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Access to Sanitation and Its Impact on Stunting in Toddlers in East Nusa Tenggara, Indonesia

Nia Junia Puteri[1], Laila Fitria[1]✉

[1]Department of Environmental Health, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

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Abstract

Background: Stunting is still one of the focuses of health problems in the world. Stunting is caused by many factors, including access to sanitation. Inadequate access to sanitation can cause infectious diseases that impair nutritional absorption in toddlers during digestion, leading to stunting. **Objective**: This study examines the connection between sanitation access and stunting in East Nusa Tenggara Province along with its confounding variables consisting of access to drinking water, toddler age, gender, and residence. **Method**: The study design was cross-sectional with a sample size of 4,224 children aged 0-59 months analyzed from the 2023 Indonesian Health Survey (IHS) data. Data were analyzed using univariate, bivariate (Chi-Square test), and multivariate (multiple logistic regression analyses with a risk factor model). **Results**: Studies showed households with inadequate sanitation access can increase the risk of stunting by 1.56 compared to those with adequate sanitation access. Other factors significantly associated with stunting included toddler age, gender, and residence. The problem of access to sanitation is related to residence and defecation behavior. **Conclusion**: Increasing indiscriminate defecation behavior can increase exposure to pathogens from feces which can cause diseases such as diarrhea, resulting in malnutrition and stunted growth. To reduce stunting in East Nusa Tenggara Province, the government is suggested to enhance programs to expand access to sanitation, especially in rural areas.

INTRODUCTION

Growth in children is a very important factor in increasing productivity in the future for both themselves and the country. However, there are still many children who experience growth disorders, one of which is stunting. Stunting is a growth disorder in children whose height is lower than that of children of the same age and sex or whose height is below -2 SD according to WHO standards (Bukari et al, 2022). Stunting occurs from the first day of life and begins to appear when the child is two years old due to malnutrition. Stunted children will increase morbidity and mortality in the short term and will have a less-than-optimal body posture in the long term, thus reducing productivity and work capacity (Soliman et al, 2021).

The problem of stunting is also still one of the focuses of health problems in the world. Even stunting is included in the SDGs' target 2.2, which aims to end all forms of malnutrition, including achieving internationally agreed targets on stunting and wasting in children under five by 2025. According to UNICEF, WHO, and the World Bank, the prevalence of toddlers experiencing stunting globally in 2022 is 22.3% or 148.1 million children. At the regional level, the Asian continent is in the third highest position for stunting in toddlers in 2022, with a prevalence of 21.3% or 76.6 million children. For the sub-regi-

✉ Correspondence Address:
E-mail: lfitria@ui.ac.id

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on, Southeast Asia is in second place, with a prevalence of stunting in toddlers in 2022 of 26.4% or 14.4 million children (Unicef, World Health Organization, and World Bank, 2023).

Meanwhile, in Indonesia, based on the results of the 2023 Indonesian Health Survey (IHS), the prevalence of stunting in toddlers was 21.5%. This figure has not been able to reach the government's target of the 2020-2024 RPJMN (Rencana Pembangunan Jangka Menengah Nasional, National Medium Term Development Plan), which targets a prevalence of stunting in 2024 of 14%. Of the 38 provinces in Indonesia, East Nusa Tenggara Province is the second highest province with the prevalence of stunting in toddlers, namely 37.9% (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia, 2023). This figure is considered high and exceeds the national prevalence rate.

Stunting can be caused by many factors, including environmental health factors. Environmental health factors, such as poor sanitation, inadequate waste disposal, lack of clean water, and soil floors in the home, are indirect causes of stunting (Bukari et al., 2022; Nurjazuli et al., 2023). Poor environmental health conditions can result in recurrent infections that hinder nutritional absorption in toddlers during digestion, leading to stunting. A study stated that toddlers with unhealthy sanitation are 6.261 times more likely to experience stunting than toddlers with healthy sanitation (Choirunnisa et al., 2020). In addition, the government has also included access to drinking water and sanitation in the national strategy to accelerate stunting reduction in Presidential Regulation of the Republic of Indonesia Number 72 of 2021 (Government of the Republic of Indonesia, 2021). This shows that access to sanitation plays an important role in stunting incidence.

