

DESCRIPTION OF ESCHERICHIA COLI CONTENT IN DRINKING WATER DIARRHEA SUFFERING IN GEBANGAN VILLAGE

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ABSTRACT

Description Of the Escherichia Coli Content in The Drinking Water of Diarrhea Sufferers in Gebangan Village. Diarrhea is a digestive system disorder characterized by the frequent passage of stools three or more times a day. According to Riskesdas, the prevalence of diarrhea in Indonesia in 2018 was 8%, translating to 1 million cases. Generally, diarrhea is caused by the Escherichia coli bacteria, which can be present due to contamination from open defecation and livestock waste. This study employs a quantitative approach with a descriptive research design. The research was conducted in Gebangan Village, involving ten respondents diagnosed with diarrhea between July and December 2022. Examining the host factors, it was found that most respondents did not treat their drinking water (60%) and consumed less than 2 liters of water per day (70%). Regarding environmental factors, 70% of respondents sourced their drinking water from drilled wells or pumps, and the majority (70%) had a piping system at their drinking water source. Additionally, 50% of respondents had their drinking water source located less than 10 meters from pollutant sources. Regarding the agent factors, the physical parameters of drinking water for all respondents (100%) indicated no taste and no odor. However, 50% of respondents reported that their drinking water was colored. The assessment of Escherichia coli content in the drinking water of the ten respondents revealed that only one respondent (10%) had drinking water contaminated with Escherichia coli bacteria. Future researchers are encouraged to investigate drinking water containers and other factors that can influence the presence of Escherichia coli, such as clean and healthy living behaviors and food sanitation.

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INTRODUCTION

Diarrhea is a digestive system disorder characterized by the frequency of defecating three times or more a day. Changes in stool consistency, from solid to liquid, also occur in diarrhea sufferers. According to the WHO, diarrhea is the world's number one cause of death for children under five. ⁽¹⁾ In 2018, the prevalence of diarrhea in Indonesia reached 8%, or 1 million cases. ⁽²⁾ Meanwhile, in 2019, the number of under-five deaths due to diarrhea reached 314 cases, making diarrhea the disease with the highest number of deaths in toddlers. ⁽³⁾ In East Java, there were 98 thousand cases of diarrhea, and 91 thousand of them were not

toddlers. In Kapongan District, it is estimated that there are 18 thousand cases of diarrhea, but only 10 thousand cases, or 58%, have been treated. Gebangan Village is one of the villages in Kapongan District, Situbondo Regency. In 2022, according to data from the Kapongan Community Health Centre, the target for finding diarrhea cases is estimated to be around 1,082 cases, with Gebangan Village having as many as 130 cases. This makes Gebangan Village the third village in Kapongan District, with the goal of finding the most cases. However, by the end of 2022, the number of cases that had been found was only 33.

Diarrhea can occur due to infection by bacteria or viruses in the digestive system. In general, diarrhea is caused by *Escherichia coli* bacteria. These bacteria can usually be found in the human intestine and can be excreted in human feces. *Escherichia coli* bacteria, which are excreted with feces, can enter the body through ingestion or consumption of food and drink, one of which is drinking water.

Total coliforms and *Escherichia coli* can be found in water due to contamination from human and livestock waste. ⁽⁴⁾ In addition to this, several factors influence the presence of microbiological content in water, such as the distance to sources of pollution and the quality of drinking water treatment. The microbiological content of water is significantly influenced by the piping system at the water source. done by comparing the microbiological content of tap water and water sources, which have quite significant differences. This can occur when there is a leak in one of the piping systems, leading to significantly different measurement results between the water source and the tap water. Water containing microbiology is consumed continuously, it can cause digestive system disorders such as diarrhea. ⁽⁷⁾

Based on the results of initial observations carried out in Gebangan Village in May 2022, it is known that of the 102 respondents interviewed, 75 used drilled wells as drinking water, 15 used dug wells as a source of drinking water, 5 used PDAM as a source of drinking water, and the rest used refillable or bottled water as drinking water. Drinking water obtained from drilled wells, dug wells, and PDAMs is consumed without being treated before consumption, so there is a possibility that the water still contains microbiology.

