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Analysis of Well Water Quality and its Relationship with the Incidence of Diarrhea in Children in South Coastal Area: A Cross sectional Study

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ABSTRACT

Diarrhea remains a leading cause of morbidity and mortality among children under five, especially in developing countries like Indonesia. Contaminated water that fails to meet physical and microbiological standards significantly contributes to disease transmission in children. This study employed a quantitative, observational analytic cross-sectional design to examine the relationship between well water quality and childhood diarrhea incidence in southern coastal areas. A total of 100 households with children aged 1-5 years, relying on well water for drinking, participated. Univariate analysis described respondent characteristics and water quality, while chi-square tests assessed associations between well water quality and childhood diarrhea incidence. Bivariate and multivariate logistic regression analyses determined risk magnitudes (odds ratios). The findings indicated a significant association between microbiological contamination of household well water and diarrhea occurrence in children (p = 0.001; OR = 4.00). Additionally, wells located less than 10 meters from septic tanks posed a higher risk (OR = 2.67). Although differences in well type (dug vs. drilled) were observed, they were not statistically significant (p = 0.202). These results indicate that poor well water quality is a major risk factor for diarrhoea in children in the southern coastal region. To reduce this risk, public health efforts need to focus on improving access to clean water, environmental sanitation education, and technical supervision in the construction and maintenance of wells. This integrated approach is important for reducing the incidence of diarrhoea in children and improving the health status of children in affected communities.

Keywords: *Well Water Quality, Diarrhea, Escherichia Coli Contamination, Well and Septic Tank Distance*

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INTRODUCTION

Diarrhea is still one of the leading causes of morbidity and mortality of children under the age of five, especially in developing countries including Indonesia. This disease is closely related to environmental sanitation and the quality of water consumed, especially in areas that experience limited access to clean water such as coastal areas and small islands (Alum et al., 2024).

Drinking water quality that does not meet physical and microbiological requirements can be a major medium for diarrhoeal disease transmission in children. In several studies, contamination of well water by bacteria such as *Escherichia coli* and *Coliform* has been shown to significantly increase the risk of diarrhea (Islamiyati et al., 2024; Mukharomah & Achmadi, 2024).

Coastal areas are known to be vulnerable to groundwater pollution due to seawater intrusion, poor sanitation conditions, and the presence of pollutant sources such as septic tanks adjacent to dug wells. This condition is exacerbated by limited clean water infrastructure, especially in areas with flat topography and high population density (Alam & Asyfiradayati, 2024).

Previous research has shown that well location and proximity to pollutant sources are major determinants of water microbiological quality. Wells less than 10 metres from septic tanks are at high risk of faecal contamination, which is the main cause of increased cases of diarrhea in children (Rusdi et al., 2022).

In addition, spatial analysis showed that drinking water quality was the most dominant factor associated with the incidence of diarrhoea in children under five compared to other factors such as handwashing habits or type of water source (Fernando P et al., 2024).

One study in eastern Indonesia revealed that only a small proportion of well water sources met the microbiological safety threshold, which is a major concern in water-based disease prevention efforts (Alam & Asyfiradayati, 2024).

On the other hand, several studies have also shown that even though water sourced from wells appears physically clear, it is not necessarily free from bacterial contamination. This indicates the need for regular microbiological testing and a review of the design and sanitation of household wells (Andriyani et al., 2022).

The Indonesian government through various regulations such as Permenkes No. 32 of 2017 and No. 2 of 2023 has set drinking water quality thresholds, but implementation and supervision in the field still face major challenges, especially in rural and coastal areas (Mukharomah & Achmadi, 2024).

This phenomenon is becoming increasingly important to study as recurrent cases of childhood diarrhea can stunt growth and lead to chronic malnutrition, ultimately impacting the quality of life and future of children in coastal areas (Ali & Kigadye, 2022).