Based on IHS 2023, in East Nusa Tenggara Province, 21.3% of households have inadequate access to sanitation, and there are still people who defecate both openly and closely, with a proportion of 6% (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia, 2023). An unhealthy environment causes children to have a high chance of being stunted. Poor sanitation is closely linked to careless defecation, increasing the likelihood of disease transmission through the fecal-oral route. This can cause various infectious diseases, so nutrition absorption in children is not optimal and will interfere with children's growth (Shrestha et al, 2020; Mahudeh et al, 2022).

Based on this, stunting in East Nusa Tenggara Province is still relatively high. It is a chronic health problem that various parties must consider because it will impact individuals and the country. In addition, access to sanitation in East Nusa Tenggara Province is also not fully adequate, even though access to sanitation can be a factor that causes stunting. Therefore, researchers hypothesize that there is a relationship between access to sanitation and the incidence of stunting in toddlers in East Nusa Tenggara Province. This study uses the latest data from the Indonesian Health Survey, which is a community-based health survey issued by the Health Development Policy Agency, Ministry of Health of Indonesia in collaboration with various parties so that the data is accurate and can represent health status from the national level to the regency/city level. In addition, this study also further analyzes the relationship between access to sanitation and its interfering variables consisting of access to drinking water, toddler age, toddler gender, and place of residence with the incidence of stunting, especially in East Nusa Tenggara Province. The findings of this study are anticipated to offer valuable insights and recommendations to the government for developing a stunting prevention program, particularly in East Nusa Tenggara Province.

METHOD

Study Design

This study has been reviewed by The Research and Ethics Committee of the Faculty of Public Health, Universitas Indonesia, with the Ethical Clearance Letter Number Ket-570/UN2.F10.D11/PPM.00.02/2024, September 12, 2024. The study design was cross-sectional. The data source was secondary data from the 2023 Indonesian Health Survey (IHS).

The population in this study was all households with children aged 0-59 months (toddlers) in East Nusa Tenggara Province, with a sample size of toddlers whose height was measured in East Nusa Tenggara Province based on the 2023 IHS data of 7,762 children aged 0-59 months. The sample criteria were selected based on households with toddlers aged 0–59 months. Incomplete data will be excluded from the analysis. After adjusting the completeness of the data between households and the number of toddlers and the process of deleting data due to missing data, the sample size analyzed was 4,224 children aged 0-59 months. The sample selection process is as follows.

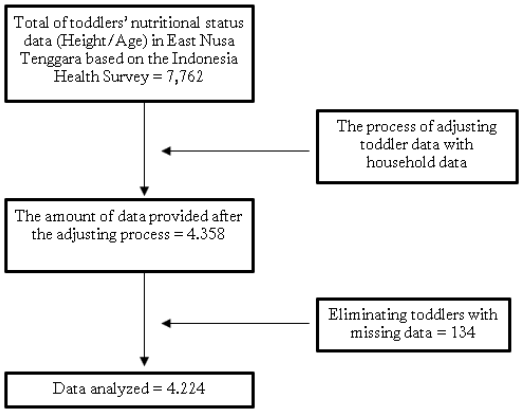

Figure 1. Sample selection process from the Indonesia Health Survey data

Data Processing and Analysis

The independent variable in this study was access to sanitation in East Nusa Tenggara Province. Access to sanitation was grouped based on ownership and behavior of toilet use, type of toilet used, and location of feces discharge. Access to sanitation was categorized as adequate if the household had a toilet (either private or shared) and was used using a toilet (upper building) with a gooseneck toilet and feces flow (lower building) using a wastewater treatment system/wastewater treatment installation, septic tank, or ground hole (specifically for rural areas) (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia, 2023; World Health Organization, 2024a). Meanwhile, the dependent variable was the incidence of stunting in East Nusa Tenggara Province with the height for age Z-score value calculation using the WHO Anthro application. The potential confounding variables in this study were other environmental health factors, namely access to drinking water and sociodemographic characteristics of toddlers consisting of toddler age, gender, and residence. Access to household drinking water was categorized based on the source used and was considered adequate if the household relied on drinking water from tap water/pipes, drilled wells/pumps, protected dug wells, protected springs, rainwater reservoirs, hydrants, or water terminals (World Health Organization, 2024b; Ministry of National Development Planning, 2021). Data were then analyzed using the IBM SPSS Statistic Version 22 application with complex samples analysis (analysis for non-SRS survey data using weighting) consisting of univariate analysis, bivariate with the Chi-Square test, and multivariate with multiple logistic regression test of the risk factor model.