Gebangan Village has significant potential for water contamination. This is due to the behaviour of people who still often throw rubbish in rivers or prefer to burn the rubbish produced. ⁽⁸⁾ The geographical condition of Gebangan Village, which has many rivers passing by, means that people prefer to throw away rubbish and defecate in the river. In addition to this, the majority of people construct cowsheds adjacent to their homes, which can lead to the contamination of water sources with the resulting manure.

Research is needed to understand the relationship between *Escherichia coli* and digestive disorders so that appropriate treatment can be given immediately. The aim of this research is to determine the presence of *Escherichia coli* bacteria in the drinking water of diarrhea sufferers in Gebangan Village.

MATERIALS AND RESEARCH METHODS

This research is a descriptive-observational study. Observational descriptive research is used to describe the conditions of the community being studied based on the variables studied. The quantitative approach method was carried out by measuring the *Escherichia coli* content in the water and conducting interviews with home owners to determine the presence of *Escherichia coli* based on influencing variables. The research was carried out in Gebangan Village, Kapongan District, Situbondo Regency, and took place from October 2022 to June 2023.

The population in this study was the people of Gebangan Village who had been diagnosed with diarrhea by the health centre during July–December 2022, totaling 11 people. This study employed total sampling to determine the sample size, as the population was less than 100. However, due to one individual receiving two diagnoses during the study period, the sample size was limited to 10 individuals.

The variables examined in this research are distance to pollutant sources, type of water source, piping system, physical parameters, drinking water treatment, and drinking water consumption, which were obtained through interviews and observation. Apart from that, there is also the *Escherichia coli* variable, which was obtained through laboratory tests at the Situbondo Regency Regional Health Laboratory. Officers from the Situbondo District Regional Health Laboratory assisted in taking drinking water samples by using alcohol to clean the tip where the water comes out and by using tools such as sterile glass bottles and coolboxes.

We process the obtained data using the SPSS application, first editing it to identify any incomplete information. Next, coding is carried out to make it easier to analyse the data, and finally, tabulation is carried out to classify the data that has been obtained based on the variables.

The processed data was analysed using two methods, namely univariate analysis and cross-tabulation analysis. Univariate analysis was carried out to determine the frequency distribution of each variable. Meanwhile, cross-tabulation analysis was used to determine the interaction between the *Escherichia coli* variable and other variables studied, such as distance to pollutant sources, type of water source, and drinking water treatment.

RESEARCH RESULTS AND DISCUSSION

Univariate Analysis

Host factors

Table 1. Assessment Based on Host Factors

Variable	Frequency (f)	Percentage (%)
Drinking Water Treatment		
Not Cooked	6	60
Cooked	4	40
Total	10	100
Drinking Water Consumption		
≥2L/day	3	30
<2L/day	7	70
Total	10	100

Table 1 shows that out of 10 respondents, there are still many people whose drinking water treatment has not been cooked first, namely 6 respondents (60%), and 4 respondents (40%) who cook it. Apart from that, if we look at the pattern of drinking water consumption every day, as many as 7 respondents (70%) admitted that their family members drink <2 L/day of water, while 3 respondents (30%) admitted that their family members drink ≥2 L/day of water. If the drinking water you consume contains *Escherichia coli* bacteria, it can accumulate in the body.

Environmental factors

Table 2. Assessment Based on Environmental Factors

Variable	Frequency (f)	Percentage (%)
Source of Drinking Water		
Dig well	3	30
Drilled well/pump	7	70
Total	10	100
Distance to Pollutant Sources		
<10 meters	5	50
≥10 meters	5	50
Total	10	100
Piping System		
There is	7	70
There isn't any	3	30
Total	10	100

According to Table 2, the majority of respondents use drilled wells or pumps as a source of drinking water; seven respondents (70%) and three respondents (30%) use dug wells as a source of drinking water. If we look at the distance from the pollutant source, there were 5 respondents (50%) whose distance between the drinking water source and the pollutant source was <10 meters. Likewise, there were 5 respondents (50%) who were ≥10 metres from the source of drinking water to the source of pollution. In addition, the majority of respondents (70%) use a piping system, while 3 respondents (30%) do not use one.

