



Analysis of Basic Environmental Health Facilities Associated with Risk Factors of Diarrhea Among Toddlers

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Article Info

Article History:

Submitted March 2022

Accepted August 2022

Published November 2022

Keywords:

Diarrhea, Environmental sanitation, and Risk Factor

DOI

<https://doi.org/10.15294/kemas.v18i2.35376>

Abstract

Diarrheal disease in young children (toddlers) seems increasingly common in tropical countries, especially in dirty and dense urban areas. Diarrhea can last several days and cause the body to lose the fluids needed for survival. This study aimed to determine the sanitation factors that influence the incidence of diarrhea. Methods: This study used a case-control design involving 100 respondents. All respondents were divided into two groups: the case class (toddlers who had diarrhea) and the control class (toddlers who did not experience diarrhea). Results and Discussion: This showed that four sub-variables of sanitation (waste, drainage conditions, domestic wastewater management, and water source safety) had a significant relationship with the incidence of diarrhea (p -value < 0.05). Domestic wastewater was the most influencing factor and securing clean water and drinking water sources, with a Nagelkerke R Square value of 0.952. There was an indication that the independent variable (sanitation) affected the dependent variable (diarrhea incidence) by 95.2%. Conclusion: The sub-variable of domestic wastewater management and the sub-variable of the safety of clean water and drinking water sources were the most affecting the incidence of diarrhea. The clean water source factor was 12 times riskier. It means children who did not get it will have 12 times the risk of getting diarrhea. Meanwhile, in the aspect of domestic wastewater management, children who did not meet the requirements for domestic wastewater have a risk of 8.13 times the incidence of diarrhea.

Introduction

Diarrhea is an environmental-based disease caused by poor sanitation, a dirty environment, and poor community behavior towards healthy living. The disease potentially leads to extraordinary events (KLB) and death when not properly managed (Profile of the Sumbawa District Health Office, 2020). Furthermore, it is the second most common disease in the world after acute respiratory infections (ARI). Approximately 1 billion cases of diarrhea are recorded annually, and it is a significant cause of morbidity and mortality among toddlers in Asia, Africa, and Latin America (Asep dan Delima, 2018).

The spread of the disease is closely related to environmental factors, along with the two most dominant factors being clean water facilities and excreta disposal. An unhealthy environment is prone to diarrheal germs contamination, and its combination with unhygienic intake of food and drink leads to diarrhea. These factors are the second leading cause of death among toddlers under the age of 5 years, and in 2010, there were 2.5 million cases globally. The prevalence of the disease in Asia and Africa is due to inadequate nutrition in toddlers as well as the lack of clean water sanitation (World Health Organization, 2013). The number of cases recorded annually

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fluctuates, and the increased prevalence is closely related to poor environmental sanitation. Meanwhile, unhealthy sanitation is due to the lack of awareness and knowledge, specifically in rural communities about healthy lifestyles, which help to prevent the spread of diarrheal diseases in Indonesia (Rasyidah, 2019).

Population growth and urbanization lead to an increased population density as well as the complexity of people's needs, specifically housing and settlements. The Decree of the Minister of Health, the Republic of Indonesia, with reference Number 829/Menkes/SK/VII/1999 concerning housing health requirements stating that a house is one of the basic human needs, which functions as a dwelling place or shelter. It shields people from climate disturbances and other living things and serves as a place for family development. Therefore, a healthy, safe, harmonious, and orderly home is essential to fully fulfill the functions and uses of a house (Jinping, 2017). Basic sanitation is defined as the minimum cleanliness level needed to create a healthy environment and control various environmental factors causing health problems. The scope of basic sanitation includes the availability of healthy latrines, clean water, waste management facilities, and wastewater disposal channels. People who live in areas with poor sanitation are prone to several health problems, such as diarrhea (Cronk & Bartram, 2018).

