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Original Research Article

Relationship between Risk Factors for Dug Well Contamination with Total Coliform Counts in Dug Well Water

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Abstract
Dug well water can be a source of disease transmission if contaminated by pathogenic bacteria. Many people in Purworejo Regency still use dug wells as a source of drinking water. This secondary data study aims to determine the risk factors associated with total coliform counts in dug well water in the working area of the Purworejo District Health Office in 2022. Cross sectional research design and data analysis techniques chi square test with fisher alternative test. The population was 61 dug wells that had been carried out Environmental Health Inspections on Household Drinking Water Quality Study data and a sample of 53 dug wells. The research was conducted in August-October 2022. The results showed an association between the risk factors of well wall condition (p value = 0.041) and well cover (p value = 0.048) to the total number of dug well coliforms. It is recommended to the local community to improve the physical condition of dug wells, especially well walls and well covers so that contaminating substances from outside the well do not enter and contaminate dug well water.

Keywords: Total coliform; contamination; dug wells

1. Introduction

Water is the main need that is needed by humans and other living things. According to UNESCO, the average human right to water is 60 liters per person per day (UNESCO, 2002). The Directorate General of Human Settlements of the Ministry of Public Works also states that the need for clean water varies by location. Rural areas require 60 liters of clean water per capita per day, small cities have a clean water requirement of 90 liters per capita per day, medium cities with a clean water requirement of 110 liters per capita per day, large cities with a clean water requirement of 130 liters per capita per day, and metropolitan areas with a clean water requirement of 150 liters per capita per day. In order to create a good degree of public health, one of them is the availability of adequate water in terms of quantity and meeting hygiene and safety requirements in terms of quality (Solihin et al., 2020). Clean water quality requirements are regulated in Permenkes RI No. 32 of 2017 concerning environmental health standards and water health requirements for sanitary hygiene purposes, swimming pools, solus per aqua, and public baths. If the community still has difficulty in accessing proper drinking water, it can result in difficulties in getting clean water that can be used as a source of drinking water so that this can have an impact on the emergence of health problems. According to a WHO report, there are around 844 million people around the world who still have difficulty in accessing adequate drinking water (WHO, 2017).

One of the most common sources of clean water used by the community is dug well water. Dug wells are water sources that are easily contaminated by bacteriology because dug well water comes from water close to the ground surface so that waste from the surface easily seeps into the well (Mahardika et al., 2018). The seepage can come from human, animal waste and waste resulting from the activities of the well water users themselves (Tangkilisan et al., 2018). The occurrence of contamination in dug wells

results in a decrease in the water quality of dug wells (Dewi et al., 2019). Contamination is the state of contamination of something by other elements that can have adverse effects. Contamination in dug wells can be caused by several risk factors such as well walls that are not watertight at least 3 m from ground level, do not have a well lip ± 80 cm and do not crack, the well floor is not watertight and less than 1 m wide, does not have a well cap and does not have a good wastewater sewerage and the distance of the pollutant source is < 10 m. Construction of dug wells affects the bacteriological clean water in the working area of the Tekung Health Center (Apriliana et al., 2017). Construction of dug wells that are not made properly can cause the entry of pollutants into the well (Souisa & Janwarin, 2018).

Total coliform is one of the biological requirements that can be used as a benchmark to determine water quality because the number of coliform colonies must be positively correlated with the presence of disease-causing pathogenic bacteria. The higher the total coliform content in water, the higher the disease-causing pathogenic bacteria contained in the water (Widyaningsih et al., 2016). The total number of coliforms in clean water should not exceed 50/100 mL of water because it can cause waterborne diseases (Departemen Kesehatan RI, 2017).

Based on data that analyzed by author, it was found that from 108 samples tested by microbiology, there were 30 positive samples containing total coliform with 23 clean water samples coming from dug wells. According to the results of interviews conducted with employees of the Purworejo District Health Office who conducted the Study of Drinking Water Quality for Households it was found that when making observations found several wells that did not meet the requirements so that they were at risk of contamination. In addition, there has been no similar research conducted in Purworejo Regency. The purpose of this study was to determine the relationship between contamination risk factors and the total amount of coliforms in dug wells. Based on the description above, the author is interested in further researching what are the risk factors for contamination related to the total amount of coliform in dug wells in the working area of the Purworejo District Health Office in 2022. It is hoped that this research can provide information and input to the Purworejo District Health Office and can increase public knowledge about the quality of dug well water in terms of risk factors. In addition, the author can also add insight into the field of microbiological water quality testing.

