The Effect of Environmental Factors on the Event of Acute Diarrhea

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Abstract: ***Diarrhea is an environment-based disease endemic in Indonesia with a high prevalence rate resulted from contaminated dug wells. From this study, we want to know the influence of environmental factors, namely microbiology of water, clean water facilities (CWF), toilet facilities and sewerage facilities (SF) and the availability of trash bins against the incidence of acute diarrhea. We used cross sectional observational analytic study with a total of 228 users of dug wells and 38 dug wells that met the inclusion criteria in the Community Health Center. We used questionnaires and checklists to collect data of variables CWF, latrine, SF and availability of trash bins also laboratory results from the Kediri Regional Health Laboratory for water microbiology. We analyzed the data by Chi square test and Linear Regression and the bivariate test results showed that water microbiological factors p = 0,000, CWF p = 0,000, toilet facilities p = 0,001 and SF p = 0,005 which significantly affected the incidence of diarrhea. The multivariate test results showed that water microbiological factors had the most significant effect on the incidence of diarrhea (p = 0,000; OR: 4,67; 95% CI: 2,51 - 8,7). The need for counseling interventions as well as improving the quality of well water and CWF by improving well construction, checking well water regularly and cooking well water before consumption. There exist a need to form a closed, permanent and non-stagnant SF and the construction of clean toilets, non-soil floors and a distance of septic tanks > 10m from CWF.***

Keywords: ***Clean water facilities, diarrhea, dug wells, latrines, waste water disposal facilities.***

I. INTRODUCTION

Diarrhea is defined as part of three or more runny stools or a number of stools that are formless or flabby in 24 hour period, with or without one of the following symptoms: fever, abdominal pain or cramps, nausea and vomiting. In 2016, diarrhea was the eighth leading cause of death among all ages and the fifth was the leading cause of death among children under 5 deaths occur in children under 5 years, and around 90% (89, 37%) of diarrhea deaths occur in southern Asia and sub-Saharan Africa [1].

Diarrhea is an environment-based disease [2]. Many risk factors are thought to cause diarrheal disease. One of the factors is poor environmental sanitation, unhygienic water supply, and lack of knowledge [3]. Safe and healthy water is a basic requirement for good health [4]. Water sources in low-income countries and rural areas are at risk of contamination [5].

The main cause of waterborne diseases is microbiological contamination [6]. Water microbiological contamination is responsible for most waterborne diseases, especially diarrhea [4]. Microbiological contamination of water can be caused by bacteria, protozoa, viruses and fungi that mostly originate from waste disposal and other human activities [7]. The most bacteria in contaminated water are E. coli, Salmonella sp., Shigella sp., Campylobacter sp. E. Coli is the most found bacterium that causes diarrhea [8]. Fecal contamination has been detected in groundwater sources in various developed and developing countries.

Based on recent studies in Bangladesh, 65% of dug wells contain faeces / thermotolerant coliforms and Escherichia coli (E. coli) that were some of the indicators of contamination of faeces. Possible mechanisms for contamination are infiltration of the contaminant from nearby latrines, septic tanks, and ponds into groundwater aquifers, the connection of short-flow contaminated surface water into wells through unsealed well components, or accumulation of bacteria in water pumps that contaminated [9]. Microbiological examination of water can determine whether the water is contaminated or not so that it can help determine actions in the prevention of diarrhea such as through counseling about water treatment before consumption [10].

II. METHODS

This study was analytic observational with a cross sectional study design. This research was conducted in the K City. The total sample of this study were 228 dug well users who had diarrhea and no diarrhea during December 2018 to February 2019. The sampling technique that used in this research was simple random sampling.

The dependent variable in this study was the incidence of diarrhea in all age groups of users of dug wells while the independent variables in this study are microbiological levels of dug well water, clean water facilities, family toilet facilities, sewerage facilities, garbage disposal facilities.

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Testing of water for the number of Coli group bacteria is carried out in several levels, namely: approximate testing, affirmation testing, and complete testing. How to calculate the Nearest Probable Number (MPN) Approximate Amount (JPT). The positive number of tubes from the assay of the assertion assumption and complete testing of the coli group testing of the double tube procedure is a combination and stated in terms of MPN or JPT.