Lack of access to clean water and good sanitation facilities increases the incidence of infectious diseases, which divert the body's growth energy to resistance against infections. It leads to difficulty in the uptake of nutrients by the body, thereby causing stunted growth. Approximately 72.04% of households in Indonesia had access to safe drinking water sources in 2017. The province with the highest percentage was Bali, accounting for 90.85% of the households, while the lowest percentage was Bengkulu which had 43.83%. However, there are still 20 provinces that are below the national standard percentage. Therefore, sources of drinking water, such as taps, public faucets, public hydrants, water terminals, rainwater reservoirs (PAH), springs, drilled wells, or pumps should be built at least 10 meters away from sewage, waste collection, and

garbage disposal. The consequences of lacking access to good drinking water and sanitation go beyond the health implication, whereby the vulnerability of these children would have a long-run economic effect on the future working population (Waziri et al., 2018).

Diarrhea coverage in Sumbawa District decreased in 2019 compared to 2018 due to the increased prevalence in each sub-district. The number of targets for finding cases of the disease at all ages in 2019 was 24,636, with a 20% morbidity rate per 100,000 people, while for toddlers, it was 10,966, with a 30% morbidity rate per 100,000 population. Based on data from the Sumbawa District Health Office in 2019, Moyo Hilir Sub-district was classified as an area with a high prevalence of the disease following the discovery of 539 cases in children. The basic sanitation facilities investigated include the condition of the clean water supply, family latrine, family wastewater disposal, and waste disposal. Therefore, this study aims to determine the relationship between basic environmental health facilities and the risk factors for diarrhea in toddlers in Moyo Hilir Sub-district, Sumbawa District.

Method

It is a case-control study using an analytical survey method, and a retrospective approach. The case samples used were households with a toddler aged 1 - <5 years who had diarrhea in the last 2 months, while controls were households with a toddler aged 1 - <5 years who is free from the disease in the last 2 months. This study took place in Moyo Hilir Sub-district, Sumbawa District, West Nusa Tenggara, between November and December 2021. The sample population consists of households with a toddler serving as the analysis unit. The sample size consisted of 100 units of analysis divided into 2 classes, namely case and control, with 50 units each.

Meanwhile, the sampling process was carried out using the purposive sampling technique. The data collected were then analyzed univariately, which involves explaining each variable's characteristics. The variable groups were presented in a frequency distribution table for basic environmental health facilities, including clean water provision, fecal disposal,

wastewater disposal, and waste disposal facilities. Bivariate analysis using chi-square was also carried out to describe the relationship between basic facilities for environmental health and the dependent variable, namely the incidence of diarrhea. Furthermore, a multivariate analysis using logistic regression was performed to determine the most dominant health facilities related to the incidence of the disease in toddlers. The toddlers used as a sampling unit fulfilled the following criteria.

They are aged 1 – 5 years, not suffering from infectious diseases, and toddlers whose parents are willing to be respondents.

Result And Discussion

Based on the results of data processing obtained in the field, the following results were obtained, covering the characteristics of respondents, cross-tabulation data, and bivariate analysis data for each sub-variable.

Table 1. Frequency Distribution of Respondents Characteristics

Gender	Frequency	Percentage (%)
Male	36	36
Female	64	64
Age Range (Years)		
0-2	25	25
2-3	27	27
3-4	26	26
4- 5	22	22
Last education		
Elementary school	27	27
Junior High School	13	13
Senior High School	34	34
University	16	16
Mother's work		
Housewife	45	45
Farmer	27	27
Indonesian workers	15	15
Trader	13	13
Total	100	100.0

Source: Primary Data, 2021

Table 2. Cross Tabulation of Sanitation Sub-Variabes with Diarrhea.

Environmental Sanitation Variable	Category	Diarrhea				Total	Percentage (%)
		Diarrhea (person)	Percentage (%)	No Diarrhea (person)	Percentage (%)		
Garbage	Good	6	6	47	47	5	53
	Bad	44	44	3	3	47	47
Drainage Condition	Good	1	1	48	48	49	49
	Bad	49	49	2	2	51	51
Domestic Wastewater Management	Good	23	23	14	14	37	37
	Bad	27	27	36	36	63	63
Safe water sources and drinking water	Good	8	8	30	30	38	38
	Bad	42	42	20	20	62	62
Implementation of PHBS	Good	22	22	21	21	43	43
	Enough	17	17	21	21	38	38
	Bad	11	11	8	8	19	19

Source: Primary Data, 2021

Table 3. Bivariate Analysis of the Relationship between Sanitation Facilities and the Incidence of Diarrhea in Toddlers under Five in Moyo Hilir Sub-district