2. Method

This research is a quantitative type with a cross sectional design. Research activities were carried out from August to October 2022 in the working area of the Purworejo District Health Office. This study used secondary data from the Purworejo District Household Drinking Water Quality Study in March-May 2022. The instruments used were Environmental Health Inspection sheets and microbiological research results. The independent variables in this study were the condition of the dug well wall, the condition of the dug well lip, the condition of the dug well floor, the well cover, the sewerage and the source of pollution. While the dependent variable is the total number of coliforms. The number of coliforms refers to Permenkes No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene Purposes, Swimming Pools, Solus per Aqua, and Public Baths. In this study, the data collected were 108 clean water samples sourced from springs, dug wells, boreholes and also PAMSIMAS. Then the data was sorted again by only taking data sourced from dug wells because from the results of microbiological examinations it was found that clean water from dug wells was most polluted by total coliform. Of the 108 clean water samples, 61 dug wells were obtained which will be used as the population in this study. Furthermore, the sample determination was carried out using the Slovin formula with a significant level of 5% and obtained as many as 53 samples taken using simple random sampling technique. After that, the data were analyzed using data processing applications in the form of univariate tests and bivariate tests. Univariate tests were conducted to see the frequency distribution of data and bivariate tests to see the relationship between the independent variable and the dependent variable. The bivariate analysis used was the chi square statistical test with an alternative test, namely the Fisher test.

3. Result

The samples used in this study were 53 samples from 61 dug well populations that had been carried out by Environmental Health Inspection in the 2022 Purworejo Regency Household Drinking Water Quality Study (SKAMRT) data. Risk factors for contamination in this study consisted of well walls, well lips, well floors, well cover, wastewater sewerage, and pollutant sources grouped into risky and non-risky while the total number of coliforms was grouped into qualified and not eligible. The frequency distribution of risk factors for contamination of dug wells is presented in Table 1.

Table 1. Frequency distribution of factors associated with the total number of coliforms in dug well water

Variable	N	%
Total Number of Coliforms		
Not eligible (> 50/100 ml)	19	35.8%
Qualified (≤ 50/100 ml)	34	64.2%
Total	53	100%
Well Wall Condition		
Yes (Risk)	11	20.8%
No (No risk)	42	79.2%
Total	53	100%
Well Lip Condition		
Yes (Risk)	13	24.5%
No (No risk)	40	75.5%
Total	53	100%
Well Floor Condition		
Yes (Risk)	13	24.5%
No (No risk)	40	75.5%
Total	53	100%
Well Caps		
Yes (Risk)	34	64.2%
No (No risk)	19	35.8%
Total	53	100%
Wastewater Sewerage		
Yes (Risk)	18	34.0%
No (No risk)	35	66.0%
Total	53	100%
Polluting Sources		
Yes (Risk)	23	43.4%
No (No risk)	30	56.6%
Total	53	100%

Source : (Secondary data of Purworejo Regency Household Drinking Water Quality Study, 2022)

Based on Table 1, it is known that there are 19 (35.8%) dug wells that do not eligible for the total number of coliforms, namely more than 50/100 mL and 34 (64.2%) dug wells that qualified, namely the total number of coliforms ≤ 50/ 100 mL, risk factors for dug well contamination based on the variable condition of the dug well wall, there are 11 (20.8%) dug wells have risky walls and 42 (79.2%) dug wells have non-risky walls; Based on the variable condition of the lip of the dug well, there are 13 (24.5%) dug wells that are risky and 40 (75.5%) dug wells are not at risk, based on the variable condition of the well floor, there are 13 (24.5%) dug wells at risk and 40 (75.5%) dug wells are not at risk, based on the well cap variable, there are 34 (64.2%) dug wells at risk and 19 (35.8%) dug wells are not at risk, based on the variable sewerage there are 18 (34.0%) dug wells at risk and 35 (66.0%) not at risk, and based on the variable polluting source there are 23 (43.4%) dug wells at risk and 30 (56.6%) dug wells that are not at risk. The results of the bivariate analysis between the risk factors for dug well contamination and the total amount of coliforms in dug well water are shown in Table 2.

