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THE INFLUENCE OF ENVIRONMENTAL SANITATION AND PERSONAL HYGIENE ON THE INCIDENCE OF DIARRHOEA

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Abstract: Lubuk Basung is one of the sub-districts in Agam Regency, West Sumatra Province in Indonesia. It has a high population density with a growth rate of 2.7% each year. Population density can affect the quality of the population's living environment, by degrading security, land availability, as well as basic sanitation, and environmental health. Environmental health is important in efforts to overcome environmental-based diseases such as diarrhoea. Diarrhoea in Lubuk Basung is the second most prevalent infectious disease handled by the Lubuk Basung Regional General Hospital, with a total of 487 cases. This research aims to determine the relationship between diarrhoeal disease and environmental sanitation and personal hygiene among Lubuk Basung residents. This research is observational with a cross-sectional approach. Based on the results of interviews and questionnaire analysis using statistical tests, it was found that there was a significant relationship between diarrhoea and drinking water sources, waste management, and personal hygiene, which was indicated by a P-value < 0.005 while other factors, namely management of clean water for Bathing, Washing, Toilet (BWT), and availability of latrines had no relationship between liquid waste management and diarrhoeal disease with a p > 0.005.

Keywords: Population density, environmental sanitation, personal hygiene, diarrhoea, Lubuk Basung.

Introduction

Basic sanitation facilities are the minimum environmental health standards required by the public. These facilities are essential for creating a healthy environment that meets health standards and focuses on monitoring various environmental factors that influence health status (Bankole *et al*., 2023). The scope of basic sanitation includes clean water facilities, the availability of latrines, wastewater disposal facilities, and waste management facilities. Sanitation is an important element to support public health. Poor sanitation conditions will hurt aspects of life, starting from a decline in the quality of the public living environment, contamination of public drinking water sources, as well as an increase in the number of various environmental-based diseases such as diarrhoea (Fontes *et al*., 2023). According to research by Dasih and Bastian (2019) and Soboksa (2021), there is a significant relationship between environmental sanitation and diarrhoeal disease.

Diarrhoea is a disease characterised by changes in the shape or consistency of stool with an increase in the frequency of defecation more than three times a day and without blood or mucus (Powell, 2008). Schiller (2000) defines diarrhoea as defecation three or more times a day and night. Based on the time of the attack, diarrhoea is divided into two, namely acute diarrhoea (< 2 weeks) and chronic diarrhoea (> 2 weeks). This disease is still a public health problem, although in general the morbidity rate still fluctuates (Siciliano *et al*., 2020). Fischer Walker *et al.* (2012) add that the incidence of diarrhoea is an indicator of the state of public health which is related to the implementation of a public health system that does not meet requirements. Diarrhoea can attack anyone, if

not treated immediately, it can cause dehydration and even death. One of the risk factors that is often studied is environmental factors, which include clean water facilities, toilet conditions, and house conditions. Poor sanitation is considered to be the cause of increasing *E. coli* bacterial contamination in water consumed by the public. *E. coli* bacterial contamination occurs in groundwater which is drawn by many members of the public and rivers, which is the source of raw water at the Regional Drinking Water Company (RDWC) (Safitri, 2023).

Based on data from the Agam Regency Health Service in 2020, before COVID-19, most cases of diarrhoea in all age groups were found at the Lubuk Basung Regional General Hospital, at 487 cases. Diarrhoea among those in the 1 to 4 age group occupy the second highest position. According to data on diarrhoea sufferers from the Lubuk Basung Regional General Hospital, in 2018 a total of 255 sufferers were recorded, 398 people in 2019, and 487 people in 2020. The number of diarrhoea sufferers among toddlers in Lubuk Basung in 2018 was 101, 123 in 2019, and 150 toddlers in 2020 (Minarni *et al*., 2021). According to Putri (2011) and Insyani (2020), in general, sanitation conditions in Lubuk Basung are not ideal, indicating infectious diseases still spread at high rate. Data from the Central Statistics Agency (2020) show that diarrhoea in Lubuk Basung is the second-most prevalent infectious disease handled by the Lubuk Basung Regional General Hospital, with a total of 487 cases. This high number makes this study necessary to investigate the relationship between environmental sanitation and diarrhoeal disease in Lubuk Basung.

This research is novel because it not only identifies the factors causing diarrhoeal disease in Lubuk Basung but also investigates their relationship with environmental sanitation and personal hygiene.