RESULT AND DISCUSSION

The following is the frequency of toddlers studied based on access to sanitation, access to drinking water, age and gender, residence, and stunting. Based on Table 1, it is known that most toddlers are aged 24-59 months (63.3%), male (50.4%), live in rural areas (71.7%), have access to safe drinking water (67.9%), have access to adequate sanitation (79.1%), and do not experience stunting (67.1%).

Table 1. Distribution of Toddlers based on Access to Sanitation, Access to Drinking Water, Toddler Age and Gender, Residence, and Stunting (n = 4224)

Variables	n	%
Access to sanitation		
Not adequate	883	20.9
Adequate	3341	79.1
Access to drinking water		
Not adequate	1234	29.2
Adequate	2990	70.8
Age		
24-59 months	2685	63.6
0-23 months	1539	36.4
Gender		
Male	2129	50.4
Female	2095	49.6
Residence		
Rural	3029	71.7
Urban	1195	28.3
Stunting		
Yes	1391	32.9
No	2833	67.1

Based on the bivariate analysis in Table 2, four of the five variables are known to be significantly related to stunting in toddlers in East Nusa Tenggara Province, namely access to sanitation, toddler age, toddler gender, and place of residence. Inadequate sanitation access can increase the risk of stunting by 1.70 times greater than access to proper sanitation. Toddlers aged 24-59 months are at 1.81 times greater risk of stunting than toddlers aged 0-23 months. Then, male toddlers are at 1.42 times greater risk of stunting than female toddlers. Toddlers living in rural areas are at 2.11 times greater risk of stunting than toddlers living in urban areas.

Based on the final modeling in Table 3, sanitation access has a significant relationship with the incidence of stunting in toddlers in East Nusa Tenggara Province after being controlled by the residence variable. Households with inadequate

Table 2. Bivariate Analysis of Access to Sanitation, Access to Drinking Water, Toddler Age, Toddler Gender, and Residence with Stunting

Variable	Stunting				OR (95% CI)	p-value
	Yes		No			
	n	%	n	%		
Access to sanitation						
Not adequate	377	42.6	506	57.4	1.70 (1.43 – 2.03)	<0.001
Adequate	1015	30.4	2326	69.6		
Access to drinking water						
Not adequate	411	33.3	823	66.7	1.03 (0.87-1.21)	0.770
Adequate	980	32.8	2010	67.2		
Age						
24-59 months	1007	37.5	1678	62.5	1.81 (1.54 – 2.11)	<0.001
0-23 months	384	25.0	1155	75.0		
Gender						
Male	783	36.8	1346	63.2	1.42 (1.23 – 1.64)	<0.001
Female	608	29.0	1487	71.0		
Residence						
Rural	1129	37.3	1900	62.7	2.11 (1.69 – 2.64)	<0.001
Urban	262	22.0	933	78.0		

Table 3. Multivariate Analysis of Access to Sanitation, Access to Drinking Water, Toddler Age, Toddler Gender, and Residence with Stunting

Variable	$_{crude}$OR	First Model		$_{adj}$OR	Final Model	
		95% CI	p-value		95% CI	p-value
Access to sanitation	1.56	1.31 – 1.86	<0.001	1.56	1.31 – 1.85	<0.001
Access to drinking water	1.04	0.88 – 1.23	0.640	-	-	-
Age	1.85	1.58 – 2.17	<0.001	-	-	-
Gender	1.47	1.27 – 1.71	<0.001	-	-	-
Residence	2.04	1.63 – 2.55	<0.001	2.00	1.60 – 2.50	<0.001

sanitation access can increase the risk of stunting by 1.56 compared to those with adequate sanitation access. In the population, the risk is estimated to be 1.30 to 1.85 after being controlled by the residence variable.

Stunting is a common health problem in children but can reduce children's survival, educational attainment, and economic productivity as adults (Humphrey et al, 2019). The study reveals that the stunting prevalence among toddlers in East Nusa Tenggara is 32.9%. This figure remains considerably high, exceeding the national prevalence of 21.5%, according to the 2023 Indonesian Health Survey (IHS) (Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia, 2023). In addition, WHO stated that if stunting is over 20%, it can be considered a major public health problem (World Health Organization, 2024c). This means that the stunting problem in East Nusa Tenggara is a chronic problem that needs to be followed up.