Table 2. Cross-tabulation between risk factors for dug well contamination with total coliform amount in dug well water

Variable	Total Number of Coliforms				Total		*p value*	PR
	Not eligible		Qualified					
	n	%	N	%	n	%		
Well Wall Condition								
Yes (Risky)	7	63.6%	4	36.4%	11	100%	0.041	4.375
No (Not risk)	12	28.6%	30	71.4%	42	100%		
Well Lip Condition								
Yes (Risk)	5	38.5%	8	61.5%	13	100%	1.000	-
No (Not risk)	14	35.0%	26	65.0%	40	100%		
Well Floor Condition								
Yes (Risk)	4	30.8%	9	69.2%	13	100%	0.749	-
No (Not risk)	15	37.5%	25	62.5%	40	100%		
Well Close								
Yes (Risk)	16	47.1%	18	52.9%	34	100%	0.048	4.741
No (Not risk)	3	15.8%	16	84.2%	19	100%		
Wastewater Sewerage								
Yes (Risk)	6	33.3%	12	66.7%	18	100%	1.000	-
No (Not risk)	13	37.1%	22	62.9%	35	100%		
Polluting Sources								
Yes (Risk)	10	43.5%	13	56.5%	23	100%	0.468	-
No (Not risk)	9	30.0%	21	70.0%	30	100%		

Source : Secondary Data of Purworejo Regency Household Drinking Water Quality Study 2022

Based on Table 2, it can be seen that of the 11 dug wells that have risky wall conditions, 7 dug wells (63.6%) do not eligible for total coliform counts and 4 dug wells (36.4%) qualified for total coliform counts, while of the 42 dug wells that have non-risky wall conditions, 12 dug wells (28.6%) do not eligible for total coliform counts and 30 dug wells (71.4%) qualified for total coliform counts. The results of statistical tests using alternative tests, namely the fisher test, obtained a value of $p = 0.041$ ($p < 0.05$), from these results it can be concluded that there is a relationship between the condition of the walls of dug

wells with the total number of coliforms in dug well water in the working area of the Purworejo District Health Office.

The results of bivariate analysis between the condition of the lip of dug wells and the total number of coliforms found that of the 13 dug wells that had the condition of the lip of the well at risk, there were 5 dug wells (38.5%) that did not eligible for the total number of coliforms and 8 dug wells (61.5%) qualified for the total number of coliforms, while of the 40 dug wells that had the condition of the lip of the well were not at risk, there were 14 dug wells (35.0%) that did not eligible for the total number of coliforms and 26 wells Dig (65.0%) qualified total amount of coliform. The results of statistical tests using the chi square method obtained a value of p= 1,000 ($p > 0.05$) so that it can be concluded that there is no relationship between risk factors for the condition of the well lip and the total number of coliforms in dug wells in the work area of the Purworejo District Health Office.

From cross-tabulation, it is known that there are 13 dug wells that have risky floor conditions with 4 dug wells (30.8%) not eligible the total number of coliforms and 9 dug wells (69.2%) qualified for the total number of coliforms while of the 40 dug wells that have floor conditions that are not at risk, there are 15 dug wells (37.5%) not eligible for the total number of coliforms and 25 dug wells (62.5%) qualified for the total number of coliforms. The results of the statistical test showed a value of p= 0.749 ($p > 0.05$) which means that there is no relationship between the condition of the risk factors of the well floor and the total amount of coliforms in dug wells in the working area of the Purworejo District Health Office.

The cross-tabulation table between the risk factors for dug well contamination and the total number of coliforms in dug well water showed that of the 34 dug wells that had risk well cover, 16 dug wells (47.1%) did not eligible for the total number of coliforms and 18 dug wells (52.9%) qualified for the total number of coliforms, while of the 19 dug wells that had non-risk cover, 3 dug wells (15.8%) did not eligible for the total number of coliforms and 16 dug wells (84.2%) qualified total amount of coliform. Based on the results of the chi square test, the result of p value = 0.048 means p value < 0.05 so that it can be concluded that there is a relationship between the risk factors of well cover and the total amount of coliform in dug wells in the working area of the Purworejo District Health Office.

