

Relationship between Bacteriological Quality of Drilled Well Water and the Incidence of Diarrhea among Families

Lilis Banowati*, Heni Fa'riatul Aeni, Cucu Herawati, and Ani

Public Health Departement, Sekolah Tinggi Ilmu Kesehatan Cirebon, Cirebon, Indonesia

*lilisbanowati508@yahoo.com

Abstract: The morbidity and mortality rates in Indonesia due to diarrhea are still high. Diarrhea can be transmitted through water which is the main media in the transmission of diarrhea. In addition to food and disease vectors, diarrhea can occur if someone consumes drinking water that has been contaminated from its source or polluted during the distribution process to the house. This study aims to determine the relationship between bacteriological quality of drilled well water and the incidence of diarrhea in families. This was an analytic survey study, with cross sectional approach. The populations were the heads of the families who had a drilled well in the family at Wotgali Village as many as 25 people. The sampling technique used total sample method. Data were obtained directly by observation and interview. Secondary data were obtained from Plered Community Health Center in Plered Subdistrict regarding the occurrence of diarrhea, data from the PSDAP Office on the bacteriological quality of drilled well water and population data were obtained from the Wotgali Village office. Analysis of study data included the bacteriological quality of drilled well water that had been examined in the laboratory and compared with the Regulation of Health Minister No.416 Year 1990, and the incidence of diarrhea. Bacteriological quality of drilled well water variable and the incidence of diarrhea variable were analysed using the exact fisher test with a 95% confidence level. The results showed that 17 (85.0%) drilled well did not meet the requirements in the Regulation of Health Minister no.416 Year 1990 regarding bacteriological quality of wellbore water, namely the existence of *Escherichia coli*. 17 families (68.0%) families had diarrhea in the last 3 months. Fisher exact test result obtained a p-value of 0.001 (0.001 < 0.05) so that there was a relationship between the bacteriological quality of drilled well water and the incidence of diarrhea in families at Wotgali Village, Plered Subdistrict, Cirebon District in 2016.

1. Introduction

Healthy environment is an optimal state or condition of the environment so that it positively influences the realization of an optimal health status as well. Environmental conditions can affect public health condition. Many aspects of human welfare are influenced by the environment, including the existence of diseases that occur in society which can be influenced by environmental factors.[1]

Water plays a very important role in life of humans, animals and plants. The entire chemical process in the body of living things takes place with water media. Water is used for various purposes such as for daily activities in the household, transportation, power generation, recreation, agriculture, and fisheries.[1]



Water is very abundant on the earth of about 70% of the earth's surface or amounting to 1.4 thousand million cubic kilometers. At a glance water supply seems sufficient to meet the needs of every resident, but in reality water is often available in inappropriate places. Of the abundant amount of water, only a small portion is actually utilized, which is around 0.003%. Most of the water, about 97% is in the ocean or sea, and the salinity is too high for most purposes. Of the remaining 3%, approximately 87% of water is contained as a layer at the poles or very deep underground.[2]

At present, the main problems faced by water resources include the quantity of water that has been unable to meet the increasing needs and the declining quality of water for domestic needs. Industrial, domestic and other activities have a negative impact on water resources, including causing a decrease in water quality. This condition may cause disturbance, damage, and danger to all living things that depend on water resources.[2]

According to Law No. 23 Year 1992 article 22 paragraph 3 concerning health it is stated that water sanitation includes the security and determination of water quality for various needs of human life. Water sanitation efforts aim to ensure the availability of drinking water or clean water that meets the health requirements of the entire community, both urban and rural. To guarantee the availability of water quality that meets health requirements, various efforts have been carried out by the government and the community, including the construction and improvement of clean water or drinking water facilities, efforts to control water quality and counseling regarding the relationship between health and the availability of water that meets health requirements.

An *Escherichia coli* bacterium is one of the pollution indicators that is used as an indication of human or animal feces pollution. Water that is polluted by human or animal feces cannot be used for drinking, washing food or cooking purposes because it is considered to contain pathogenic microorganisms that are harmful to health.[3]

The bacteria that may cause diseases such as included in the enteric group can last a long time outside the body. The organism can be transmitted mechanically by flies that breed in domestic waste piles around the residence.[3]

The incidence of diarrhea in the United States also occurs among adults, it is estimated that 8,000,000 patients go to the doctor and more than 250,000 patients are hospitalized each year (1.5% are adult patients) due to diarrhea. The frequency of diarrhea in developing countries including Indonesia is more than two to three times compared to developed countries.[4]