Considering all these aspects, research on the analysis of well water quality and its relationship with the incidence of diarrhoea in children in southern coastal areas is very relevant and urgent. The results of this study are expected to form the basis for policy making in evidence-based sanitation and water supply planning in coastal areas.

METHODS

This study used a quantitative approach with an observational analytic study design and cross-sectional design to examine the relationship between well water quality and the incidence of diarrhoea in children in southern coastal areas. This approach was chosen because it allows researchers to identify and analyse the relationship between the independent variable, well water quality (both physical and microbiological), and the dependent variable, the incidence of diarrhea in children under five years of age, at a single point in time.

The population in this study was all households that have children aged 1-5 years and use well water as the main source of drinking water in a predetermined south coastal area. Sampling was conducted by purposive sampling by considering inclusion criteria such as ownership of household dug or drilled wells, as well as records or reports of childhood diarrhea in the last three months. The sample size was determined based on the population proportion formula by considering a 95% confidence level and a 5% margin of error, and adjusted to field conditions.

Primary data were collected through two main techniques. First, structured interviews were conducted with parents or caregivers using a standardised questionnaire covering demographic data, child health history, frequency of diarrhea occurrence, and household sanitation practices. Secondly, water samples were collected from each household's well for water quality analysis, including physical parameters (colour, odour, turbidity, temperature) and microbiological parameters (total *Coliform* and *Escherichia coli* counts), in accordance with Permenkes RI No. 2 Year 2023. Laboratory testing was conducted at an accredited local public health laboratory using the Most Probable Number (MPN) method for microbiological analysis.

To ensure validity and reliability of the data, the research instruments were pretested in locations with similar characteristics but not included in the main research area. Content validation was conducted by environmental health and epidemiological experts, while reliability testing was conducted using Cronbach's Alpha formula.

The data obtained were analysed using statistical software. Univariate analysis was used to describe the characteristics of the respondents and the distribution of the study variables. Furthermore, bivariate analysis using the chi-square test was conducted to determine the relationship between well water quality and the incidence of diarrhoea in children. To determine the magnitude of risk (odds ratio), bivariate and multivariate logistic regression analyses were used, with p values <0.05 considered statistically significant.

RESULTS

This study involved 100 households with children aged 1-5 years and using well water as the main source of drinking water in the south coastal region. Data were analysed univariately to describe respondent characteristics and water quality, and bivariately to identify the association between well water quality and the incidence of childhood diarrhea. The results of the study are presented in the following table.

Table 1. Distribution of Respondents' Characteristics and Environmental Conditions Related to Well Water Quality and Incidence of Diarrhea in Children in South Coastal Area

Variable	Category	Frequency (n)	Percentage (%)
Gender of the child	Male	52	52,0%
	Female	48	48,0%
Child age	1-3 years old	56	56,0%
	4-5 years old	44	44,0%
History of diarrhoea in the last 3 months	Yes	38	38,0%
	No	62	62,0%
Type of well	Dug well	71	71,0%
	Borehole well	29	29,0%
Well to septic tank distance	<10 metres	63	63,0%
	≥10 metres	37	37,0%
Microbiological test results of well water	Contaminated (*E. coli*)	42	42,0%
	Not contaminated	58	58,0%

Most of the children were 1-3 years old and came from households using dug wells. About 42% of well water samples showed *E. coli* bacterial contamination. Diarrhea in the last three months was found in 38% of children, especially in households with wells <10 metres away from septic tanks.

Table 2. Distribution of Associations between Well Water Quality and Childhood Diarrhea in the South Coastal Region

Variable	Incidence of Diarrhea		Total	p-value	OR (95% CI)
	Diarrhea	No Diarrhea			
Microbiological contamination					
- Contaminated	26	16	42	0.001	4.00 (1.78-8.99)
- Not contaminated	12	46	58		
Distance Between the Well and the Septic Tank				0.015	2.67 (1.18-6.05)
- <10 metres	28	35	63		
- ≥10 metres	10	27	37		
Well type					
- Dug well	30	41	71	0.202	1.67 (0.76-3.68)
- Drilled wells	8	21	29		

Notes: Significant at $p < 0.05$

There was a significant association between the microbiological quality of well water and the incidence of diarrhoea in children. Children who consumed contaminated well water were four

times more likely to experience diarrhea than children who consumed clean water (OR = 4.00; p = 0.001). Well to septic tank distance of less than 10 metres was also significantly associated with diarrhoea (OR = 2.67; p = 0.015). Well type (dug vs drilled) showed no statistically significant association with diarrhea incidence (p = 0.202).