Access to Sanitation and Stunting

Households with access to proper sanitation in East Nusa Tenggara Province in this study were 79.1%. This means there are still households with inadequate access to sanitation because there are still people who practice indiscriminate defecation or use inappropriate sanitation buildings, such as not using gooseneck toilets or feces that do not use waste disposal channels/waste treatment systems. The results of the bivariate analysis indicate a significant relationship between access to sanitation and the occurrence of stunting in toddlers in East Nusa Tenggara, with a risk of 1.70 greater. The multivariate analysis shows a significant association between access to sanitation and the incidence of stunting in toddlers in East Nusa Tenggara after being controlled by place of residence with a risk of 1.56. This

study aligns with research in Tasikmalaya that shows that toddlers with unhealthy sanitation are 6.26 times more likely to experience stunting than toddlers with healthy sanitation (Choirunnisa et al, 2020). Furthermore, a study in Bangladesh indicates that households without access to basic sanitation facilities are 1.12 times more likely to experience stunting (Hasan et al, 2023).

The problem of access to sanitation is related to residence and defecation behavior. Generally, access to sanitation in urban areas is better than in rural areas because it is related to infrastructure. The use of toilets in rural areas mostly uses shared toilets and is even more at risk of defecating in the open (Prakash et al, 2022). The increase in open-defecation behavior can increase exposure to pathogens from feces. Repeated exposure to fecal pathogens can cause absorption and loss of nutrients through diseases such as diarrhea, resulting in malnutrition and stunted growth (Mudadu et al, 2023). Additionally, inadequate sanitation and hygiene conditions at home lead to prolonged exposure to environmental pathogens, which can alter the morphology and function of the gut microbiota, contributing to stunted growth in children (Batool et al, 2023). If this continues for a long time, the potential for stunting will increase.

Access to Drinking Water and Stunting

In this study, households in East Nusa Tenggara Province have access to adequate drinking water of 70.8%. This means that there are still people who have access to unsafe drinking water, such as using unprotected drinking water sources. The results of both the bivariate and multivariate analyses show that access to drinking water is not significantly associated with the incidence of stunting in toddlers in East Nusa Tenggara. This study is in line with other studies, which state that access to drinking water has no relationship with the incidence of stunting (Lestari et al, 2023). In addition, another study found that access to clean drinking water has a negative, though partially insignificant, relationship with the incidence of stunting (Soliman et al, 2021). But, a study in Ethiopia found that the source of drinking water was associated with stunting rates in toddlers (Kwami et al, 2019).

In theory, inadequate access to drinking water is closely linked to water quality. Unprotected drinking water sources have a greater potential for contamination by various pathogens. Contamination of these sources is common and can serve as a potential source of diarrhea and gastroenteritis among children (Batool et al, 2023). Studies have found that better water sources alone do not provide comprehensive health benefits (Mudadu et al, 2023). Moreover, if the drinking water source used in the household is of poor quality or unsuitable, it can negatively impact the health of the family. Therefore, access to drinking water is an indirect factor in stunting.

Toddler Age and Stunting

Most toddlers studied in East Nusa Tenggara Province are aged 24-59 months, which is 63.6%. According to the results of the bivariate analysis, the age of toddlers is significantly associated with the incidence of stunting, with toddlers aged 24-59 months being 1.81 times more likely to experience stunting compared to those aged 0-23 months. This aligns with research conducted in Rwanda, it was stated that children aged 24-59 months are 6.34 times more likely to experience stunting (Nshimyiryo et al, 2019). In addition, another study found higher stunting prevalence among children until around 28 months (Karlsson et al, 2023). However, in the multivariate analysis, toddler age was not a confounding variable.

Toddler age is a risk factor related to the growth period (Noor et al, 2022). Toddlers aged 24-59 months have experienced lifestyle changes, such as changes in eating patterns from breast milk to solid foods, and generally have played an active role in choosing the food consumed, such as random snacks, without paying attention to the cleanliness and nutritional value of the food. At that age, toddlers are actively exploring their environment but have not yet developed an understanding of personal hygiene and healthy living habits. If food consumption and lifestyle are not properly monitored, the risk of stunting can be increased (Ratnayani et al, 2024; Wicaksono et al, 2021; Woldesenbet et al, 2021).