The morbidity survey conducted by the Diarrhea Sub Directorate of Health Department from 2000-2010 showed an increase tendency in the incidence. Outbreaks (OB) of diarrhea also still occur frequently, with still a high CFR. In 2008 there were outbreaks in 69 districts with 8133 cases with 239 deaths (CFR 2.94%). In 2009 there were outbreaks in 24 districts with a total of 5,756 cases, with 100 deaths (CFR 1.74%), while in 2010 there were outbreaks of diarrhea in 33 districts with 4204 patients with 73 deaths (CFR 1.74%).[4]

Diarrhea can be transmitted through water which is the main media in the transmission of diarrhea. In addition to food and disease vectors, diarrhea can occur if someone consumes drinking water that has been contaminated from its source or polluted during the distribution process to the house.[4]

The village of Wotgali is a furniture craftsman area, and most of the people work as employees of furniture making, and some are furniture entrepreneurs. Wotgali Village is a densely populated area and is placed in one of the small street in a slum area and many people did not know about the importance of clean and healthy life, so that many people experienced by diarrhea. There were 36 people who had diarrhea recorded from December to February 2016.[5]

This study aims to determine the relationship between bacteriological quality of drilled well water and the incidence of diarrhea in families.

2. Methods

This was an analytic survey study. The design used in this study was observation with a cross sectional approach. The independent variable in this study was the bacteriological quality of drilled well water (*Escherichia coli* content). The dependent variable in this study was the incidence of diarrhea. The

populations were the heads of the families who had a drilled well in the family at Wotgali Village, amounting to 25 people. The sampling technique used total sample method. Data were obtained directly by observation and interview. Secondary data were obtained from Plered Community Health Center in Plered Subdistrict regarding the occurrence of diarrhea, data from the PSDAP Office on the bacteriological quality of drilled well water and population data were obtained from the Wotgali Village office. Analysis of study data included the bacteriological quality of drilled well water that had been examined in the laboratory and compared with the Regulation of Health Minister No.416 Year 1990, and the incidence of diarrhea. Bacteriological quality of drilled well water variable and the incidence of diarrhea variable were analysed using the chi-square test, to determine the relationship between variables using a 95% confidence level ($\alpha = 0.05$), if the chi-square test requirements were not met then an exact fisher test was used.

3. Results

3.1 Description of the Existence of Drilled Wells at Wotgali Village in 2016

Table 1. Description of the existence of drilled wells

No	The Existence of the Drilled Well	Frequency	Percentage (%)
1	Distance between septic tank and drilled well		
	- <10 meters	8	32
	- ≥ 10 meters	17	68
2	The depth of the drilled well		
	- <20 meters	7	28
	- 20 – 40 meters	18	72

Based on table 1 it was shown that 68% families had the distance between septic tank and drilled wells of ≥ 10 meters, while 32% families had the distance between septic tank and drilled wells of <10 meters. 28% of families had the depth of drilledwell water of <20 meters while 72% of families had the depth of drilledwell water of 20-40 meters.

3.2 Bacteriological quality of Drilled Well Water

Table 2. Distribution of drilled well water content

Category	Frequency	Percentage (%)
Did not meet the requirements	20	80
Meet the requirements	5	20
Total	25	100

Based on table 2, out of 25 samples, 80% of the samples did not meet the requirements and 20% met the requirements in accordance with Regulation of Health Minister of the Republic on Indonesia No.416 of 1990.

3.3 Description of the Incidence of Diarrhea

Table 3. The incidence of diarrhea

Incidence of Diarrhea	Frequency	Percentage (%)
Existed	17	68
Did not exist	8	32
Total	25	100

Based on table 3 it turned out that in the last 3 months there were family members who experienced diarrhea, namely as many as 17 families (68%).

3.4 Relationship between Bacteriological quality of Drilled Well Water and the Incidence of Diarrhea

Table 4. Relationship between bacteriological quality of drilled well water and the incidence of diarrhea among families

No	The content of Escherichia coli	Incidence of Diarrhea				Total	P value	
		Yes		No				
		n	%	n	%			
1	Did not meet the requirements	17	85	3	15	20	100	0.001
2	Meet the requirements	0	0	5	100	5	100	

Based on table 4 it was shown that of the 20 drilled water wells that did not meet the requirements, as many as 17 families (85.0%) experienced diarrhea within the last 3 months. Whereas, from the 5 wells that met the requirements, no family experienced diarrhea. Because the data did not meet the chi square requirements, the analysis used fisher exact test. Based on the fisher exact test result, it was obtained a p-value of 0.001 ($0.001 < 0.05$) so that it can be concluded there was a significant relationship between the bacteriological quality of drilled well water and the incidence of diarrhea among families at Wotgali Village, Plered Subdistrict, Cirebon District in 2016.