Based on Table 2, it is known that of the 18 dug wells that have wastewater sewerage at risk, 6 dug wells (33.3%) do not eligible for the total number of coliforms and 12 dug wells (66.7%) qualified for the total number of coliforms, while of the 35 dug wells that have wastewater sewerage that is not at risk, 13 dug wells (37.1%) do not eligible for the total number of coliforms and 22 dug wells (62.9%) qualified for the total number of coliforms. From the results of statistical tests using the chi square test, a value of p = 1,000 (p > 0.05) was obtained, which means there is no relationship between wastewater sewerage risk factors (SPAL) and the total number of coliforms in dug wells in the working area of the Purworejo District Health Office.

In the table 2, it can be seen that of the 23 dug wells that have a source of risk pollutants, 10 dug wells (43.5%) do not eligible for the total number of coliforms and 13 (56.5%) dug wells qualified for the total number of coliforms while of the 30 wells that are not at risk there are 9 dug wells (30.0%) do not eligible for the total number of coliforms and 21 dug wells (70.0%) qualified for the total number of coliforms. Based on the results of statistical tests using the chi square test, a value of p= 0.468 ($p > 0.05$) was obtained so that it can be concluded that there is no relationship between risk factors for polluting sources and the total number of coliforms in dug wells in the working area of the Purworejo District Health Office.

4. Discussion

Dug wells are a source of clean water that is widely used by the community for daily purposes such as cooking, purifying and so on. Dug well water is susceptible to bacterial contamination because it is close to the ground surface. Total coliform is a bacterium that can contaminate dug well water and is used as an indicator in determining the quality of clean water. If total coliform is found in high amounts

in water then there is a possibility of other bacteria contained in the water because total coliform is positively correlated with other pathogens so the higher the level of contamination of coliform bacteria, the higher the risk of other pathogenic bacteria (Bambang et al., 2014). Based on Permenkes RI No. 32 of 2017, the total amount of coliforms allowed in clean water is <50/100 mL of water. If the total amount of coliforms in clean water exceeds 50/100 mL of water, then the water is not eligible for daily use because it can cause health problems. One source of water that is easily polluted is drinking water from wells. Water can be contaminated if the sanitary condition of the dug well is not healthy, such as the construction of walls, lips, floors, sewerage, and infiltration holes. In addition, the layout of the dug well must be in accordance with the distance between the well and pollutant sources, such as garbage bins, garbage tanks, and sewerage (Rasako et al., 2018; Zulfikar, 2018).

4.1 Relationship between Risk Factors for Well Wall Conditions and Total Number of Coliforms

Based on the results of statistical tests obtained a value of p = 0.041 (p < 0.05), from these results it can be concluded that there is a relationship between the condition of the walls of dug wells with the total number of coliforms in dug well water in the working area of the Purworejo District Health Office with a value of RP= 4,375, which means that the condition of the walls of unqualified dug wells has a risk of 4,375 times the total number of coliforms. The risky condition of the dug well wall is that it has a distance of less than 3 meters from the ground surface and is not made of impermeable and strong material. The results of this study are in line with research conducted by Rahayu (2019) in the residential environment of RW IV Jabungan Semarang City which shows that there is a significant correlation between the condition of the dug well wall and the bacteriological quality of total coliform. Unqualified condition of dug well walls can cause a high possibility of contamination of dug well water, causing a decrease in water quality (Rahayu et al., 2019).

Based on other observations, it is known that many of the dug wells used by residents have qualified, namely concrete well walls. However, there are still cracks in the walls of the dug wells, potentially causing pollution of the dug well water. The community feels that the dug wells they built are safe and pollution-free because the walls of the dug wells are made of concrete so that the water quality of the dug wells is clean.(Zulfikar, 2018). Well walls that are not impermeable to water can cause dirty water around the well to seep and enter through the pores on the well wall and flow into the dug well, causing the well to become polluted (Wicaksana, 2019). Well walls with a height of less than 3 meters from ground level can cause the entry of bacteria through the soil, therefore the well wall must be made of impermeable material at least 3 meters from ground level because in general bacteria cannot live at that depth (Sangadjisowohy, 2019). Well walls made of more than 3 meters can also prevent landslides on the ground around the dug well facility.