DISCUSSION

This study showed a significant association between several environmental variables and the incidence of diarrhea in children under five years of age.

1. Microbiological Quality of Well Water (*Escherichia Coli* Contamination)

The results of bivariate analysis showed that there was a significant association between the microbiological quality of well water and the incidence of diarrhoea in children (p = 0.001; OR = 4.00). Children who consumed water from wells contaminated *with E. Coli* had a four times higher risk of developing diarrhoea than children who used uncontaminated water.

According to theory, water serves as the primary pathogen-transmission medium in the fecal-oral based disease transmission chain. Acute diarrhea in children is frequently caused by *E. Coli*, especially pathotypes like ETEC (Enterotoxigenic) and EAEC (Enteroaggregative), in underdeveloped nations (Suleiman et al., 2022).

A nationwide study in Bangladesh also found that children exposed to water with high *E. coli* contamination had a 2.28 times greater risk of developing diarrhoea than children with uncontaminated drinking water (Khan et al., 2022). Similar findings were also reported in Ethiopia, where *E. Coli* toxins in water were directly correlated with toxins found in the faeces of people with diarrhoea (Gemeda et al., 2022).

The researchers' assumption in this case is that microbiological contamination of household water is more critical than physical parameters. Exposure to biological contaminants directly affects the digestive system of children who are still in the immunological developmental stage. Therefore, interventions that target water quality at the point of consumption are critical.

2. Distance Between the Well and the Septic Tank

Bivariate analysis also showed a significant association between well to septic tank distance and diarrhea incidence (p = 0.015; OR = 2.67). Children living in homes with wells <10 metres from the septic tank had a 2.67 times higher risk of diarrhoea than those living in homes with wells ≥10 metres away.

Theoretically, sanitation engineering principles suggest a minimum distance of 10 metres between wells and septic tanks to avoid fecal waste infiltration into the aquifer. When the distance is not sufficient, pathogenic microorganisms such as *E. Coli* may enter through cracks or inhomogeneous soil pores, especially in sandy soils.

Research in Nigeria supports this finding. In a study by Odetoyin et al. (2021), wells close to septic tanks had a higher probability of containing *diarrheagenic E. Coli* pathotypes such as ETEC and EAEC (Odetoyin et al., 2021). Local studies in Indonesia have also shown that wells within a radius

of <10 metres from pollutant sources have *E. Coli* levels of up to 10^6 CFU/100 ml, exceeding the Permenkes quality threshold (Nissa & Pujiastuti, 2024).

The researchers' assumption is that many household wells were built without technical sanitation considerations, especially in coastal areas where the topography is flat and the water table is shallow. Therefore, technical recommendations such as impermeable concrete slabs and increased well spacing need to be enforced.

3. Well Type (Dug vs. Drilled)

The results showed that there was no significant association between well type (dug vs drilled) and the incidence of diarrhea in children ($p = 0.202$; OR = 1.67). Theoretically, dug wells have a higher risk of contamination than drilled wells, due to their shallow depth, more exposed well walls, and potential ingress of contaminants from the ground surface. However, in the context of the southern coastal region, this difference was not statistically confirmed.