Gender and Stunting

Most of the toddlers in East Nusa Tenggara are male, 50.4%. The results of the bivariate analysis indicated a significant relationship between gender and the incidence of stunting., where male toddlers were at 1.42 times greater risk of experiencing stunting than female toddlers. This study is in line with other studies in Ethiopia, which stated that male children were more malnourished than female children (Samuel et al, 2022). In addition, research in Rwanda found that male toddlers are at 1.51 times higher risk than female toddlers (Nshimyiryo et al, 2019). However, in multivariate analysis, toddler gender was not a confounding variable.

The nutritional needs of boys and girls are very different. Muscle tissue composition in boys is greater than fat tissue, which is inversely proportional to that of girls. Muscle tissue is more active than fat tissue, requiring greater intake. In addition, boys have more active and predominantly physical activities, such as playing outside the house, which makes them more susceptible to exposure to dirty environments (Thompson, 2022). If it is not balanced with sufficient food intake and an unhealthy environment, boys will be more susceptible to stunting than girls.

Residence and Stunting

Based on the analysis, toddlers live more in rural areas with 71.7%. The bivariate results show a significant relationship between place of residence and the incidence of stunting, with toddlers living in rural areas being 2.11 times more at risk for stunting compared to those in urban areas. In the multivariate analysis, place of residence becomes a confounding variable. This study's results align with a study by Siramaneerat et al (2024) which found that children residing in rural areas had a significantly higher rate of stunting compared to those in urban areas (Siramaneerat et al, 2024). In addition, research in Sierra Leone stated significant differences between rural and urban areas in the prevalence of stunting, with rural areas having a greater proportion of children experiencing stunting than urban areas (Sserwanja et al, 2021).

Several factors can cause toddlers to experience stunting in rural areas, such as family characteristics related to parental education and income, the availability of nutritious food due to existing local production, limited access to internet networks for searching information related to children's health and limited access to healthcare facilities (Widyaningsih et al, 2022). In addition, rural areas have inadequate facilities and infrastructure compared to urban areas, such as sanitation facilities. There are still villagers who defecate carelessly, which will later have the potential to transmit fecal-oral diseases (Prakash et al, 2022). The transmission of this disease can disrupt nutrient absorption in children, potentially leading to stunting.

Research Limitations

Studies showed that child stunting in Indonesia was associated with the determinants such as male sex, low birth weight, not getting the deworming program, maternal age, preterm birth, antenatal care, lack of breastfeeding, food insecurity, low education level, low parental income, unimproved drinking water, rural residence, and unimproved sanitation (Insani, 2020; Gusnedi et al, 2023). However, the most direct causes of stunting are inadequate nutrition due to insufficient food intake or the consumption of foods lacking essential growth-promoting nutrients, along with recurrent infections or chronic diseases that lead to poor nutrient intake, absorption, utilization, or other forms of nutrient loss (World Health Organization, 2024d). But, due to the limited data available, this study did not analyze factors directly related to stunting. This study only included indirect causes of stunting, namely environmental health variables (sanitation and drinking water) and sociodemographic variables (age, gender, and place of residence), even though stunting is caused by many factors. Thus, future research is expected to focus on factors directly related to stunting in East Nusa Tenggara, while also considering other risk factors related to environmental health and sociodemographic characteristics.

CONCLUSION

Based on statistical results, access to sanitation had a significant relationship with stunting in toddlers in East Nusa Tenggara after being controlled by the residence variable. As an implication of this condition, the local government is suggested to enhance programs to expand access to sanitation, especially in rural areas, such as the WASH (Water, Sanitation, and Hygiene) Program, which can be implemented with support from the Indonesian Government and in collaboration with the private sector and other partners. The limitations of this study are that it only includes indirect variables from the causes of stunting, namely environmental health variables (sanitation and drinking water) and sociodemographic variables (age, gender, and residence). Because stunting is related to various factors, our recommendation for future research on stunting in Ebukast Nusa Tenggara is to conduct a study that includes more comprehensive variables accompanied by a more detailed analysis.

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