4.1.1 Relationship between Risk Factors for Well Lip Conditions and Total Number of Coliforms

The results of the univariate test showed that the condition of the well lip was not at more risk, namely as many as 40 dug wells (75.5%) and from the results of bivariate analysis obtained a value of *p*= 1,000 (*p* > 0.05) which means that there is no relationship between risk factors for the condition of the well lip with the total number of coliforms in dug wells in the working area of the Purworejo District Health Office. The lip of the well that is not risky is the lip of the well that has a height of at least 80 cm from the floor and is made of strong and water-tight material. If the lip of the dug well is less than 80 cm and cracked, it can increase the risk of contamination of dug well water because water from the surface can seep into the well.

This study showed no relationship between risk factors for well lip conditions and total coliform because as many as 40 of the 53 dug wells had met the well lip qualified or were not at risk. Of the number of wells that have qualified or are not at risk, as many as 26 wells dug or 65.0% of the total amount of coliforms below the quality standard, namely <50/100 mL of water. This is because most of the lips of dug wells have used concrete with a height of approximately ± 80 cm so that the total number of dug well

coliforms in the working area of the Purworejo Regency Health Office may not be caused by the condition of the well lips. Qualified well lips are intended to maintain the safety of its users and prevent water that has been used from flowing into the well again (Khomariyatika & Pawenang, 2011).

4.2 Relationship between Risk Factors for Well Floor Conditions and Total Number of Coliforms

Based on the results of univariate analysis, it can be seen that the variable condition of the well floor is at most not at risk, namely 40 dug wells (75.5%). The floor of a dug well that is not risky is a dug well whose floor around the well is watertight and has a minimum width of 1m. The results of the bivariate test showed no relationship between risk factors for the condition of the dug well floor and the total number of coliforms with a value of p= 0.749 (p > 0.05). This is because most of the well floors in this study were not risky or qualified, namely as many as 40 of the 53 dug wells were not at risk with 25 dug wells (62.5%) having qualified for the total number of coliforms. The floor around the dug well is usually made of a layer of cement although there are still some cracked floors. Ikbal Nur in his research also stated that there was no relationship between the floor of dug wells and the bacteriological quality of dug well water in RW 03 Ujung Bori Kelurahan Bitowa Makassar City (Nur et al., 2021). Qualified floor conditions can prevent water from the well surface from seeping into or seeping into the well, so researchers assume that the total coliform in dug well water in the working area of the Purworejo District Health Office is not affected by the condition of the well floor.

4.3 Relationship between Risk Factors for Well Caps and Total Number of Coliforms

The univariate test showed that in the variable of well cover most did not have a lid or were at risk, namely 34 dug wells (64.2%) and from the results of the chi square test obtained a p value = 0.048, meaning that there was a relationship between the well cover and the total number of coliform in dug wells. The value of PR = 4,741, From these results it can be interpreted that the well lid that does not eligible can risk 4,741 times to the total number of coliforms in dug well water. Dug wells that do not have caps can increase the risk of contamination of dug well water because contamination substances from outside the well can easily enter the dug well. Based on the results of the Environmental Health Inspection, there were 34 out of 53 dug wells that had risky well caps with 18 dug wells (52.9%) not eligible for the total amount of coliform. The results of this study are in line with research conducted by Ashuro (2021) which states that there is a relationship between the well cap and the coliform content in dug wells in Southern Ethiopia (Ashuro et al., 2021). Based on the results of the Environmental Health Inspection, there were 34 out of 53 dug wells that had risky well caps with 18 dug wells (52.9%) not eligible for the total amount of coliform.

4.4 Relationship between Sewerage Risk Factors and Total Coliform Count

In the results of univariate tests, it is known that the most risk factors for wastewater sewerage are not at risk of 35 dug wells (66.0%). Dug wells that are not at risk are dug wells around which have good wastewater disposal channels so there are no puddles around the well that have the potential to enter the dug well. The results of the chi square test also showed that there was no relationship between wastewater sewerage risk factors and the total number of coliforms in dug wells in the working area of the Purworejo District Health Office with a value of p= 1,000 (p > 0.05). This study shows no relationship because almost all dug wells studied already have qualified wastewater sewerage channels, namely as many as 35 of the 53 dug wells already have good wastewater sewerage with 22 well samples (62.9%) have qualified for the total number of coliforms. A well-made sewerage can prevent pollution in dug wells (Syafarida et al., 2022) so researchers assume that the total amount of coliforms in dug wells in the Purworejo District Health Office work area is not caused by wastewater sewerage.