This finding is in line with studies in Ghana and Pakistan, which found that boreholes do not always guarantee better water quality if construction and maintenance are not up to technical standards. For example, boreholes that are shallow, without watertight casings, or not sealed remain vulnerable to infiltration of household waste (Hanif et al., 2024; Husein et al., 2023). Similarly, it was reported in some rural areas in Ethiopia and Nigeria, where well type was not a major factor, but rather the surrounding sanitary conditions, distance from septic tanks, and quality of well maintenance determined the microbiological quality of water (Odetoyin et al., 2021; Gemeda et al., 2022).

The insignificance of the results in this study can be explained by several possibilities. First, well construction variables (depth, quality of casing, presence of a barrier at the well mouth) were not measured in detail, so variations in quality between boreholes and dug wells were not captured in the analysis. Second, household behavioral factors, such as water collection methods, container storage, and hygiene practices, may be additional sources of contamination that mask differences between dug and drilled wells. Previous studies in Bangladesh and Indonesia have shown that household-level contamination often determines diarrhea risk more than the initial water source (Khan et al., 2022; Andriyani et al., 2022).

The assumption of this study is that well type fundamentally affects the potential for contamination, but only if technical factors (depth, construction and distance from the contaminant source) are controlled for. By not accounting for these technical variables in the analysis, the results were not statistically significant. This indicates that in the context of coastal areas, well type cannot stand alone as a determinant of water quality, but must be viewed as part of a broader system involving technical factors, community behavior and environmental conditions.

Thus, the results of this study do not completely contradict the international literature, but rather confirm that well type is not the sole determinant of water quality. The quality of construction, maintenance and household hygiene practices play an equally, if not more, dominant role in explaining the incidence of diarrhea among children in rural and coastal areas.

CONCLUSIONS

Based on the results of this study, it can be concluded that the microbiological quality of household well water in the southern coastal area has a significant association with the incidence of diarrhea in children under five years of age. Children who consume well water contaminated with *Escherichia coli* have a four times higher risk of diarrhea than those who consume uncontaminated water.

The results of this study indicate that the microbiological quality of household well water has a significant association with the incidence of diarrhoea in children under five years of age in the southern coastal region. Wells contaminated with Escherichia coli increase the risk of diarrhoea by fourfold compared to uncontaminated wells. Additionally, wells located less than 10 metres from a septic tank significantly increase the risk of diarrhoea by 2.67 times ($p < 0.05$). These findings underscore the importance of implementing technical sanitation standards, such as the minimum distance requirement between wells and pollution sources, as stipulated in Ministry of Health Regulation No. 2 of 2023.

Although the type of well (dug or drilled) did not show a statistically significant association ($p > 0.05$), this variable remains important to consider due to the potential for contamination, especially if well design, construction, and maintenance do not meet adequate sanitation standards. Community hygiene practices in water management and sanitation also play a supporting role in minimising the risk of disease transmission.

Overall, this study reinforces evidence that poor well water quality, particularly from a microbiological perspective, is the primary determinant of diarrhoea incidence among children in coastal areas. Therefore, evidence-based public health interventions are urgently needed, including: (1) providing access to safe drinking water, (2) ongoing education on environmental sanitation and personal hygiene, and (3) technical supervision and regulation in the construction and maintenance of household wells. An intersectoral approach involving the health, environment, and spatial planning sectors is crucial to reducing the incidence of diarrhoea and improving the health status of children in vulnerable areas.

REFERENCES

Alam, W. S., & Asyfiradayati, R. (2024). Microbiological analysis of well water quality in Gempol Village, Klaten Regency, Indonesia. Malahayati International Journal of Nursing and Health Science, 7(9), 1123–1129. https://doi.org/10.33024/minh.v7i9.507

Ali, W. M., & Kigadye, E. S. (2022). Determination of factors contributing to the prevalence of diarrhea among children under five years of age in association with the status of drinking water sources at Bububu, Zanzibar. Tanzania Journal of Science, 48(2), 474–486. https://doi.org/10.4314/tjs.v48i2.21

Alum, E. U., Obeagu, E. I., & Ugwu, O. P.-C. (2024). Enhancing quality water, good sanitation, and proper hygiene is the panacea to diarrhea control and the attainment of some related sustainable development goals: A review. Medicine, 103(38), e39578. https://doi.org/10.1097/md.0000000000039578

