste management, and (4) presence of sewerage (Household Wastewater Drainage System). Data were collected through observations and interviews using a questionnaire with a Guttman scale (yes/no answers) and looking at KMS books. The dependent variable was stunting status measured by height-for-age (TB/U) categorised using WHO standards. Data were analysed *univariately* to see the frequency distribution and percentage of each variable, and *bivariately* using the Chi-square test to see the relationship between environmental sanitation variables and the incidence of stunting. Statistical tests were conducted with a 95% confidence level and a significance value of $\alpha = 0.05$. Results were declared meaningful if the *p-value* $\leq 0.05$.

## RESULTS AND DISCUSSION

### Distribution of Environmental Sanitation Variables

Based on Table 1, most of the respondents have fulfilling environmental sanitation conditions, especially in the aspects of clean water (62%), healthy latrines (74%), and Household Wastewater Drainage System (62%), although waste management is still a problem with only 56% fulfilling the requirements. The results of this study show that access to basic sanitation facilities in the area is relatively good, but there are still gaps in the aspect of solid waste management. This condition is in line with previous research by Aprihatin et al. (2020) and Zahtamal et al. (2024) which shows that household waste management is one of the biggest challenges in rural sanitation. In addition, research by Ningsih et al. (2021) also found that although access to clean water and latrines is good, waste management is still a barrier in preventing stunting. This implies the need for special education and intervention programmes related to household waste management (Rahman et al., 2023). Local governments and public health workers need to increase counselling on the importance of proper waste management to the community, to prevent the spread of environmentally-based diseases such as diarrhoea and skin infections (Susanti et al., 2024).

**Table 1.** Frequency Distribution of Environmental Sanitation Variables

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Clean Water | Not Qualified | 19 | 38 |
| | Eligible | 31 | 62 |
| | Total | 50 | 100 |
| Healthy Latrines | Not Qualified | 13 | 26 |
| | Eligible | 37 | 74 |
| | Total | 50 | 100 |
| Household Wastewater Drainage System | Not Eligible | 19 | 38 |
| | Eligible | 31 | 62 |
| | Total | 50 | 100 |
| Waste Management | Not Eligible | 22 | 44 |
| | Eligible | 28 | 56 |
| | Total | 50 | 100 |

OR= Odds Ratio

**Relationship between Clean Water and the Incidence of Stunting**

The results of the analysis in Table 2, show that there is a significant relationship between the availability of clean water and the incidence of stunting in toddlers, with a p value = 0.02 (p < 0.05). Toddlers living in households without access to clean water had a stunting prevalence of 73.7%, much higher than the group with clean water at 35.5%. The *Odds Ratio of* 5.091 (95% CI: 1.446-17.922) indicates that children without clean water sanitation are five times more likely to be stunted. This result suggests that poor water sanitation contributes significantly to stunting. This interpretation is reinforced by field observations that most respondents still use water from open sources and do not go through the cooking process before consumption. Thus, water that does not meet health requirements becomes a pathway for disease transmission that affects children's nutritional status.

**Table 2.** Relationship between Clean Water Availability and Stunting Incidence

| Clean Water | Stunting | | Not stunted | | Total | | *p-value* | OR |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Not Eligible | 14 | 73.7 | 5 | 26.3 | 19 | 100 | 0.02 | 5.091 |
| Eligible | 11 | 35.5 | 20 | 64.5 | 31 | 100 | | |
| Total | 25 | 50.0 | 25 | 50.0 | 50 | 100 | | |

OR= *Odds Ratio*

This finding is in line with research by UNICEF Indonesia (2012) and Ningsih et al., 2021) showed that poor sanitation can cause infectious diseases such as diarrhoea, can damage the intestinal mucosa and interfere with nutrient absorption, which ultimately causes stunting in toddlers. Research from (Ministry of Health, 2015) also confirms that proper clean water must fulfil physical, construction, and sanitary requirements to prevent environment-based diseases. In addition, research by (Nisa et al., 2021; Oktarina & Sudiarti, 2014) also proved that children living in homes with unprotected water sources have a higher risk of stunting. Research by Zahtamal et al. (2024) found that the quality of drinking water and water sources for sanitation are the dominant factors causing stunting. On the other hand, the presence of stunting cases in groups with access to clean water indicates other factors, such as the socioeconomic conditions of families. Family income and low purchasing power can limit the ability to fulfil children's nutritional needs, even when clean water is available and contribute to stunting (Agustin & Rahmawati, 2021). Therefore, interventions to reduce stunting do not only focus on providing clean water facilities, but also include improving the knowledge and economic well-being of families.