III. RESULTS

A. *Univariate analysis of Characteristics of Respondents Based Microbiology Air, Clean Water, Toilet Facilities, SF, Trash*

Based on table 1, the respondent obtained by simple random sampling number of 228 respondents, of which 72 (31.6%) had suffered from diarrhea in the last 3 months and 156 (68.4%) do not suffer from diarrhea in the last 3 months. The respondent who had the microbiology result is good was 112 (49,1%) and the respondent who had the water microbiology is not eligible was 116 (50,9%). The respondent who had the quality of clean water result is good was 116 (50,9%) and the respondent who had the clean water was not eligible is 112 (49,1%). The respondent who had the quality of means latrine result is good was 101 (44,3%) and the respondent who had the means latrine was not eligible is 127 (55,7%). The respondent who had the quality of means SF result is good was 123 (53,9%) and the respondent who had the means SF was not eligible is 105 (46,1%). The respondent who had the quality of means trash result is good was 135 (57,9%) and the respondent who had the means SF was not eligible is 96 (42,1%).

A. Bivariate Analysis Relationship Between Water Microbiology factor, CWF, toilet and Means Means SF with Genesis Diarrhea

The data analysis in table 2 showed that there is a correlation between microbiological water means clean water, toilet facilities and means SF against diarrhea while means trash showed no relationship to the incidence of diarrhea in the wells in Public Health Center of Northern Territory Town of Kediri. Relationships water microbiology laboratory results on the incidence of diarrhea has a significant value of p (0.000). Clean water facilities have been associated with diarrhea with significant value of p (0.000). Latrines have been associated with diarrhea with significant value of p (0.000). SF has been associated with diarrhea with significant value of p (0.005). Means bins have significant value of p (0.176) on the incidence of diarrhea.

B. Multivariate Analysis Relationship Between Water Microbiology factor, CWF, toilet and Means Means SF with Genesis Diarrhea

Multivariate analysis of factors affecting the incidence of diarrhea in the wells in Public Health Center of Northern Territory town of Kediri using logistic regression as the table below.From table 3 noted that the variables that had a p-value <0.05 was water microbiology. Microbiology of water has a sig. = 0.000 which means the respondent with the results of microbiological underground water in wells that do not qualify have an influence on the incidence of diarrhea in Public Health Center of Northern Territory town of Kediri. Value OR (odds ratio) obtained is 4.67 meaning that the possibility of diarrhea in the wells with underground water microbiology results that do not qualify higher diarrhea 4.67 time the wells with underground water microbiology results that qualify , Because OR> 1 can also be said the wells with underground water microbiology results that do not qualify higher chance against diarrhea.

Table- I: Result of Univariate Analysis of Characteristics of Respondents

Diarrhea			
Factor	**Total**	**Percent**	**Total**
Diarrhea	72	31,6%	228 (100%)
Not Diarrhea	156	68,4%	
Total	228	(100%)	
Water Mictobiology			
Factor	**Criteria**	**Percent**	**Total**
Quality	E. Coli (-)	112 (49,1%)	112 (49,1%)
	Total Coliform < 50	112 (49,1%)	
Not Eligible	E. Coli (+)	27 (11,8%)	116 (50,9 %)
	Total Coliform > 50	111 (48,6%)	
Total	228 (100 %)		
	Clean water		
Quality	Colorless	112 (49,1%)	112 (49,1 %)
	Not smelling	112 (49,1%)	
	Not feeling	112 (49,1%)	
Not Eligible	Colored	94 (41,2%)	116 (50,9 %)
	Smelling	79 (34,6%)	
	Taste	7 (3,1%)	
	Means Latrine		
Quality	Clean	101 (44,3%)	101 (44,3 %)
	Ceramic floor	101 (44,3%)	
	Distance cesspools >10m	101 (44,3%)	
Not Eligible	Not clean	101 (44,3%)	101 (44,3 %)
	Not ceramic floor	101 (44,3%)	
	Distance from cesspools >10m	101 (44,3%)	
	Means SF		
Quality	Close and not stagnant	123 (53,9 %)	123 (53,9 %)
	Permanent	123 (53,9 %)	
	Not smelling	123 (53,9 %)	
Not Eligible	Open and welled	88 (38,6%)	105 (46,1 %)
	Non permanent	30 (13,2%)	

	No Odor	76 (33,3%)	
	Means Trash		
Quality	Close	135 (57,9 %)	135 (57,9 %)
	Waterproof	135 (57,9 %)	
	Not strewn	135 (57,9 %)	
Not Eligible	Open	79 (34,6%)	96 (42,1 %)
	Not waterproof	79 (34,6%)	
	Strewn	64 (28,1%)	

Well users with water microbiology results that do not qualify chance of diarrhea by 47%. Users wells with water microbiology results were eligible likely to occur diarrhea by 18.7%. From Wald test results are known only one significant variable, namely microbiological water so that when used as a percentage of 10.9% (Cox & Snell R Square) effect on the incidence of diarrhea.

