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Drinking Water Facilities and Hygiene Behavior on the Incidence of Diarrhea in Toddlers in North Jakarta City

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ABSTRACT

North Jakarta City is a Coastal Area in the Province of DKI Jakarta. Data from 2017-2021 shows that diarrhea cases in toddlers in North Jakarta City have fluctuated over a 5-year period, with more than 15,000 cases each year. Drinking water facilities that meet health requirements only reach 37.01%. This study aims to analyze the risk factors for the incidence of diarrhea in toddlers in North Jakarta City. This study uses a cross-sectional study design with a sample size of 112 samples taken using cluster sampling technique. The variables examined in the study are the incidence of diarrhea in toddlers, total bacteriological quality of E.coli in water, quality of water storage places, household drinking water treatment, food hygiene sanitation conditions, and handwashing behavior of mothers/caregivers. Data were processed and analyzed descriptively as well as hypothesis testing using chi-square test and multiple logistic regression analysis using the backward: Likelihood Ratio (LR) method. The results showed that the bacteriological quality of total E.coli in water that did not meet the requirements, household drinking water treatment, and handwashing behavior with soap of mothers/caregivers are risk factors for the incidence of diarrhea in toddlers. Therefore, increasing the knowledge and skills of mothers/caregivers and monitoring the quality of household drinking water are needed to prevent and address diarrhea in toddlers.

Keywords: Diarrhea, Risk factors, Children under five years, Drinking water quality

INTRODUCTION

Diarrhea is a condition characterized by an increased frequency of bowel movements, caused by bacterial infection with Escherichia coli (E. coli). Diarrhea can occur in all age groups; however, in vulnerable conditions such as in children under five years old, diarrhea is a leading cause of death, wasting, and stunting (Sahiledengle et al., 2023). Toddlers experiencing diarrhea show symptoms ranging from fever, vomiting, nausea, mild dehydration, to severe dehydration. Diarrhea can lead to death in toddlers when they experience acute diarrhea, which is characterized by softer and more liquid bowel movements at least three times within 24 hours for less than 14 days, accompanied by vomiting and severe dehydration (Shabella et al., 2023).

Jakarta, the bustling capital of Indonesia, is an urban agglomeration that is home to more than 11 million people. It is important to note that about 7% of the city's population consists of children under the age of five. This demographic information is crucial for researchers studying the social and economic impacts of rapid urbanization, particularly in developing countries like Indonesia. This data provides insights into the health and well-being of the city's youngest residents and underscores the need for evidence-based policies that prioritize early childhood development in Jakarta.

Many risk factors influence the incidence of diarrhea in toddlers, some of which are environmental and behavioral factors. Dominant environmental factors include the use of unsuitable water sources (Mebrahtom et al., 2022), poor water facilities (Rau & Novita, 2021), and bacteriological water quality not meeting drinking water quality standards (Candra et al., 2014). When an unhealthy and unsafe environment is contaminated with E. coli and is combined with poor maternal/caregiver behavior, such as unsafe storage of clean water, lack of household drinking water treatment practices, poor food hygiene sanitation, and poor maternal/caregiver handwashing behavior (Uddin et al., 2023), the transmission of diarrhea will be faster and easier.

Based on the data on causes of death in toddlers (12-59 months) in the Province of DKI Jakarta in 2022, diarrhea has been scientifically proven to be the second highest cause of death after pneumonia (Dinas Kesehatan Provinsi DKI Jakarta, 2023). Over four years, from 2017 to 2021, an average of 15,000 diarrhea cases were reported annually among toddlers living in North Jakarta City. These alarming statistics highlight the urgent need for effective

public health interventions aimed at preventing and managing this debilitating disease among the most vulnerable population groups (Statistics, 2022). The prevalence of diarrhea in toddlers in North Jakarta City is 62%. Compared to East Jakarta City, which has the highest population in the Province of DKI Jakarta at 3.31 million (29.23%), the prevalence of diarrhea in toddlers is 48% (Dinkes DKI Jakarta, 2022).

North Jakarta City is a coastal area in the Province of DKI Jakarta. Coastal areas are attractive places to live, work, and recreate despite facing increasing threats from global environmental changes. At the same time, parts of the population will experience both positive and negative health impacts related to coastal areas.