**The Relationship between Latrines and the Incidence of Stunting**

The results shown in Table 3 indicate a significant association between ownership of a healthy latrine and the incidence of stunting in children under five, with a p value = 0.01 (p < 0.05). Toddlers from families without healthy latrines had a stunting prevalence of 84.6%, much higher than the 37.8% in the group with healthy latrines. *The Odds Ratio* (OR) of 9.036 (95% CI: 1.741-46.89) indicates that toddlers without healthy latrines have a nine times greater risk of being stunted. This finding suggests that poor latrine sanitation may be a major risk factor for chronic child malnutrition. The underlying mechanism is that exposure to faecal-contaminated environments increases the risk of infections, particularly diarrhoea and helminthiasis, which interfere with nutrient absorption. The accumulation of these disruptions results in impaired linear growth of children under five, which is clinically manifested as stunting.

**Table 3.** Relationship between healthy latrines and the incidence of stunting

| Healthy Latrines | Stunting | | Not stunted | | Total | | *p-value* | OR |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Not Eligible | 11 | 84.6 | 2 | 15.4 | 13 | 100 | 0.01 | 9.036 |
| Eligible | 14 | 37.8 | 23 | 62.2 | 37 | 100 | | |
| Total | 25 | 50.0 | 25 | 50.0 | 50 | 100 | | |

OR= *Odds Ratio*

The results of this study are supported by the literature that unhealthy latrines can be a medium for transmitting microorganisms such as bacteria, viruses and fungi through water, food, soil, and insects, thus increasing the risk of infectious diseases (Ministry of Health, 2015). Research Danaei et al. (2016) also noted that 7.2 million cases of stunting in the world are caused by poor sanitation, including the unavailability of healthy latrines. This research is in line with the study of Nasrul, (2019) and Sukmawati et al. (2021) which found a significant relationship between ownership of healthy latrines and the incidence of stunting in children under five. However, there are still cases of stunting among under-fives who have healthy latrines, which can be explained by other factors such as low socioeconomic conditions of the family. Economic factors affect children's nutritional adequacy through limited access to nutritious food and health services. Therefore, stunting prevention efforts must be carried out integratively by improving environmental sanitation while improving family welfare.

**Relationship between Household Wastewater Drainage System and the incidence of stunting**

The results showed that there was a significant relationship between the condition of Household Wastewater Drainage System and the incidence of stunting in toddlers, with a p value = 0.02 ($p < 0.05$). Of the 19 respondents who did not have an household wastewater drainage system that met the requirements, 73.7% of toddlers were stunted. Meanwhile, only 35.5% of the 31 respondents who had an household wastewater drainage system that met the requirements were stunted. The Odds Ratio (OR) value of 5.091 (95% CI: 1.446-17.922) indicates that children under five living in neighbourhoods without proper household wastewater drainage systems have a five times greater risk of being stunted. The high prevalence of stunting in the group without proper household wastewater drainage systems suggests that domestic wastewater management plays an important role in child health. Open, unsanitary, and muddy drains provide a breeding ground for disease vectors that increase exposure to infections in children under five. Repeated infections in toddlers due to poor sanitation can interfere with the absorption of nutrients, thus inhibiting physical growth (Ministry of Health, 2015).

**Table 4.** Relationship between Household Wastewater Drainage System and the incidence of stunting

| Household Wastewater Drainage System | Stunting | | Not stunted | | Total | | *p-value* | OR |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Not Eligible | 14 | 73.7 | 5 | 26.3 | 19 | 100 | 0.02 | 5.091 |
| Eligible | 11 | 35.5 | 20 | 65.5 | 31 | 100 | | |
| Total | 25 | 50.0 | 25 | 50.0 | 50 | 100 | | |

OR= *Odds Ratio*

Unqualified Household Wastewater Drainage Systems can contaminate clean water sources, cause odour, and become breeding grounds for pathogenic microorganisms and mosquito larvae. These conditions can increase the risk of infectious diseases such as diarrhoea and helminthiasis, which in the long run lead to impaired nutrient absorption in toddlers. When a child's body is constantly fighting infection, the energy that should be used for growth is instead used for healing, leading to impaired growth and development. In addition, wastewater that is not sanitised will pollute the environment and increase the chance of spreading worm eggs and pathogenic bacteria. According to Ministry of Health of the Republic of Indonesia (2022) and Ministry of Health (2015) According to the Ministry of Health (2015), a qualified Household Wastewater Drainage System must have a closed channel, smooth flow, and be at least 10 metres away from a clean water source. This shows that poor Household Wastewater Drainage System conditions can cause environmental health problems that have a direct impact on the incidence of stunting. This condition is supported by research Sukmawati, (2021) showed a significant relationship between Household Wastewater Drainage System and stunting. Similar research was also revealed by Ningsih, (2021) which found that unsafe Household Wastewater Drainage Systems were strongly associated with an increase in the prevalence of stunting among under-fives. Thus, the difficulty of access to wastewater disposal facilities is one of the indirect factors that cause stunting (Kanan et al., 2024; Purba et al., 2020).