4. Discussion

4.1 Description of Drilled Well

The sources of clean water used by residents of Wotgali Village were drilled wells. Drilled wells in the environment have a depth of around 20-40 meters. The minimum depth of drilled water is 20 meters, it is due to if the depth of the well is less than 20 meters, the people will only get infiltration water from the surface of the ground, this infiltration water usually contains bacteria that are harmful to health. Drilled well with a depth of less than 20 meters is at risk of experiencing water shrinkage during the dry season, when the flow of well water decreases during the this season.

Based on the laboratory test on drilled well water, there were 20 (80%) samples with the presence of Escherichia coli in the drilled well water that did not meet the health requirements in accordance with Regulation of the Minister of Health no.416 Year 1990.[6]

Based on the results of field observations it can be seen that the entire drilled wells did not meet construction requirements completely. Construction of well that did not meet the requirements was due to several factors, including residents who did not know about the characteristics of wells that met health requirements and the impact on health if these requirements were not met, especially the requirement of the distance of the well from the source of pollution that is the septic tank.

The existence of the source of pollution such as a septic tank is bad if it is <10 meters from the drilled well since this allows the occurrence of drilled well water pollution by bacteria come from the source of the pollution.[7]

It is also important to note the distance between the well and the septic tank as the source of pollution. Based on the requirements regarding location or the distance to the source of pollution such as septic tank, 8 (32%) families had the distance between septic tank and drilled wells of <10 meters while 17 (68%) families had the distance between septic tank and drilled wells of ≥ 10 meters.

4.2 Bacteriological quality of Drilled Well Water

The source of clean water for some residents at Wotgali Village is from drilled wells. Clean water that meets health requirements has physical, chemical and biological parameters that must be fulfilled, among others it cannot contain pathogenic microorganisms that can cause disease. To find out the presence of pathogenic bacteria it must be done a test on the presence of Escherichia coli bacteria

which is an indicator of water pollutants. This parameter is found in water contaminated with human feces and this condition can cause interference among humans in the form of diarrhea disease due to the content of pathogenic bacteria. Requirement for the amount of E. coli allowed are 0/100 ml of water sample.[6].

Based on the data obtained about bacteriology, it was proven that there was E.coli bacteria contained in the drilled wellwater, namely that 80% of the samples did not meet the requirements in accordance with Regulation of the Minister of Health no.416 Year 1990.

4.3 Description of the Incidence of Diarrhea

Based on the results of the study at Wotgali Village among the owners of the drilled wells, it was shown that 17 families (68%) had family members who experienced diarrhea in the last 3 months. Diarrhea is a waterborne disease which is still a major problem in developing countries including Indonesia. Diarrhea is generally caused by the quality of environmental hygiene and sanitation that still does not meet the requirements. This disease is an infectious disease characterized by symptoms such as: changes in the shape and consistency of the stool to become soft until it melts and the frequency of bowel movements is increased more than usual (three or more times a day) accompanied by vomiting, so the sufferer will experience deficiency in body fluids (dehydration) which if not treated, in the end it immediately can cause death.[8]

4.4 Relationship between Bacteriological quality of Drilled Well Water and the Incidence of Diarrhea

Well water is used by residents for drinking, cooking, washing, bathing and others. For drinking and cooking purposes they should boil water until it reaches boiling point of 100°C. According to Pratiwi (2008) one of the factors that influenced bacterial growth was temperature. E. coli bacteria is included in mesophilic bacteria that can grow optimally at a temperature of 20 – 45°C.[9]

Besides that well water containing E. coli can also contaminate cooking and eating utensils, Thus, washing tableware is very important to understand to make the equipment clean and healthy.[10]

Based on Fisher exact test result, it was obtained p-value of 0.001 ($0.001 < 0.05$) so that there was a significant relationship between bacteriological quality of drilled well water and the incidence of diarrhea among families at Wotgali Village, Plered Subdistrict, Cirebon District in 2016. This result is in line with the study conducted by Profita (2014) which stated that there was a relationship between the bacteriological quality of clean water and the incidence of diarrhea among infants ($p = 0.001$).

5. Conclusions

Regarding bacteriological quality of drilled well, 20 (80%) families had the presence of Escherichia coli that did not meet the requirements in accordance with Regulation of the Minister of Health no.416 Year 1990. There were 17 (68%) families who experienced diarrhea in the last 3 months. Based on Fisher exact test result, it was obtained p-value of 0.001 ($0.001 < 0.05$) so that there was a significant relationship between bacteriological quality of drilled well water and the incidence of diarrhea among families at Wotgali Village, Plered Subdistrict, Cirebon District in 2016.

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