

Environmental risk factors of diarrhea in the coastal communities of Manado city

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Research Paper

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Diarrhea is a major cause of morbidity and mortality in the world. Diarrhea killed about 1.8 million children under five in developing countries. Each year diarrheal disease in infants in developing countries as much as 2 billion cases with an average incidence rate of 3.2 cases every child. One of the risk factor of diarrhea is environmental factor. The purpose of this study is to analyze the occurrence of diarrhea is based on indicators of environmental health in coastal communities of Manado city. A cross sectional questionnaire survey was carried out on 247 families of the Manado city. Forty families were have diarrhea and 207 families weren't have diarrhea included in the study. All the subjects were asked about diarrhea they had experienced in the six previous months. A questionnaire as the instrument and data obtained were tested using the chi squared test with SPSS 18.0

software. The findings of present study showed there was a significant correlation of source of drinking water ($r= 0.351, p<0.05$), existence of latrine ($r= 0,007, p> 0,05$) and type of latrine ($r=0.258, p<0.05$) with diarrhea. However, there was a statistically significant positive correlation found between source of drinking water and type of latrine with diarrhea ($p<0.05$). There was not statistically significant correlation found between existence of latrine with diarrhea ($p>0.05$). Diarrhea occurred at a low rate within this city. This study identified that source of drinking and type of latrine correlated with the diarrhea among families in Manado city.

Key words: Water source, latrine, diarrhea, coastal community.

INTRODUCTION

Based on data from the World Health Organization (WHO), diarrhea is estimated to have caused 1.1 million deaths in the community aged 5 years and over, and 1.5 million deaths in children under 5 years of age in 2009. In 2004 approximately 2.5 billion cases of diarrhea occur and result in 1.5 million deaths among children under the age of five. More than half came from Africa and South Asia. The prevalence of this disease has decreased the death rate of 5 million per year in the past two decades. Diarrhea remains the second leading cause of infant

mortality (16%) after pneumonia (17%) (WHO, 2013).

Diarrhea kills 1.8 million children under five in developing countries. This was an increase of 1.5 million deaths in the last 20 years. The annual incidence of cases of diarrheal disease in children aged less than five years in developing countries as much as 2 billion cases with an average incidence rate of 3,2 cases per child illness. In a community-based study, the ratio between boys and girls under five suffering from acute diarrhea is 1.2: 1.4 (Black, 2007; Mandal, 2013).

Diarrhea is public health problem in developing countries such as Indonesia. Based on the results of Basic Health Research in 2007 showed that the prevalence of clinical diarrhea in Indonesia amounted to 9.0% (4.2% -18.9%). Based on data obtained from the Ministry of Health (2013) showed that the incidence of diarrhea in 2012 as many as 2,843,801 people with morbidity as much as 214 events per 1000 population (Kementerian Kesehatan Republic Indonesia, 2013).

Diarrhea was health problem in North Sulawesi. This disease has a high morbidity. This disease is a disease that is a potential cause of Extraordinary Events. Based on the results of the study of National Planning and Development Ministry in 2010, northern Sulawesi included in the category of medium and high occurrence of diarrhea. The incidence of diarrhea in North Sulawesi in 2008 reached 19 286 cases (Badan Perencanaan dan Pembangunan Nasional, 2010; Dinas Kesehatan Provinsi Sulawesi Utara, 2010).

Manado city is a coastal city that threatened the quality of the environment. This is due to the discharge of wastewater into rivers and waterways city of Manado. On the other hand, the city of Manado has a population of more than 20 thousand people and the population continues to increase because of the public have easy access to natural areas (beaches, rivers and islands), ease of access to services and employment and housing availability. The rapid growth of the coastal city since last 10 years followed by health problems. Based on data obtained from Manado city Health Department in 2008 and 2009 there were five diseases associated with poor environmental quality, namely malaria, leprosy, tuberculosis, dengue hemorrhagic fever (DHF) and the high prevalence of diarrhea. Number of patients with diarrhea increased where 2445 cases in 2011 to 2629 cases in 2013 (Dinas Kesehatan Kota Manado, 2010).