4.5 Relationship between Risk Factors of Contaminant Sources and Total Number of Coliforms

Univariate tests showed that the risk factor for the most polluting sources was not at risk of 30 dug wells (56.6%). Dug wells that are not at risk are dug wells around which there are no sources of pollution such as septic tanks, livestock pens, garbage and waste with a distance of ≤ 10 meters. Based on the results of statistical tests using the chi square test, a value of p= 0.468 (p > 0.05) so it can be concluded that there is no relationship between risk factors for polluting sources and the total amount of coliforms in dug wells in the working area of the Purworejo District Health Office. There was no link in this study because as many as 30 of the 53 dug well samples had non-risk polluting sources with 21 wells (70.0%) qualifying for the total number of coliforms. Around the dug wells there are mostly no sources of pollution ≤ 10 meters. The distance of dug wells that are farther from polluting sources will reduce the number of bacteria carried by water because of the presence of minerals contained in the soil that can filter particles and bacteria through it so that the farther the distance of the polluting source, the higher the level of filtration that makes bacteria in well water also more efficient (Siswandi et al., 2020).

5. Conclusions

Based on the research that has been done, it can be concluded that there is a relationship between contamination risk factors consisting of factors in the condition of the walls of dug wells and well caps with the total amount of coliforms and there is no relationship between contamination risk factors consisting of factors such as well lip conditions, well floor conditions, wastewater sewerage (SPAL) and polluting sources with the total amount of coliforms in dug wells. Based on the research that has been done, it can be concluded that there is a relationship between contamination risk factors consisting of factors in the condition of the walls of dug wells and well caps with the total amount of coliforms and there is no relationship between contamination risk factors consisting of factors such as well lip conditions, well floor conditions, wastewater sewerage (SPAL) and polluting sources with the total amount of coliforms in dug wells.

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References

Apriliana, C. & Sunarko, B. 2017. Pengaruh Konstruksi Sumur Gali Terhadap Kualitas Bakteriologis Air Bersih Di Puskesmas Tekung Kabupaten Lumajang Tahun 2017. Gema Lingkungan Kesehatan, 15(3), 43–49.

Ashuro, Z., Aregu, M. B., Kanno, G. G., Negassa, B., Soboksa, N. E., Alembo, A., Ararsa, E., Badecha, F., & Tassew, S. 2021. Bacteriological Quality of Drinking Water and Associated Factors at the Internally Displaced People Sites, Gedeo Zone, Southern Ethiopia: A Cross-sectional Study. Environmental Health Insights, 15, 0–5.

Bambang, A. G., Novel, dan, & Kojong, S. 2014. Analisis Cemaran Bakteri Coliform Dan Identifikasi Escherichia Coli Pada Air Isi Ulang Dari Depot Di Kota Manado. PHARMACON Jurnal Ilmiah Farmasi – UNSRAT Agustus, 3(3), 2302–2493.

Departemen Kesehatan RI. 2017. Peraturan Menteri Kesehatan Republik Indonesia Nomor 32 Tahun 2017 Tentang Standar Baku Mutu Kesehatan Lingkungan Dan Persyaratan Kesehatan Air Untuk Keperluan Higiene Sanitasi, Kolam Renang, Solus Per Aqua dan Pemandian Umum.

Dewi, P. N. Y., Darundiati, Y. H., & Setiani, O. 2019. Hubungan Sanitasi Lingkungan Dan Bakteriologis Air Sumur Gali Dengan Kejadian Diare Di Kelurahan Genuksari Kecamatan Genuk Kota Semarang. Jurnal Kesehatan Masyarakat (e-Journal), 7(4), 187–194.

Khomariyatika, T., & Pawenang, E. T.(2011. Kualitas Bakteriologis Air Sumur Gali. Jurnal Kesehatan Masyarakat, 7(1), 63–72.

Mahardika, A. N. T., Rahardjo, M., & Yunita D, N. A. 2018. Gambaran Kualitas Bakteriologis Air Sumur Gali di Wilayah Kerja Puskesmas Pengasih 1 Kabupaten Kulon Progo. Jurnal Kesehatan Masyarakat (e-Journal), 6(6), 8–16.