Physical parameters

Table 3. Assessment of Physical Parameters of Drinking Water

Variable	Frequency (f)	Percentage (%)
Taste Indicator		
Taste	0	0
Tasteless	10	100
Total	10	100
Odor Indicator		
Smelly	0	0
Odorless	10	100
Total	10	100
Color Indicator		
Colored	5	50
Colorless	5	50
Total	10	100

Table 3 shows that all of the drinking water consumed by respondents, namely 10 respondents (100%), was tasteless. Apart from that, all respondents also used odourless drinking water (100%). However, regarding the colour indicator, there were 5 respondents (50%) whose drinking water was coloured and 5 respondents (50%) who did not drink coloured water.

Escherichia coli

Table 4. Laboratory results for *Escherichia coli* examination

Variable	Frequency	Percentage (%)
<i>Escherichia coli</i> content		
Exceeds threshold (>0/100ml)	1	10
Does not exceed the threshold (0/100ml)	9	90
Total	10	100

According to Table 4, the majority of results measuring the *Escherichia coli* content in respondents' drinking water did not exceed the threshold, namely 9 respondents (90%). Meanwhile, one respondent obtained an *Escherichia coli* content measurement of 1/100 ml, which exceeded the threshold set in Minister of Health Regulation No. 49 of 2010 regarding drinking water quality requirements.

Cross Tabulation Analysis

Escherichia coli content based on host factors

Table 5. *Escherichia coli* content based on host factors

Drinking Water Management	<i>Escherichia coli</i> content				Total
	Exceed (>0/100ml)	(%)	Do not exceed (0/100ml)	(%)	
Not Cooked	0	0	6	66.7	6
Cooked	1	100	3	33.3	4
Total	1	100	9	100	10

Table 5 shows that there was 1 *Escherichia coli* bacteria in the cooked drinking water samples, and no *Escherichia coli* bacteria were found that exceeded the threshold in the

unboiled drinking water samples. There were 6 samples of uncooked drinking water and 3 samples of cooked drinking water that did not contain *Escherichia coli* bacteria.

Escherichia coli content based on environmental factors

Table 6. Content *Escherichia coli* Based on Type of Water Source

Type of Water Source	Escherichia coli content				Total
	Exceed (>0/100ml)	(%)	Do not exceed (0/100ml)	(%)	
Dig well	0	0	3	33.3	3
Drilled well/pump	1	100	6	66.7	7
Total	1	100	9	100	10

Table 6 reveals that one drinking water sample, originating from drilled wells or pumps, had an *Escherichia coli* content that exceeded the threshold, while no drinking water samples from dug wells had such a content. There were 3 drinking water samples from dug wells and 6 from drilled wells or pumps whose *Escherichia coli* content did not exceed the threshold.

Table 7. Content *Escherichia coli* Based on Distance of Pollutant Source

Distance to Pollutant Sources	Escherichia coli content				Total
	Exceed (>0/100ml)	(%)	Do not exceed (0/100ml)	(%)	
<10 meters	0	0	5	55.6	5
≥10 meters	1	100	4	44.4	5
Total	1	100	9	100	10

Table 7 reveals that a single sample with a distance of less than 10 metres from the pollutant source had an *Escherichia coli* content that exceeded the threshold, while no samples with a distance of less than 10 metres from the pollution source showed any such content. There were 5 drinking water samples that had a distance of <10 metres and 4 drinking water samples that had a distance of ≥10 metres whose *Escherichia coli* content did not exceed the threshold

Drinking Water Treatment

According to Wardhani and Putri's (2021) research, water that is consumed without prior processing contains a lot of microbiology, as evidenced by the presence of microbiology in 13 out of 20 samples studied. The study conducted by Sektioningrum et al. (2020) in East Java Province revealed that out of the 29 water samples, 8 exceeded the threshold, with the highest content being >1600/100 ml. So, treating water before consumption is something that must be done, such as cooking it first. Cooking water until it boils (100 °C) can kill the microbiology in the water.