Methods

This research includes an observational survey with a cross-sectional approach (Wang & Cheng, 2020; Jakovljevic *et al*., 2021). This research was conducted in the Lubuk Basung sub-district from August to December 2023.

The population in this research was the 185 residents who sought treatment for diarrhoea in 2023 at the Lubuk Basung Regional General Hospital. Sampling in this research was carried out by calculating the number of samples using the cross-sectional formula (Wang & Cheng, 2020; Jakovljevic *et al*., 2021) so that a sample of 53 people was obtained using the random sampling method.

The research stages carried out included creating a questionnaire regarding the provision of clean water, availability of latrines, rubbish dumps, liquid waste storage areas, and personal hygiene. This questionnaire was then tested for validity and reliability. The valid characteristic means that the measuring instrument used is capable of providing the true value of the desired parameter. Reliability means that an instrument will produce the same data when used several times to measure the same object. Questionnaires that have been declared valid and reliable can be distributed to respondents at the research location. In Table 1, the questionnaire is outlined based on the stages of the research carried out regarding the provision of clean water facilities, availability of latrines, rubbish disposal sites, liquid waste storage areas, and personal hygiene.

Explanation

- Main variables: A variable studied such as clean water facilities, availability of latrines, etc.
- Questionnaire items: Questions related to the main variables for collecting data.
- Measurement scale: The method used to measure respondents' answers such as a Likert scale, yes/no answers, or multiple choice.

The data analysis used in this research is a univariate analysis which describes each variable, both the independent variable and the dependent variable, as well as the characteristics

Table 1: Questionnaire model for research on the provision of clean water facilities, availability of latrines, rubbish dumps, liquid waste storage places, and personal hygiene

No.	Topic	Questions	Answer Choices
1	Provision of clean water facilities	– Do you have access to clean water for bathing, washing, and toileting?	– Yes/No
		– What source of clean water do you use?	– Wells/PAM water/Rain water/ River water/Others
		– How often do you clean the clean water source?	– Every day/Every week/Every month/Never
2	Availability of latrines	– Do you have a private latrine at home?	– Yes/No
		– If not, where do you usually defecate?	– Public latrine/Neighbour's latrine/River/Others
		– How often do you clean your toilet?	– Every day/Every week/Every month/Never
3	Garbage dump	– How do you dispose of household waste?	– Burned/Thrown into the river/ Thrown into the trash/Others
		– Do you sort your waste before throwing it away?	– Yes/No
		– How often do you take out the trash?	– Every day/Every week/Every month/Never
4	Liquid waste storage place	– Do you have a liquid waste disposal system at home?	– Yes/No
		– If yes, what is the condition of the system?	– Well maintained/Clogged/Not working
		– Is your liquid waste directly discharged into the environment without treatment?	– Yes/No
5	Hygiene	– How often do you wash your hands with soap before eating?	– Always/Sometimes/Never
		– How often do you wash your hands with soap after defecating?	– Always/Sometimes/Never
		– Do you always eat well-cooked food?	– Yes/No
		– Do you use clean water to wash cutlery?	– Yes/No
6	Respondent characteristics	– Your gender?	– Man/Woman
		– Your age?	– < 20 years/20-30 years/31-40 years/ > 40 years
		– Your highest level of education?	– Not attending school/Elementary school/Middle school/High school/College
		– Your employment status?	– Working/Not working/ Housewife/Others

of the respondents, and bivariate analysis to test the relationship between the independent variable and the dependent variable using the chi-square statistical test ($\chi 2$) (Turhan, 2020). The chi-square test was carried out using computer software with a significance level of $p >$ 0.05 (95% confidence level) (Turhan, 2020; Roshan *et al*., 2024).

Results and Discussion

Respondent were differentiated based on gender, age, education, employment status, and income. Data from the Indonesian Ministry of Health (2019) show that there were more cases of diarrhoea among women. This could be explained by the fact that Lubuk Basung's population has 205 more women than men (Minarni *et al*., 2021), Meanwhile, according to Yanti (2024), men are considered to be more active and physically stronger than women, men tend to have superior endurance. A good immune system is needed to prevent the transmission of various diseases, one of which is diarrhoea.

Respondent Characteristics

The majority of respondents, at 47% have a history of high school education. Higher education makes it easier for someone to receive information.