Table- II: Result of The Bivariate Analysis

Factor	Criteria	Diarrhea		Total	P
		No diarrhea	Diarrhea		
Clean Water	Qualify	83.9%	16.1%	100%	0000
	Not eligible	53.4%	46.6%	100%	
Means Latrine	Qualify	83.2%	16.8%	100%	0000
	Not eligible	56.7%	43.3%	100%	
Means SF	Qualify	76.4%	23.6%	100%	0005
	Not eligible	59%	41%	100%	
Means Trash	Qualify	72%	28%	100%	0176
	Not eligible	63.5%	36.5%	100%	
Microbiological Groundwater At the Well Drilling	Qualify	84.1%	15.9%	100%	0000

IV. DISCUSSION

In this study, a microbiology of underground water digs, clean water facilities, SF facilities and the ownership of latrine had a significant incidence of diarrhea (p value <0.005) while the disposal garbage had not a significant effect to diarrhea incidence (p value 0.316) at the working area of the public health centre in the northern territory of the city of Kediri.

Diarrhea can be caused by contaminating water in dugs well who provides water that comes from the soil layer which is relatively close from ground level, therefore it can be easily to contamination through seepage. The seepage can comes from a place for human latrines or toilets and animal waste. The seepage also can be from well waste itself.

Research by Rasako said that there was a significant influence between the quality of water microbiology and the incidence of diarrhea. This can be caused by contamination of dug well water from an adjacent distance (less than 10 m) with septic tanks found in 155 respondents. The distance of the septic tank adjacent to dig well is polluted by the *Escherichia coli* water due to the limited land area, and the construction of septic tanks that are not airtight, as well as porosity, the permeability of the soil that can be accessed by infiltration according to the needs caused by bacteria [11].

Research by Asnel and Sari 2019 clean water facilities also have a significant influence on the incidence of diarrhea. The quality of underground water depends on the management of human transport, as well as the physical and chemical characteristics of substances that have a well. Color, smell, taste, pH, turbidity, total coliform and other dissolved ions proved to cause contamination. High turbidity levels due to low air volume in wells. The air volume is less able to cause mud deposits under the surface to be mixed. This can increase the risk of microbial contamination [12].

Many cases of diarrhea caused by people who still used water source from dug wells. The dugs well that did not meet the requirements were a factor in the entry of microbial contamination. The use of drinking water that is not properly cooked and the use of water in washing dishes and bathing is the entry point for the pathogens germs that cause diarrhea. Other things that affect the incidence of diarrhea are latrines. Research conducted by Asnel and Sari states that there is a significant correlation between the use of healthy latrines on the incidence of diarrhea. One of

Table- III: Result of The Multivariate Analysis

	B	Wald	Sign.	Exp (B)	95% CI for EXP (B)	
					Lower	Upper
Water Microbiology (1)	1,542	23 532	.000	4,672	2,506	8710
Constant	-1664	41 876	.000	.189		
No.	Water Microbiology		The formula Y = α + β1X1		Probability of Diarrhea	

1	TMS	Y = -1664 + (1.542 * 1)	47%
2	MS	Y = -1654 + (1.542 * 0)	18.7%

the criteria for healthy latrines was the distance of a septic tank of more than 10 meters [12].

The quality of latrines has an influence on the incidence of diarrhea. It caused by the lifestyle of people who pay less attention to personal hygiene when they finished defecating, it can contaminate food which will be eaten by them. Beside that, the community have not good enough knowledge about making septic tank that needs a minimum range are 10 m so it can't contaminate clean water sources.

In this study, SF also influences because SF that is not managed in advance can cause public health and environment problems, which can be a transmission or media for the proliferation of pathogenic microorganisms, causing odors, sources of water pollution, and the spread of diseases caused by various micro-organisms, such as diarrheal diseases [13].

The waste itself in this study did not affect the incidence of diarrhea, because of the many factors that affect the components of the waste to be able to contaminate well water and disrupt the wells. Some of the garbage in the working area of the Northern Territory partly fulfills the requirements, one of which is the cover of garbage, the destruction of garbage by burning, the garbage is not scattered, and the separation of dry and wet waste. Garbage will cause diarrhea only if it is not managed properly. Organic waste that can rot easily can be a media for the nesting of microorganisms to survive, the presence of a pungent odor attracts some vectors of diseases and disruptive animals such as flies. Dangerous diseases such as diarrhea, cholera, typhus, spread quickly in places where waste management is inadequate [13].

V. CONCLUSION

Water microbiology is the most influential factor on acute diarrhea incident, with the chance of acute diarrhea in improper dug well water users were 4.67 times higher compared to dug well users with the proper microbiology results. This study showed that counselling about the importance of clean water facilities, latrine, and waste water disposal for living society is needed to prevent acute diarrhea.

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