Many health risks can occur in Coastal Areas due to viral or bacterial infections, either through food contamination or exposure to toxic/microbial water or dust. These negative impacts are continuously increasing due to global climate change, which affects changes in water temperature, salinity, and microbial interactions with nutrients, heavy metals, antibiotics, and microplastics (Sandifer, 2023).

Data from the Jakarta Statistics Service Center in 2019 show several major issues related to clean water services in Jakarta, namely irregular water flow (55%), cloudy water (23%), and smelly water (20%), and pipe leaks (2%) (Dinas Lingkungan Hidup Jakarta, 2021). Additionally, the drinking water facilities in North Jakarta that meet the quality standards for drinking water as per the Ministry of Health Regulation No. 2 of 2023 only reach 37.01% (Ministry of Environment and Forestry, 2021). Of the 89.9% of drinking water facilities that underwent environmental health inspections, only 7.3% met the requirements as drinking water (Ministry of Health, 2022).

The lifestyle of most residents of North Jakarta also pays little attention to hygiene and environmental sanitation, which can lead to water pollution and increase the risk of diarrhea. All villages and sub-districts in North Jakarta have implemented Community-Based Total Sanitation (STBM) 100% as an effort to break the chain of disease transmission, but access to adequate sanitation facilities (healthy latrines) has not yet reached 100% and ranks as the second lowest compared to the six cities in the Province of DKI Jakarta (Ministry of Health, 2022).

Many studies have investigated the risk factors for diarrhea incidence in toddlers in Indonesia. A spatial analysis study on the presence of dug wells with bacteriological water quality that does not meet standards in Jabungan Village, Semarang City, shows that it can increase the likelihood of diarrhea (Dangiran & Dharmawan, 2020). Research on the determinants of diarrhea based on the pillars of Community-Based Total Sanitation (STBM) in Lampung Regency shows that the implementation of STBM has not been optimal, resulting in no visible changes in healthy living behaviors, as indicated by the still high cases of diarrhea (Ahyanti & Rosita, 2022). A study analyzing the risk factors for diarrhea in toddlers in the working area of North Jayapura Health Center, looking at waste management, food hygiene and sanitation, handwashing behavior, type of flooring, clean water facilities, and feces disposal facilities, shows a significant relationship with the incidence of diarrhea (Irjayanti et al., 2024).

Based on the facts outlined above, this study aims to analyze drinking water facilities and hygiene behavior related to the incidence of diarrhea in toddlers that has recently been conducted in the Coastal Area of the Province of DKI Jakarta, namely North Jakarta City.

RESEARCH METHODOLOGY

The research method used is observational analytic with a cross-sectional design. The population in this study is 143,021 children aged 0-5 years in North Jakarta City. The sample size was 112 toddlers and water samples from Cilincing, Tanjung Priok, and Koja sub-districts were obtained from sample calculations using cluster sampling (area sampling) techniques.

Water samples were obtained from drinking water sources (self-treated clean water, bottled water, refill drinking water). Sample collection and care guidelines were followed according to the Regulation of the Minister of Health Number 2 of 2023 (Permenkes RI, 2023). The variables investigated in this study include the incidence of diarrhea in toddlers, total bacteriological quality of E. coli in water, quality of water storage, household drinking water treatment, food hygiene and sanitation conditions, and handwashing behavior of mothers/caregivers. Variables were measured using instruments such as questionnaires and observation sheets, compact dry E. coli tests, and water sampling tools. Data processing mainly involved data collection, editing, coding, classification, and tabulation.

The questionnaires and observation sheets were tested for validity and reliability. The test results on 30 respondents with characteristics similar to the research sample showed that the questionnaires and observation sheets on 5 variables were valid with positive correlation values, sig (2-tailed) <0.05, and a Cronbach's alpha value of 0.634, while the r table value was 0.361.

This study consists of three stages of data analysis: univariate, bivariate, and multivariate analysis. To determine the adjusted odds ratio (OR) of the independent variables, multivariate multiple logistic regression analysis with the backward

method was used, while controlling for potential confounding factors that could adversely impact the bacteriological quality of water. Any variable showing a P value of less than 0.05 was considered statistically significant.

This study has passed ethical review by the Health Research Ethics Committee of the Faculty of Public Health, Diponegoro University, with Number 387/EA/KEPK-FKM/2023.