Nur, I., A. Rizki Amelia, & Sumiaty. 2021. Hubungan Konstruksi Sumur dengan Kualitas Air Sumur Gali Di Kelurahan Bitowa Kota Makassar. Window of Public Health Journal, 2(5), 1239–1250.

Rahayu, P., Joko, T., & Dangiran, H. L. 2019. Hubungan Faktor Risiko Pencemaran Sumur Gali Dengan Kualitas Bakteriologis Di Lingkungan Pemukiman Rw Iv Kelurahan Jabungan Kota Semarang. Jurnal Kesehatan Masyarakat (e-Journal), 7(3), 156–163.

Rasako, R. F., Joko, T., & Dangiran, H. L. 2018. Hubungan Kualitas Bakteriologis Air Sumur Gali Dengan Kejadian Diare Di Kelurahan Waihaong Kota Ambon. Jurnal Kesehatan Masyarakat (e-Journal), 6(2), 143–150.

Sangadjisowohy, D. 2019. Uji Kandungan Bakteriologi Pada Air Sumur Gali Ditinjau Dari Konstruksi Sumur Di Kelurahan Sangaji Kecamatan Ternate Utara. Jurnal Kesehatan Masyarakat, 9(0451), 20–27.

Siswandi, E., Abdullah, T., & Majdi, M. 2020. Hubungan Antara Jarak Sungai Sebagai Sumberpencemar Dengan Kandungan Coliform Pada Sumur Gali the Relationship Between River Distance As a Source of Pollutants With Coliform Content of the Dug Wells. Jukung Jurnal Teknik Lingkungan, 6(2), 129–135.

Solihin, D., Prasetiyani, D., Sari, A. R., Sugiarti, E., & Sunardi, D. 2020. Pemanfaatan Botol Bekas Sebagai Penyaring Air Bersih Sederhana Bagi Warga Desa Cicalengka Kecamatan Pagedangan Kabupaten Tangerang. Dedikasi PKM UNPAM, 1(3), 98.

Souisa, G. V., & Y. Janwarin, L. M. 2018. Kualitas Sumur Gali di Dusun Wahakaim. HIGEIA (Journal of Public Health Research and Development), 2(4), 612–621.

Syafarida, U. Y., Jati, D. R., & Sulastri, A. 2022. Analisis Hubungan Konstruksi Sumur Gali dan Sanitasi Lingkungan Terhadap Jumlah Bakteri Coliform Dalam Air Sumur Gali (Studi Kasus : Desa PAL IX , Kecamatan Sungai Kakap). Jurnal Ilmu Lingkungan, 20(3), 437–444.

Tangkilisan, sharon laurenzi mariabie, Joseph, W. B. S., & Sumampouw, O. jufri. 2018. Hubungan Antara Faktor Konstruksi dan Jarak Sumur Gali Terhadap Sumber Pencemaran dengan Total Coliform Air Sumur Gali di Kelurahan Motto Kecamatan Lembeh Utara. Jurnal KESMAS, 7(4).

UNESCO. 2002. The UN Committee on Economic, Social and Cultural Rights adopted its general comment No. 15 on the right to water stating.

WHO. 2017. Effect of glucagon on ethanol oxidation in isolated rat liver cells. In Experientia, 37(6)

Wicaksana, A. 2019. Identifikasi Serta Hubungan Konstruksi Sumur Gali Terhadap Kandungan Coliform Pada Air Sumur Gali Di Dusun Jiken Kabupaten Lombok Timur. Bioscientist : Jurnal Ilmiah Biologi, 7(2), 115–122.

Widyaningsih, W., Supriharyono, & Widyorini, N. 2016. Analisis Total Bakteri Coliform di Perairan Muara Kali Wiso Jepara. Diponegoro Journal Of Maquares, 5, 157–164.

Zulfikar, R. 2018. Hubungan Risiko Tercemar Sumur Gali Dengan Keberadaan Bakteri Escherichia coli di Gampong Daroy Kameu Kec. Darul Imarah Kab. Aceh Besar Tahun 2017. Nasuwakes:Jurnal Kesehatan Ilmiah, 11, 150–166.