The form of processing referred to in this research is cooking first before consumption. According to the interview findings, 60% of respondents did not process or boil the water first. Drinking water that has not been boiled first allows bacteria such as *Escherichia coli* to enter the water when it is consumed. ⁽¹²⁾ This condition was also found in the research conducted by Nurmalasari et al. (2019), who found that the raw water used was positive for containing *Escherichia coli* bacteria. Therefore, processing the water to be consumed aims to ensure that the drinking water consumed does not cause health problems.

Drinking Water Consumption

There were 7 respondents (70%) who consumed less than 2 litres of drinking water per day. Dehydration is the most serious risk when suffering from diarrhea. When experiencing diarrhea, the body loses a significant number of fluids due to frequent and watery bowel movements. Therefore, it is crucial to replenish these fluids by consuming an adequate amount of drinking water. (World Health Organisation, 2017). On research by Arda et al. (2020), it was also found that the problem that often arises in diarrhea sufferers is a lack

of fluids. As a result, the need for drinking water consumption must be met in order for the diarrhea to not worsen.

Source of Drinking Water

The community in Gebangan Village uses dug wells, drilled wells, and pumps to provide drinking water. Of the 10 respondents, there were 3 respondents (30%) who used dug wells and 7 respondents (70%) who used drilled wells or pumps. According to research by Arsyina et al. (2019), many drinking water samples originating from groundwater contain microbiology, compared to drinking water originating from DAMIU. In this research, it was found that 11 samples of boiled well water contained high microbiological levels.

Not only does it affect the *Escherichia coli* content in water, but the choice of drinking water source can also be an indirect cause of diarrhea. According to research by Zara and Fitriany (2021), the daily consumption of drinking water sources influences the incidence of diarrhea because people continue to use unprotected sources. However, according to research conducted by Marini et al. (2020) in South Sumatra Province, the relationship between diarrhea and well water, both unprotected and protected, showed that these two sources of drinking water did not cause diarrhea.

Distance to Pollutant Sources

Rivers and livestock pens are sources of pollution that exist around the community in Gebangan Village and have the potential to reduce the quality of drinking water. To prevent contamination from pollutant sources, the ideal distance between drinking water sources and pollutant sources is at least 10 meters. In this study, it was found that 5 respondents had a distance between pollutant sources and drinking water sources of 10 meters or more, while 5 other respondents still had a distance of less than 10 meters. According to Gufran and Mawardi (2019), a distance of less than 10 meters between the pollutant source and the water source can cause bacteriological contamination in the form of *Escherichia coli* and coliform.

Study Hasanain et al. (2019), conducted at the Dasan Lekong Community Health Centre, stated that the distance of the cage from the water source had an effect on the incidence of diarrhea. Of the 101 respondents who had an inappropriate distance between the cage and the water source, 100 experienced diarrhea because livestock waste contained various types of microbiology that could cause diarrhea. However, according to research Setiyono (2019) conducted in Tasikmalaya City, there was no influence between the distance of the dug well to the faeces disposal site and the incidence of diarrhea because the community had processed it before consuming it.

Piping System

A total of 7 respondents used a pipe system to obtain water from drilled wells or pumps. The piping system's disadvantage is that when a leak occurs in the pipe, repairs must be carried out immediately so that the water used does not become contaminated. ⁽²²⁾ According to research conducted by Marini et al. (2020) in South Sumatra Province, people who used tap water experienced diarrhea, which could be caused by leaks in the distribution pipes.

***Escherichia coli* content**

A total of nine water samples that have been tested in the laboratory show that they are free from *Escherichia coli*, while one sample showed that it still contained *Escherichia coli*. According to Hasanah et al. (2023), microbial contamination is related to the incidence of diarrhea. Research conducted by Kadir et al. (2021) also showed that of the 6 toddlers who suffered from diarrhea, 5 of them used drinking water containing *Escherichia coli*.