Based on these facts, the government has implemented various strategies to eradicate and control of diarrheal diseases in the form of regulation. These regulations include targeting CFR outbreaks of diarrhea at the time of less than 1 and the number of diarrhea cases as much as 285/1000 inhabitants. Some of the basic implementation of eradication of this disease, among others, the regulation of Ministry of Health Republic Indonesia 1216/Menkes/SK/XI/2001 on Diarrhea Disease Guidelines, Minister of Health of the Republic of Indonesia 852/Menkes/SK/IX/2009 on Community-Led Total National Strategy and the Minister of Health of the Republic of Indonesia HK.03.01/160/I/2010 on the Strategic Plan of the Ministry of Health in 2010 (Department Kesehatan Republic Indonesia, 2001; Department Kesehatan Republic Indonesia, 2009; Kementerian Kesehatan Republic Indonesia, 2010).

Several studies in order to evaluate several factors to be risk factors of diarrhea. Study from Strand were found that a high frequency of bowel movements, not breast fed, young age and had diarrhea in the rainy season is a

risk factor for acute diarrhea (Strand et al., 2012). Genser et al (2006) was showed that the major risk factors (determinants) of diarrhea are low socioeconomic status, poor sanitary conditions, the presence of intestinal parasites, and lack of prenatal examination. The influence of socioeconomic status largely mediated by the living and sanitary conditions. Diarrheal disease is a disease that is based environment. Two dominant factors are water supply and excreta disposal. Both of these factors will interact with human behavior. If environmental factors unhealthy because contaminated with germs diarrhea and accumulates with unhealthy behaviors as well, namely through food and drink, it can cause diarrhea (Sudaryat, 2010).

Preventing diarrhea in infants is to provide exclusive breastfeeding for 6 months and continued until 2 years, throwing feces baby properly, and provide age-appropriate complementary feeding. In addition, by providing drinking water that has been boiled and use of clean water, wash hands with water and soap before eating and after defecation, defecation in the toilet, as well as providing measles immunization is a preventive measure toddler diarrhea (Kementerian Kesehatan Republic Indonesia, 2010). The purpose of this study is to analyze the environmental factors associated with the incidence of diarrhea in coastal communities in the city of Manado.

RESEARCH METHODS

This study used a cross-sectional design. Forty families (have a diarrhea) and 207 families (have not diarrhea) were selected and invited to take part in the present cross-sectional study. The location of research is in the city of Manado which lies between 1°30'-1 [B1]°40' north latitude and 124°40'-126 [B2] °50' east longitude, and is bordered to the north by Sub district Wori (District Minahasa) and Manado Bay, to the east by Sub district Dimembe, south of the Sub district of Pineleng and west by the Gulf Manado/ Sulawesi Sea. Manado city administratively divided into nine sub-districts and eighty-seven urban/rural. Manado city has an area of 157.26,km², which Mapanget sub district has an area of 58,21 km² that most (37%), Bunaken 28,35 km² (28%) and the smallest land area of 1,75 km² sub district Sario (2%)¹⁵ (Figure 1).

Research Variable

The variable is seen that kind of drinking water sources, existence of latrines, and type of latrine as independent variables and the incidence of diarrhea as the dependent variable.