Sanitation Facilities item		Diarrhea (person)	Percentage (%)	No Diarrhea (person)	Percentage (%)	Total (Person)	Percentage (%)	P value	OR
Garbage	Good	6	6	47	47	53	53	< 0,001	0,009
	Bad	44	44	3	3	47	47		
Total		50	50	50	50	100	100		
Drainage Condition	Good	1	1	48	48	49	49	< 0,001	0,001
	Bad	49	49	2	2	51	51		
Total		50	50	50	50	100	100		
Domestic Wastewater Management	Good	23	23	14	14	37	37	0,062	2,2
	Bad	27	27	36	36	63	63		
Total		50	50	50	50	100	100		
Water sources	Safe	8	8	30	30	38	38	<0,000	0,127
	Not safe	42	42	20	20	62	62		
Total		50	50	50	50	100	100		
PHBS	Good	22	22	21	21	43	43	0,632	0,127
	Enough	17	17	21	21	38	38		
	Deficient	11	11	8	8	19	19		
Total		50	50	50	50	100	100		
latrine facilities	Worthy	27	27	23	23	50	50	0,424	1,378
	Not feasible	23	23	27	27	50	50		
Total		50	50	50	50	100	100		

Source: Primary Data, 2021

Logistics Regression Test

Table 4. Significance Value per Item Sub-Variabile Sanitation

No	Sanitary Items	Significance value
1	Garbage	0.000
2	Drainage	0.000
3	Water_Waste_Domestic	0.062
4	Source_Clean_Water	0.000
5	PHBS	0.632
6	latrine facilities	0.424

Source: Primary Data, 2021

Table 5. Sub Variable Elimination Matrix

Step 6	Significance	OR Value	Value of Nagelkerke R Square
Domestic wastewater	0,004	8,127	0.952
Safety of clean water sources and drinking water	0,001	12	
PHBS (1)	1,000	0.000	
PHBS (2)	0,673	0.178	

Source: Primary Data, 2021

Table 1 shows that the respondents' children are female (64%). The age range of respondents is in the age category of 3-4 years, as much as 26%. The respondent's latest education is dominated by high school graduates (34%) who consider the mother's occupation a housewife (IRT) as much as 45%. Based on Table 2, only in implementing PHBS that the respondents have a good category. In contrast, in solid waste, drainage, domestic wastewater treatment, and the safety of clean water sources are still poor. The incidence of diarrhea was dominated by respondents who had poor sanitation and vice versa. Respondents who did not experience diarrhea in the last two months during the study period had good sanitation. Toddlers suffer from diarrhea, who have unqualified landfill conditions (44%), and toddlers suffer from diarrhea who have eligible landfill conditions (6%).

Meanwhile, for respondents who did not experience diarrhea, their waste was in a good category (47%). The bivariate analysis results with the chi-square statistical test showed a relationship between the condition of the trash can and the incidence of diarrhea in children under five in Moyo Hilir District with a p-value < 0.001. Table 3 shows that in the cases that experienced diarrhea, the drainage condition was still in the bad category (49%). The p-value indicates a relationship between drainage conditions and the incidence of diarrhea. Table 3 shows no relationship between domestic wastewater management and the incidence of diarrhea. By cross-tabulation, the domestic wastewater management of respondents who experienced the major incident was in a bad category (27%).

Table 3 shows that the safety of clean water sources has a relationship with diarrhea incidence in children under five in Moyo Hilir District. Most respondents have clean water sources from PDAM, dug wells, and drilled wells. Most respondents buy gallons of bottled water and store it in closed containers regarding drinking water needs. However, some have a source of drinking water directly from the well. It was especially the case in the case class where the source of water used for drinking and household needs came from well water which was not well located at a safe distance from

the septic tank. Table 3 shows that the case group of toddlers who experienced diarrhea in the last two months had unsafe drinking and clean water sources (42%), while in the class of toddlers who did not experience diarrhea, as many as 30% of toddlers had safe water sources. Based on Table 3, there is no relationship between the implementation of PHBS and the incidence of diarrhea. In the case class, the application of PHBS to the respondents is in the good and sufficient category. Likewise, in the toddler class, who did not experience diarrhea. Based on Table 3, there is no relationship between latrine conditions and the incidence of diarrhea.