Physical Parameters

According to the research results, all the water samples examined had no smell or taste, but of the 10 samples, there were 5 that did not meet the colour parameters. According to research by Rimbawati and Surahman (2019), the physical quality of water influences the incidence of diarrhea in toddlers. Respondents whose physical water quality meets the requirements have a 7.268 times higher chance of avoiding diarrhea compared to respondents whose physical water quality does not meet the requirements.

Escherichia coli Content Based on Host Factors

In the results of this study, of the 10 respondents, only 1 (100%) found *Escherichia coli* bacteria in their drinking water, and this respondent had boiled their drinking water before consuming it. These results are certainly not in line with theory (CDC, 2022), which explains that boiling water can kill the microbiological content of the drinking water that will be consumed. Research conducted by Nawan et al. (2023) found that at temperatures of 70 °C to 100 °C, there was no detectable growth of *Escherichia coli*. *Escherichia coli* can be destroyed by cooking it at 700 °C or more for a minimum of one minute at that temperature. (CDC, 2022).

The possibility of contamination occurs after cooking, namely during containerization. According to research by Wahyudinir and Pujiono (2023), the type of container used can cause microbiological contamination even after the water has been boiled. According to Iqbal et al. (2019), it is also stated that factors that can cause drinking water contamination are location, presentation, and type of container.

Escherichia coli content based on environmental factors

According to the research results, out of the 7 respondents who used drilled wells or pumps, there was one drinking water sample that contained 1/100 ml of *Escherichia coli*. These results are in accordance with research conducted by Afifah (2019), which states that not all groundwater contains *Escherichia coli* bacteria. This is adjusted to match the distance between the water source and the septic tank. However, this research does not agree with the research conducted by Sari et al. (2021), who found that all of the 5 dug well water samples studied contained *Escherichia coli* with an average content of 2012 MPN/100 ml.

The presence or absence of *Escherichia coli* in drinking water sources can be influenced by several things. According to Sari et al. (2021), factors that influence the presence of *Escherichia coli* in drinking water sources include the distance between irrigation canals, rice fields, and septic tanks that are close to drinking water sources. Additionally, according to Widiyanti (2019), there are two factors that can influence groundwater quality: natural factors, which include climate, vegetation, soil, rocks, and time, and non-natural factors that can arise due to human activities.

Apart from drinking water sources, the distance between pollutant sources and drinking water sources also determines the level of *Escherichia coli* in drinking water. Based on the results of research on six drinking water sources located ≥ 10 metres away, there was one drinking water source that contained *Escherichia coli*. These results are not in accordance with research conducted by Kusumoachmad et al. (2020). According to the results of this study, the farther the pollution source is from the water source, the lower the *Escherichia coli* content in the water, and vice versa.

Other factors that can cause diarrhea include handler and food sanitation. In their research, Girsang et al. (2023) found that the results showed that some of the handlers did not have good sanitation, which affected the incidence of diarrhea. Food sanitation, environmental sanitation, and poor behaviour influence food contamination, which can cause diarrhea. ⁽³⁴⁾

CONCLUSIONS AND RECOMMENDATIONS

According to laboratory examinations, there was one drinking water sample that did not meet the requirements for *Escherichia coli*. According to the cross-tabulation results, *Escherichia coli* bacteria were found in boiled drinking water, while *Escherichia coli* bacteria were not found in uncooked drinking water. Apart from that, *Escherichia coli* bacteria are found in drinking water that comes from drilled wells or pumps and is more than 10 metres away from the source of pollution. The presence of *Escherichia coli* bacteria in water that has been cooked and is more than 10 metres away from the source of pollution is likely caused by other factors such as contamination that occurs during the container or sanitation of the handler. There is a need for regular examination of *Escherichia coli* bacteria in drinking water so that a clear picture of *Escherichia coli* bacteria in drinking water can be obtained and further research can be carried out regarding contamination of drinking water containers, sanitation of handlers, and other factors that can cause diarrhea.

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