Research Instrument: The instrument was used a

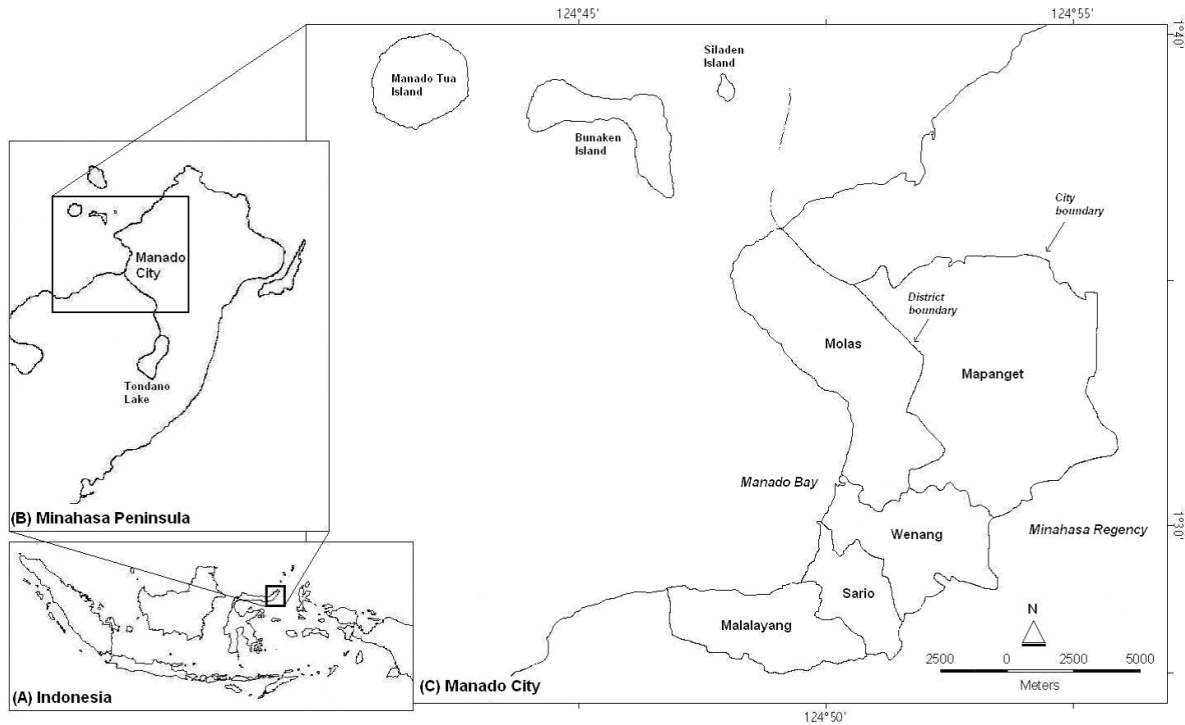


Figure 1. Location of the study (BAPPEDA Kota Manado, 2010).

questionnaire.

Analysis of the Data: The data obtained were tested using the chi squared test with SPSS 18.0 software.

RESULTS AND DISCUSSION

Table 1 shows the basic characteristics of the study's subjects. Drinking water sources, existence of latrines, and type of latrine of the families with and without diarrhea were almost similar. There were statistically significant differences between drinking water sources and diarrhea ($p < 0.05$). Eight families in group with diarrhea and 56 families in group without diarrhea reported to have not good of drinking water source.

There were no statistically significant differences between existence of latrine and diarrhea ($p > 0.05$). Seven families in group with diarrhea and 11 families in group without diarrhea reported to have no latrine. There were statistically significant differences between type of latrine and diarrhea ($p < 0.05$). Ten families in group with diarrhea and 36 families in group without diarrhea reported to have not good type of latrine.

Azhar et al. (2014), showed that diarrhea and typhoid were influenced by the difficulty of the access to get water from sources, difficulty level for obtaining the water, non physical-standards water, low educational background, behavior of hand washing and latrine usage.

The conclusion of this study was water-borne diseases occurred if the access of water was limited, inadequate water's physical quality and unhygienic behavior.

Nugraheni showed that drinking water source, garbage disposal facilities, hand washing after defecate and hand washing before eating has correlation with diarrhea incidence in the Semarang city (Nugraheni, 2012). A study in coverage area of Belopa Health Center Luwu regency showed that water source, breastfeeding and mother's knowledge has correlation with under three children diarrhea incidence (Galman and Wahyuni, 2014).

A study for identified the correlation between health behavior with diarrhea 1-3 years children incidence in Tegowanu Grobogan. This study showed that health behavior such as water source has correlation with diarrhea incidence (Kusumawati et al., 2012). According to the study done in Gorontalo Indonesia, there was correlation between clean water source and type of latrine with under five children diarrhea in coverage area of Pilolodaa Kota Barat region city of Gorontalo (Bumulo, 2014).

The quantitative study research with cross-sectional design with a sample size of 83 respondents, taken at random with a systematic random technique (Systematic Sampling). Results of this research showed that as much as 60.2% of respondents have a sanitary latrine families who are not eligible, 54.2% of respondents have a poor knowledge, 57.8% of respondents said the role of health

Table 1. Results of cross tabulation and chi squared analysis.

		Event of Diarrhea		Total	x ² Value	p-value
		With	Without			
Source of drinking water	Not good	8	56	64	0,351	0,002 (p < 0,05)
	Good	32	151	183		
	Total	40	207	247		
The existence of latrines	No	7	11	18	0,007	0,212 (p > 0,05)
	Yes	33	196	229		
	Total	40	207	247		
Type of latrines	Not good	10	36	46	0,258	0,005 (p < 0,05)
	Good	30	171	201		
	Total	40	207	247		

workers is not good. The results of the bivariate analysis showed that significant relationship between family latrine sanitation with diarrhea incidence (Hilal and Munandar, 2014).