RESULT & DISCUSSION

The characteristics of the 112 respondents in this study are shown in Table 1.

Table 1
Frequency Distribution of Respondent Characteristics in the Coastal Area of North Jakarta City in 2023

Respondent Characteristics	F n=112	%
Age:		
13-18 years	1	0.9
19-29 years	26	23.2
30-49 years	72	64.3
50-64 years	12	10.7
65-80 years	1	0.9
Education Level:		
No schooling	2	1.8
Did not finish SD/MI	4	3.6
Finished SD/MI	15	13.4
Finished SMP/equivalent	32	28.6
Finished SMA/equivalent	49	43.8
Finished D1/D2/D3/PT	10	8.9
Occupation:		
Unemployed	3	2.7
Student	2	1.8
Government employee	1	0.9
Private employee	2	1.8
Entrepreneur	4	3.6
Housewife	100	89.3
Length of Residence:		
1-15 years	53	47.3
16-30 years	31	27.7
>30 years	28	25.0
Relationship to Toddler:		
Mother	91	81.3
Father	0	0
Grandmother	16	14.3
Others	5	4.5

Age, education, and occupation of mothers/caregivers of toddlers can influence their experience in childcare and their knowledge of diarrhea, its transmission, and risk factors. Children born to or cared for by mothers aged 25-34 years have a 15% lower likelihood of experiencing diarrhea compared to children born to mothers aged 15-24 years (Chari et al., 2023).

Respondents have been residing for over 30 years, while the majority of respondents have lived for 1-15 years (47.3%). The longer respondents have lived or settled, the more they are considered to understand the surrounding conditions and accurately depict the actual situation.

Table 2 shows the tabulated results of the frequency distribution of independent variables concerning the incidence of diarrhea in toddlers in the Coastal Area of North Jakarta City.

Table 2
Frequency Distribution of Independent Variables on the Incidence of Diarrhea in Toddlers in the Coastal Area of North Jakarta City

Variable	Diarrhea Incidence		*p-value*	OR	95 % CI	
	Yes	No				
	n= 66	n= 46			*Lower*	*Upper*
Total Bacteriological Quality of E. coli in Water						
Meets Standards	9 (18.0%)	41 (82%)	0.000*	10.168	4.344	23.799
Does Not Meet Standards	57 (91.9%)	5 (8.1%)				
Quality of Water Storage						
Safe	43 (52.4%)	39 (47.6%)	0.021*	2.038	1.025	4.053
Unsafe	23 (76.7%)	7 (23.3%)				
Household Drinking Water Treatment						
Yes	12 (24.5%)	37 (75.5%)	0.000*	0.189	0.101	0.354
No	54 (85.7%)	9 (14.3%)				
Food Hygiene and Sanitation Conditions						
Good	14 (41.2%)	20 (58.8%)	0.012*	1.765	1.158	2.690
Poor	52 (66.7%)	26 (33.3%)				
Handwashing Behavior of Mothers/Caregivers						
Good	40 (48.8%)	42 (51.2%)	0.000*	3.841	1.506	9.799
Poor	26 (86.7%)	4 (13.3%)				

Note: *(significant)

Research conducted in Welkite, Ethiopia, a city with the second highest population density in Africa where 14% of the population are toddlers, currently facing a water crisis, indicates that 88 (20.7%) out of 426 toddlers suffer from diarrhea (Wolde et al., 2022). This figure is slightly lower compared to the findings in this study. This difference could be related to the population size of DKI Jakarta reaching 11 million people, with 7% being toddlers (Central Statistics Agency, 2022; Mardiansjah & Rahayu, 2019).

Most water samples in this study did not meet the bacteriological quality standards for total E. coli in water. Research on 88 toddlers living in urban slums in India highlights the importance of consistent water treatment at home to prevent the presence of coliform bacteria in drinking water. By emphasizing the importance of proper water treatment, families can take necessary steps to

ensure their drinking water is safe and free from harmful bacteria ($p < 0.05$) (Wani et al., 2022).