Andriyani, M., Noraida, & Rahmawati. (2022). Relationship of contamination risk of clean water facilities and bacteriological water quality with the occurrence of diarrhea in toddlers in the work area of Puskesmas Liang Anggang. Journal of Environmental Health: Journal and Applications of Environmental Health Engineering, 19(1), 47–52. https://doi.org/10.31964/jkl.v19i1.438

Fernando P, N., Raharjo, M., & Nurjazuli, N. (2024). Spatial analysis of drinking water quality and environmental sanitation on the incidence of diarrhea in toddlers. Journal of Science Education Research, 10(11), 9033–9043. https://doi.org/10.29303/jppipa.v10i11.8894

Gemeda, S. T., Desta, A. F., Gari, S. R., Jass, J., & Tefera, D. A. (2022). Diarrheagenic toxins in stool correlate with drinking water from improved water sources in Ethiopia. Environmental Challenges, 8, 100592. https://doi.org/10.1016/j.envc.2022.100592

Hanif, A., Nakano, Y., & Matsushima, M. (2024). The benefit of clean water on child health: An empirical analysis with specific reference to Escherichia coli water contamination. Water Resources and Economics, 100249. https://doi.org/10.1016/j.wre.2024.100249

Husein, M. H., Nounkeu, C. D., Armah, S. M., & Dharod, J. (2023). Examination of water quality at the household level and its association with diarrhea among young children in Ghana: Results from UNICEF-MICS6 survey. PLOS Water, 2(6), e0000049. https://doi.org/10.1371/journal.pwat.0000049

Islamiyati, S., Lestarisa, T., Augustina, I., Sri Yuliani, N. N., & Jelita, H. (2024). Relationship between drinking water sources and bacteriological water quality with occurrence of diarrhea in children in the Murjani Bawah settlement area, Palangka Raya City. Barigas, 1(3). https://doi.org/10.37304/barigas.v1i3.8006

Khan, J. R., Hossain, Md. B., Chakraborty, P. A., & Mistry, S. K. (2022). Household drinking water E. coli contamination and its associated risk with childhood diarrhea in Bangladesh. Environmental Science and Pollution Research, 29. https://doi.org/10.1007/s11356-021-18460-9

Mukharomah, N. A., & Achmadi, U. F. (2024). Clean water for small islands in Indonesia: Case study of child diarrhea in Kelapa and Kelapa Dua Islands, Kepulauan Seribu. Journal of Health Research, 13(2), 106–113. https://doi.org/10.31983/jrk.v13i2.12159

Nissa, G. B., & Pujiastuti, P. (2024). Identification of Escherichia coli and organic substances based on the distance from the dug well to the septic tank. Journal of Environmental, Industrial, and Health Biology, 11(1), 24–31. https://doi.org/10.31289/biolink.v11i1.11485

Odetoyin, B., Ogundipe, O., & Onanuga, A. (2021). Prevalence of diarrheagenic Escherichia coli and associated risk factors in dug wells in Ile-Ife, Southwestern Nigeria. Research Square. https://doi.org/10.21203/rs.3.rs-255440/v1

Rusdi, M., Pramistyowati, M. B., Farindra, I., & Irawan, D. (2022). Relationship of water source location and physical quality of water with the occurrence of diarrhea in toddlers (Purwodadi Village, Purwodadi District, Pasuruan Regency). Medical and Health Science Journal, 6(02), 7–11. https://doi.org/10.33086/mhsj.v6i02.3070

Suleiman, K., Kolo, I., Mohammed, S. S. D., & Magaji, Y. G. (2022). Bacterial diarrhea among infants in developing countries: An overview of diarrheagenic Escherichia coli (DEC). Gadau Journal of Pure and Applied Sciences, 1(1), 73–81. https://doi.org/10.54117/gjpas.v1i1.10