According the study in Sei Musam Kendit village Langkat regency. The result of statistic analysis indicates that there was a significant correlation to the education and ownership of household's latrine, the income ownership of household's latrine, the knowledge on ownership of household's latrine, the ownership of latrine with diarrhea incidence and personal hygiene with diarrhea incidence (Dharma and Santi, 2015). According the study in Tualang Sembilar village Aceh Tenggara regency Indonesia, the results of the statistical test using Chi-square tests were conditions of latrines, knowledge, and attitudes have a significant relationship with diarrhea (Pebriani et al., 2013).

Data of Basic Health Research 2010 report stated that the households with the physical quality of drinking water 'good' by 90% from 86% in 2007. Moreover, it was found that water Drinking Water Company was used as the main source of water for domestic use by 19,7%. There is a shift in the pattern of consumption of drinking water sources, especially in urban areas, where the use of bottled water as drinking water increased from 6,0 percent in 2007 to 7,2 percent in 2010, while the use of depot drinking water as a source of drinking water for 13,8 % (Kementerian Kesehatan Republic Indonesia. 2010).

Household access to protected drinking water sources according to criteria of the Millennium Development Goals (MDGs) by 45,1%, but this has decreased from 2007. When taking into account the bottled water and water from drinking water depot, percentage of households with access to water resources protected drinking to 66,7%. Access to drinking water sources 'quality' which takes into consideration the type of water source protection (including bottled water and drinking water depot), the distance to the source of drinking water, access to drinking water and the physical quality of drinking water for 67,5% (Kementerian Kesehatan Republic Indonesia. 2010).

In 2005, an estimated level of public investment of only USD 2 or IDR 22 thousand per capita per year. It is not enough to expand the service and to maintain assets related to water facilities. In addition, fragmented policy responsibility in different ministries. Since decentralization was introduced in Indonesia, local government (sub district/city) has been given the responsibility for water supply and sanitation. However, this has so far not been translated on improving access or quality of service, especially since devolution of responsibility has not been accompanied by adequate mechanism for channeling funds to carry out this responsibility (The United Nations Children's Fund, 2014).

Provision of drinking water/clean yet become a priority, especially in the provincial governments. Lack of access to clean water and sanitation remains a serious challenge, especially in slums and rural areas. This is a major concern because of the lack of clean water reduces the level of sanitation in the community and also increases the chances of developing diseases such as diarrhea. Failure to promote behavior change, especially among low-income families and people in slums, has worsened the health effects of poor water and sanitation situation in Indonesia (The United Nations Children's Fund, 2014).

According to the results of the Joint Monitoring Programme for Water Supply and Sanitation of the WHO and UNICEF in 2010, access to water sources are eligible up to 82% and access to sanitation facilities by 54% (Table 2). Indonesia one level of ownership sewerage coverage lowest in Asia with only 2% access in urban areas (World Health Organization and The United Nations Children's Fund, 2010).

Other studies are conducted to determine the distribution of the incidence of diarrhea in infants spatially, determine the relationship between risk factors sources of drinking water, household toilets, wastewater disposal, garbage disposal, sanitation distance to source of drinking water, and physical accessibility to health services with events diarrhea in infants in Sub-District Gandus Palembang. This type of study is analytic

Table 2. Access to water.

	Urban Areas (44% of population)	Rural Areas (56% of population)	Total
Access to clean water	92%	74%	82%
Water PAM	36%	8%	20%
Sanitation	73%	39%	54%
The drains of latrines	2%	0%	1%

observational case-control design. The results showed the most dominant risk factor diarrhea incidence drinking water sources (Adawiyah, 2012).

Sanitation behavior of the mother (personal hygiene, feeding habits in children under five, the management of drinking water) and environmental sanitation (excreta disposal, wastewater disposal, and landfills) are risk factors for diarrhea incidence in Jetis Yogyakarta. This study was conducted using the analytical observational case control study. The results of this study showed that the variables that influence the incidence of diarrhea in children under five, namely bacteriological quality of drinking water, personal hygiene, feeding habits of children under five, the management of drinking water and excreta disposal facilities (Pratama, 2012).

Entitled relationship of the presence of a household latrine improved with diarrhea and under-five child mortality in Indonesia. The subjects of this study are a toddler in Indonesia. This study found that the lack of quality latrines associated with diarrhea and mortality in Indonesia (Semba et al., 2011). Study of diarrhea risk factors in infants and young children in Indonesia. This study is a systematic review of academic research field of public health. This study found that the risk factors for diarrhea is the most widely studied environmental factors (water supply and latrines) (Adisasmito, 2010). A study on the use of spatial analysis sources of drinking water, basic sanitation and physical accessibility of diarrhea incidence in the sub-district Gandus Palembang. This research was carried out observational case-control analytic approach to 70 cases and 70 control group. This study found that the risk factors for the incidence of diarrhea in infants drinking water sources (Adawiyah, 2012).