The bacteriological quality of total E. coli in drinking water is significantly associated with the incidence of diarrhea (p-value 0.000; OR 10.168; CI: 4.344-23.799). These findings are consistent with research in Ethiopia involving 196 toddlers suffering from diarrhea, where it was found that 13.1% were caused by bacteria, with 6.1% of these cases being due to E. coli bacteria (Balew & Kibret, 2023). Water contaminated with fecal bacteria has a 12.56 times higher likelihood of transmitting diarrhea to toddlers compared to families with safe drinking water (CI: 6.83-23.20) (Birhan et al., 2023).

Unsafe storage of drinking water can increase the risk of diarrhea in toddlers by 2.038 times compared to safe water storage (CI: 1.025-4.053). Caregivers who maintain clean storage conditions for drinking water can reduce the potential for bacterial contamination, ensuring safe consumption. This is supported by research in Bleber Village, which found that 5 water samples stored unsafely contained E. coli compared to those stored safely (Sundusin et al., 2023). Similarly, Ferleke and Kombat discovered that caregivers who do not store water in clean drums at home have an 8.6 times higher likelihood of causing diarrhea (CI: 1.51-48.84), and unsafe drinking water sources have a potential 1.25 times higher risk of causing diarrhea (Feleke et al., 2022; Kombat et al., 2024).

Household water treatment is crucial to prevent or reduce specific harmful bacteria/chemicals (Organization, 2017). The study results show that household water treatment is significantly associated with the incidence of diarrhea (p-value 0.000; OR 0.189; CI: 0.101-0.354). This finding aligns with Chari et al. in South Africa, where toddlers consuming untreated water are also a factor in diarrhea occurrence (AOR 6.22; CI: 95% 2.13–18.20) (Chari et al., 2023).

Food hygiene and sanitation are critical aspects of preventing diarrhea in toddlers. The five keys to safe and healthy food include ensuring clean eating areas free from vectors and rodents, separating food storage and cooked food, ensuring thorough cooking of food, maintaining food temperature, and using safe water and ingredients (Machava et al., 2024). Research by Wolde et al. shows that toddlers finding flies on their food at home have twice the likelihood of diarrhea compared to those with clean eating areas (AOR: 2.24; 95% CI: 1.05-4.78) (Wolde et al., 2022).

The study results indicate that poor food hygiene and sanitation conditions in households have a potential 1.756 times higher risk of diarrhea compared to healthy and safe food hygiene conditions (CI: 1.158-2.690). Research on 326 toddlers in 2023 also shows that toddlers are 9 times more likely to have diarrhea if their households have food storage areas vulnerable to vector contamination compared to households where food storage areas are protected or free from vectors (CI: 4.06-20.52) (Birhan et al., 2023).

Handwashing behavior with soap at critical times is a crucial part of personal hygiene for mothers or caregivers of children. Statistical tests show that a significant number of toddlers suffer from diarrhea, with 26 out of 66 cases occurring due to caregivers who exhibit poor handwashing behavior with soap (p-value: 0.000). This poor handwashing behavior with soap also has the potential to increase the likelihood of causing diarrhea by 3.841 times (CI: 1.506-9.799). This finding aligns with research on 717 toddlers in Ethiopia, where caregivers who do not practice handwashing at critical times are 5.92 times more likely to cause diarrhea in toddlers compared to those who do practice handwashing at critical times (CI: 2.58-13.70) (Feleke et al., 2022).

Table 3
Multivariate Regression Test Results

Variable	Sig	OR	95% CI	
			Lower	Upper
Total bacteriological quality of E. coli in water	0.000*	0.004	0.000	0.045
Quality of water storage place	0.080	0.139	0.015	1.270
Household water treatment	0.001*	0.026	0.003	0.231
Hygienic and sanitary conditions of food	0.645	1.467	0.288	7.477
Mothers/caregivers handwashing behavior with soap	0.035*	0.045	0.003	0.808

The results of the multivariate regression analysis in Table 3 indicate that the total bacteriological quality of E. coli in water is a risk factor for diarrhea in toddlers (Sig. 0.000). Toddlers who consume water containing E. coli are prone to diarrhea, as evidenced by research on 290 water samples from unsafe sources or contaminated water sources. It was found that 62.4% of the water was contaminated with E. coli (Gebrewahd et al., 2016). The contamination of bacteria, especially E. coli, in refill drinking water consumed in households, correlates strongly with causing diarrhea in 1,124 toddlers aged 0-60 months (OR: 11.613; CI: 6.495-20.765, p-value: 0.000) (Suge et al., 2023).