The implications of these results suggest the importance of environmental sanitation interventions as part of stunting prevention efforts. Government and communities need to increase awareness and access to sanitary sewerage systems that meet health standards.

The provision of proper household wastewater drainage systems should be prioritised, especially in rural or low-sanitation areas. In addition, community education on the importance of maintaining a clean environment and the potential risk of infection from wastewater is also urgently needed. Toddlers who live in a healthy environment have a greater chance of growing and developing optimally. Good wastewater management is not just a matter of infrastructure, but an integral part of the strategy to prevent malnutrition and stunting. Improving sanitation must be done comprehensively and sustainably as part of a public health approach.

**Relationship between Waste Management and the Incidence of Stunting**

The results showed a significant relationship between waste management and the incidence of stunting in toddlers, with a p value = 0.046 (p < 0.05). Of the 22 respondents who did not have proper waste management, 68.2% had stunting. Meanwhile, of the 28 respondents who had proper waste management, only 35.7% were stunted. The Odds Ratio (OR) value of 3.857 (95% CI: 1.180-12.606) indicates that toddlers from families without proper waste management have almost 4 times higher risk of being stunted. This suggests that poor household waste management is closely associated with an increased risk of child development disorders. The existence of uncovered bins, infrequent cleaning, and indiscriminate waste disposal are major factors in the high incidence of stunting. These conditions open up opportunities for the breeding of flies, rats, and other disease vectors that can transmit infectious diseases to toddlers.

**Table 5.** Relationship between Waste Management and the Incidence of Stunting

| Waste Management | Stunting | | Not Stunting | | Total | | *p-value* | OR |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | |
| Not Eligible | 15 | 68,2 | 7 | 31,8 | 13 | 100 | 0.046 | 9.036 |
| Eligible | 10 | 35,7 | 18 | 64,3 | 37 | 100 | | |
| Total | 25 | 50,0 | 25 | 50,0 | 50 | 100 | | |

OR**=** *Odds Ratio*

Waste management that does not meet environmental health standards can create unhygienic conditions that increase the likelihood of toddlers being exposed to infectious diseases. Household waste that is allowed to accumulate or disposed of carelessly becomes a medium for bacteria, parasites, and disease vectors such as flies and mosquitoes to grow. Infections that are often experienced by toddlers due to unclean environments such as diarrhoea, helminthiasis, or ARI, can cause impaired absorption of nutrients which leads to stunting. Some toddlers who already have qualified waste management but still experience stunting, may be influenced by other factors such as low family economic levels. Economic factors affect the family's ability to fulfil children's nutritional needs optimally (Purnamasari & Safitri, 2024). According to Ministry of Health (2015), an eligible household rubbish bin should have a lid, be easy to clean, and be located away from eating or food storage areas. Recent research also supports that poor environmental sanitation increases the risk of chronic nutritional disorders in children (Hurint et al., 2023; Soeracmad et al., 2019). Thus, environmental sanitation conditions including waste management are indirect risk factors for stunting.

These results reinforce the urgency of raising community awareness about the importance of healthy and hygienic household waste management. Neighbourhood-based interventions should include the provision of closed bin facilities, education on household waste management, and regular supervision by environmental health officers. Local governments need to encourage the implementation of the 3R principles *(Reduce, Reuse, Recycle*) at the household level to reduce the negative impact of waste. In addition, the integration of sanitation programmes with nutrition interventions can be an effective approach in reducing the prevalence of stunting. Collaboration across sectors, including the health, environment and education sectors is essential in building healthy households. Changes in community behaviour in managing waste can be key to preventing infectious diseases and growth disorders in children under five. Therefore, waste management should be seen as an integral part of stunting prevention strategies at the community level.

**CONCLUSIONS**

From the results of this study it can be concluded that poor environmental sanitation significantly increases the risk of stunting in children under five. Family and community-based interventions are needed to improve access to clean water, use of healthy latrines, Household Wastewater Drainage System and proper waste management in vulnerable areas such as Beka Village.

**SUGGEST**

The community of Beka Village is expected to increase awareness of the importance of environmental sanitation by routinely maintaining house cleanliness, using clean water, healthy latrines, and managing waste properly. Puskesmas Marawola needs to strengthen environmental health education through regular counselling and home visits, in order to prevent stunting and improve the quality of life of children under five in the area.

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