Most feces and waste water discharged is not processed first before being discharged into the local sewer or water bodies. This causes environmental pollution. Dense housing, seasonal floods and drains are clogged with solid waste also exacerbate this problem (Colin, 2011). Some studies have found that coliform bacteria can be an indicator of household waste water pollution in estuaries tropics and indicators of water quality in the area of reclamation (Bahlaoui et al., 1997; Nagvenkar and Ramaiah, 2009; Costán-Longares et al., 2008).

Furthermore, Wery et al were found *Salmonella* sp., and *Clostridium jejuni* as bacterial indicators of wastewater treatment. Furthermore, *Streptococcus* sp.,

also can be an indicator of sewage pollution in estuaries tropics (Wery et al., 2008; Nagvenkar and Ramaiah, 2009; Sumampouw and Risjani, 2014). Several studies have been done that look *Pseudomonas* sp., as an indicator of pollution in wastewater treatment ponds and the lagoon/artificial pond in Doula Cameroon (Bahlaoui et al., 1997; Akoachere, 2008). Furthermore, *Nitrosomonas Oligotroph*, *Nitrosomonas* and *Citrobacter* can be an indicator of sewage pollution in the environment (Cao, 2012; Wang et al., 2010; Al-Bahry et al., 2011).

Proper latrines can improve health status because it allows people to properly dispose of feces. According to data from the Center for Disease Control and Prevention (CDC), in developing countries many people do not have access to latrines that are standards compliant, so much the practice of improper disposal of feces. Based on research by the World Bank, unsanitary latrines, Indonesia has lost more than Rp 58 trillion (USD 265,000/person/year) and the incidence of diarrhea by 121.100 and the incident resulted in the deaths of more than 50.000 people/year (Center for Disease Control and Prevention, 2014; Indonesian Public Health, 2014).

Approximately 2.6 million people (more than 40% of the population) do not use the toilet/latrine, but dispose of faeces in the open or place is not sanitary. In 2004, as many as 3 out of 5 people who live in rural areas (more than 2 billion people) do not have access to basic sanitation facilities/toilets (World Health Organization and The United Nations Children's Fund, 2006).

Latrines that do not qualify as not closed, do not have a septic tank and without enough water rinse risk of causing diarrhea. The lack of basic sanitation facilities in this case, toilets can cause an unhealthy environment contaminated by feces (Bruni et al., 1997; Black, 2007). Without proper sanitation facilities, waste-containing agent of human disease can contaminate soil and water. Proper disposal of faeces can slow/inhibit the causative agent of infectious disease cycle. Unsanitary latrine can contribute to the spread of many diseases. Without proper sanitation facilities, the community had no choice but to stay in the environment and drinking water contaminated with feces containing the causative agent of the disease, resulting in the risk of disease. Improper disposal of feces cause many diseases such as diarrhea agents can be spread through the soil, food, water, and contaminated insects (Center for Disease Control and Prevention, 2014).

In urban communities, especially in densely populated

areas, this requirement is difficult to be fulfilled so that people prone to health problems and diseases such as diarrhea. One solution to this problem that is making a communal septic tank (one hole-do/Salume). This method is made with a toilet inside the house, but the discharge channel leading to the septic tank that will accommodate community stool in a certain capacity (Indonesian Public Health, 2014).

Some studies have found that, the most dominant determinant environment ie the distance between the source of drinking water, latrines conditions, and septic tanks. In addition, the quality of drinking water sources, types of excreta disposal site, the type of home flooring, kitchen hygiene associated with the incidence of diarrhea in infants (Lauziah, 2012; Pebriani et al., 2013; Wibowo et al., 2004; Wulandari, 2009; Wijayanti, 2013). In other hand, contamination of clean water sources and condition the garbage were influenced to incidence of diarrhea in under 1 year children (Marsanti, 2013; Chandran et al., 2011).

CONCLUSION

Diarrhea occurred at a low rate within Manado city. This study identified that source of drinking water and type of latrines correlated with the diarrhea. Further extensive studies involving social economics, behavior and health service are needed to validate our results for Manado city community.

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