Household water treatment is a risk factor for diarrhea in toddlers in this study (Sig. 0.001). Household water treatment can be done through filtration, solarization, chlorination. The majority of households in North Jakarta use refill drinking water obtained from Refill Drinking Water Depots (RDWD) whose hygiene and sanitation certificates are unknown. This was evidenced by research on 6 RDWDs tested in Magetan showing that the bacteriological quality of total E. coli in refill drinking water did not meet health standards (Kusumaningrum et al.,

2022). Therefore, it is crucial for households to treat water before consumption by boiling it to avoid E. coli contamination.

This is supported by research on low to middle-income diarrhea toddlers that household water treatment, especially through filtration, solarization, and chlorination, can reduce the risk of diarrhea by 52% (Wolf et al., 2022). Another study on 1,004 toddlers also found that consuming untreated drinking water is a risk factor for diarrhea [AOR = 1.795, 95% CI (1.184, 2.721)] (Kefale Mengistu et al., 2024).

Handwashing behavior with soap by mothers/caregivers of toddlers is a risk factor for diarrhea in toddlers in this study (Sig. 0.035). The research findings are consistent with studies in Ethiopia that handwashing practices are a risk factor for diarrhea in toddlers (AOR: 2.50, 95% CI: 1.012-6.179) (Bellini et al., 2024). Changes in handwashing behavior as studied by Meierhofer also show a correlation with improved child health. The frequency of handwashing with soap is significantly associated with a reduction in bacterial infections causing diarrhea and stunting in toddlers (OR = 0.75, 95% CI = 0.66-0.92, p = 0.003) (Meierhofer et al., 2023).

Handwashing with soap is crucial as it can prevent bacterial contamination. Despite mothers/caregivers reporting that they wash their hands, a study of 225 toddler caregivers showed a high prevalence of bacterial contamination on their hands, at 72%. This study identified several factors related to hand hygiene status, with the highest risk being not removing accessories while washing hands (OR = 20.844, 95% CI: 2.190-9.842; P = 0.0080) (Ango et al., 2023).

The findings of this study highlight the importance of handwashing behavior with soap and household water treatment, as they are closely related to the presence of E. coli bacteria in drinking water. Mothers/caregivers, as frontline caregivers for toddlers, should be capable of creating a healthy environment for them. The occurrence of diarrhea in toddlers can lead to a decline in their nutritional status and the incidence of stunting in toddlers (Meierhofer et al., 2023; Sahiledengle et al., 2023).

In its implementation, this study has several limitations, including in the data collection process, where respondents' information provided through questionnaires may not always reflect their true opinions. This discrepancy can occur due to differences in thinking, assumptions, and understanding among respondents, as well as other factors such as honesty in completing their questionnaires.

CONCLUSION

This study aims to analyze the risk factors for diarrhea among toddlers in North Jakarta. Factors such as inadequate total bacteriological quality of E. coli in water, unsafe water storage conditions, household water treatment practices, food hygiene and sanitation conditions, and handwashing behavior with soap by caregivers are associated with the occurrence of diarrhea. However, only inadequate total bacteriological quality of E. coli in water, household water treatment practices, and handwashing behavior with soap by caregivers are identified as risk factors for diarrhea among toddlers. In accordance with the mandate of Law Number 36 of 2009 concerning Health, to achieve sanitary facilities and qualified drinking water in settlements, it is essential to enhance monitoring and awareness of the causes, risk factors, and prevention methods for diarrhea in children under five years old through environmental health inspection programs focusing on household drinking water quality.

SUGGESTION

Based on observations and conclusions drawn from this study, the Health Department, Community Health Centers, policymakers, environmental health practitioners, and others should take several actions. Firstly, intensify monitoring and awareness campaigns across various regions about the causes, risk factors, and prevention methods of diarrhea in children under five years old. Secondly, consider the identified risks of diarrhea from this research in designing interventions to help reduce the prevalence of diarrhea in North Jakarta. Thirdly, conduct regular environmental health inspections of household drinking water quality at least once a month by health officers to ensure safe and bacteria-free drinking water, particularly from E. coli contamination.

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