In the case class, most latrines used are in the proper and healthy category. Meanwhile, the latrine facilities used in the control class were not included in the proper category. Findings in the field indicate that although the latrine facilities are following the criteria, the depth of the septic tank and the location of the existing dug holes do not meet the requirements. The process of logistic regression analysis was carried out after bivariate analysis of each sub-variable, with the incidence of diarrhea obtaining a significant value in Table 3. Based on the p-value in Table 3, 3 variables met the requirements for further analysis. They are the solid waste sub-variable, drainage, and clean water sources. However, the domestic wastewater variable is still included in the test criteria because the tolerance limit in logistic regression in determining the variable matrix is 0.1. So that only PHBS variables are not included in the modeling.

SPSS software version 16.0 tested the four sub-variables with a binary logistic regression test, using a backward method. Meanwhile, the test was carried out to determine the most influential sub-variables in the incidence of diarrhea in toddlers. Table 5 shows the test results, which revealed the two most influential sub-variables. They are domestic wastewater and the safety of clean water and drinking water sources with a Nagelkerke R Square value of 0.952. This finding indicates that sanitation has a 95.2% effect on the incidence of diarrhea, and 4.8% of other factors that also influence it. The factor value shows that the source_air_clean factor has a 12-fold risk, which indicates that toddlers that do not fulfill the criteria for clean

water have a 12-fold risk of developing the disease. Meanwhile, in the aspect of domestic wastewater management, a toddler that does not fulfill the criteria has an 8.13 times risk of having the disease.

Diarrheal disease in young children (toddlers) seems increasingly common in many tropical countries, especially in dirty and dense urban areas (Herawanto et al., 2020). Diarrhea can last several days and can cause the body to lose the fluids needed for survival. The community's awareness and willingness are needed to change people's behavior to care more about their environment. Behavioral changes only occur when the community is educated on the importance of environmental sanitation. Therefore, it is necessary to increase public knowledge about clean and healthy living behavior, specifically environment sanitation, which decreases diarrhea morbidity (Rasyidah, 2019). Other factors that increase the risk of the disease include lack of clean water for personal and household hygiene, improper disposal of feces, contamination of water with feces, and improper preparation and storage of food, specifically breast milk complements.

Efforts to prevent diarrhea in toddlers include maintaining environmental and personal hygiene, continuous breastfeeding, balanced nutrition, and immunization (Kue et al., 2022). The correlation between diarrhea-associated deaths of children and UISF in rural areas was weaker than in urban areas, which shows the importance of sanitation facilities in urban areas. Meanwhile, UIDWS had a stronger correlation with children's death in rural areas compared to urban areas, which can be possibly due to the availability of clean, piped water in urban areas and also the use of surface water in rural areas (Bidkhorri et al., 2019).

This study showed that landfills had a relationship with the incidence of diarrhea but had no effect on it. Improper garbage disposal in an upper-middle-income city increases hospitalization rates for diarrhea, specifically due to the Rotavirus (Ahmed et al., 2020). The features of a good waste container include a solid body, does not leak easily, is easy to open, clean, and carry (Nemat et al., 2020). Meanwhile, safe household waste management consists of waste collection using closed containers,

transporting it to a temporary place outside the house, recycling inorganic waste, and harmless waste disposal (Nemat et al., 2020). Organic waste can be disposed of through a composting process, which involves digging a hole in the yard to store of the wastes.

Drainage conditions also have a relationship with the incidence of the disease but do not affect it. A settlement drainage system that does not fulfill the standard requirements is a potential breeding ground for diseases (Corburn et al., 2020). Poor drainage has become a new problem for the public because it causes environmental-based diseases, such as diarrhea. Meanwhile, the closed channel drainage system is safe for domestic wastewater flow. The system is generally used for the dirty water or drains in the city center (Antwi et al., 2021). Several surveys showed domestic wastewater was left in an open stream, causing water puddles behind the respondent's house.

This study also shows that domestic wastewater management has a strong relationship and effect on the incidence of diarrhea. Environmental health is part of the fundamentals of modern public health, including all aspects of human beings concerning the environment, which is bound to various ecosystems. The scope of environmental health includes water sources. Cleanliness of latrines, garbage disposal, housing conditions, and wastewater management. The environment is anything surrounding and the conditions outside of humans or animals that cause disease transmission (Hakim et al., 2018). Based on observations, most respondents had poor wastewater management because the water was not properly treated and is directly discharged into rivers. Several respondents also stated that they use water from the laundry to wet the yard. Generally, there are two categories of wastewater. Namely black and grey water. Facilities are needed at the domestic level in the form of infiltration wells and wastewater disposal channels to properly get rid of greywater. Sewage in the form of feces and urine (blackwater) should be channeled into septic tanks equipped with infiltration wells because it helps to prevent the proliferation of vectors, such as flies. Rural populations obtain water on an individual or household basis from

the closest surface and groundwater sources where the microbial quality is often unknown (Potgieter et al., 2020).

Conventional urban wastewater treatment plants are not designed to remove micropollutants, which may have more long-term effects than previously thought (Pesqueira et al., 2020). Dirty water pollutes clean water sources that are within its vicinity. Hence, it is advisable to build wastewater reservoirs in the form of infiltration wells or public sewers. Meanwhile, most respondents did not have a proper wastewater disposal system, consequently, the toddlers in the house are prone to diarrhea. It is because the wastewater logs around, which leads to various public problems, such as the increased transmission of diseases, the proliferation of mosquitoes larvae as well as unpleasant odors and appearance (El-Hefni et al., 2020).

The results also showed that clean water sources have a relationship and influence on the incidence of diarrhea. Sources of water used for various activities need to fulfill the appropriate requirements, namely construction of processing facilities, maintenance, and quality control. Furthermore, clean water sources can be obtained from regional drinking water companies, such as groundwater, rainwater, drilled wells, pumps, and artesian wells (Corburn et al., 2020). Improving the quality and quantity of water sources as well as individuals' efforts can reduce the possibility of contracting pathogenic bacteria that cause diarrheal disease. The overall prevalence of under-five diarrhea among individuals is high. Child immunization, latrine presence, water shortage in the household, solid waste disposal, and per capita water consumption/water access at the individual level, water shortage in households, child immunization, and solid waste disposal had a statistically significant association with diarrhea occurrence (Ayalew et al., 2018). However, the ideal distance of 10 meters between the water source and the septic tank seems difficult to apply in areas with high population density due to insufficient land. Several attempts can be made to overcome land limitations. One of them is by knowing the direction of groundwater flow to put the septic tank so that the flow direction does not lead to

wells or water sources (Wijayanti et al., 2020).

This study shows that the PHBS category does not have a relationship and influence on the incidence of diarrhea. The categories studied include washing with soap (CTPS) as well as processing, and serving toddler food. The observations revealed that the people in the study location practiced open defecation because they had proper latrines. They were also obedient in implementing CTPS and paid attention to sanitation and hygiene in serving food. In Indonesia, diarrhea is one of the general public fitness problems, specifically in teenagers

under five. Diarrhea is averted if the community can follow The Clean and Healthy Lifestyle (PHBS) (Alamsyah & Marianthi, 2020). One of the causes of diarrhea in toddlers is due to their parents' unhealthy hygiene behavior because they do not understand the benefits of washing hands properly after activities outside or inside the house (Bennion et al., 2021). According to the Water and Sanitation Program (WSP) in 2008, the criteria for healthy latrines include the presence of fecal disposal facilities that fulfill the requirements, namely unharmed to water bodies, prevent contact between humans and feces, safe feces disposal to prevent disease vector, keeps the discharge odorless as well as being safe for the user. In the current study in Ethiopia in 2018, type of roof material, hand washing facility, presence of latrine facility, presence of feces around the pit hole, presence of feces around the house compound, and risk of contamination of household storage had significant associations with diarrheal morbidity (Getachew et al., 2018).

Conclusion

Conclusively, this study shows a relationship between basic sanitation facilities and the incidence of diarrhea in toddlers in the Moyo Hilir Sub-district. The most influential factors that cause the disease are domestic wastewater facilities and clean water sources. Therefore, the community needs to pay attention to the condition of sanitation facilities, such as solid waste and domestic wastewater facilities as well as drainages, latrines, healthy lifestyles, and clean water sources to avoid diarrheal diseases. Health services are also advised to place more

emphasis on field observation-based education than theoretical counseling to make the process more effective.

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