Economic conditions were chosen as a respondent characteristic because it can influence the level of active participation in implementing public service efforts such as improving health facilities, adequate environmental conditions, and good nutritional status. These factors can influence the emergence of diseases, one of which is diarrhoea (Firdaus *et al*., 2024). Housewives constitute the highest percentage of respondents, at 68%. These results were adjusted to the time of distribution of the questionnaire, which was during formal working hours, so that could explain why most respondents were housewives. According to Purkis and Ceylan (2023), a housewife can be defined as a woman who organises household work (not working in the office) such as cooking, washing, sweeping, and others. This can be interpreted as meaning that the housewives were in a better position to provide answers regarding the sanitation of the environment being studied.

Most respondents, at 79%, had an income of < 500,000. This result has to consider that most of the respondents are housewives. Income level was chosen as characteristic because economic circumstances of respondents can influence the level of active participation in implementing public service efforts such as improving health facilities, adequate environmental conditions, and good nutritional status. In addition, low-income individuals generally have poor environmental sanitation and personal hygiene conditions (Sarkingobir *et al*., 2023). The results of the analysis on the relationship between environmental sanitation and diarrhoeal disease in Lubuk Basung in 2023 can be seen in Table 2.

The results show that the variables of providing clean water for BWT, availability of latrines, and liquid waste management in Lubuk Basung in 2023 have no relationship

Table 2: Results of analysis of the relationship between environmental sanitation and diarrhoeal disease in Lubuk Basung

Variables	P-values	Results
Providing clean water for bathing, washing, and toileting	1.000	No connection
Source of drinking water	0.025	There is a connection
Availability of latrines	0.718	No connection
Waste management	0.03	There is a connection
Liquid waste management	0.846	No connection
Personal hygiene	0.032	There is a connection

Source: Analysis results (2023)

with the incidence of diarrhoea as indicated by the P-values of 1,000, 0.718, and 0.846. The variables of drinking water source, waste management, and personal hygiene in Lubung Basung in 2023 have a relationship with the incidence of diarrhoea as indicated by the P-values of 0.025, 0.03, and 0.032. This research divided respondents into two groups: Sufferers who experienced diarrhoea once a year and sufferers who experienced diarrhoea more than once a year based on the respondents' visits to the Lubuk Basung Regional General Hospital. It was found that the majority of respondents suffered from diarrhoea once a year.

Relationship between Providing Clean Water for BWT and Diarrhoea

Individuals who live near or on riverbanks generally use the river for BWT. This was observed among the respondents from Lubuk Basung. Based on field observations, the condition of the river water was brownish in colour, sometimes cloudy and smelly. According to Spellman (2017), this water cannot be said to meet the requirements for good clean water. Several respondents use RDWC water, which is classified as meeting clean water requirements according to the Minister of Health Regulations 2014. There was no utilisation of other clean water facilities such as dug wells because according to the public, the quality of well water was not much different from the river water they use. Based on the analysis carried out, it was found that the value of $p = 1{,}000 > 0.05$, which means that there is no relationship between the provision of clean water sources for RDWC purposes and the incidence of diarrhoea in Lubuk Basung in 2023. This is because respondents with good sanitation have a higher percentage of vulnerability to diarrhoea than respondents who have water supplies that do not meet health requirements. So, the provision of clean water by RDWC and diarrhoeal diseases are deemed to have no relationship even though the water used were not good. This is also supported by research by Dewata and Putra (2021), which found that clean water did not have a significant relationship with the incidence of diarrhoea because respondents who use clean water sources that are not protected have a small potential for spreading diarrhoea.

Relationship between Drinking Water Sources and Diarrhoea

Analysis carried out on respondents based on data from the Lubuk Basung Regional General Hospital obtained a value of $p = 0.025 \leq 0.05$, which means that there is a relationship between the provision of drinking water sources and the incidence of diarrhoea. The research results of Purwatiningsih *et al.* (2013) explain that there is a relationship between the source of drinking water consumed by respondents. Drinking water sources play a role in the spread of several infectious diseases, including diarrhoea. Some bacteria that cause diarrhoea are transmitted via the faecal-oral route, which means they can be transmitted by putting fluids or objects that have been contaminated by faeces into the mouth. Generally, respondents in Lubuk Basung use rainwater as a source of drinking water.

According to Abbasi and Abbasi (2011), rainwater harvesting is a method to collect and store rainwater from the roof of a house when it rains. As a source of clean water, the use of rainwater can overcome the problem of water scarcity, reduce the volume of rainwater runoff, and replenish groundwater. Rainwater harvesting systems consist of several components, namely a place to capture rainwater, channels to storage tanks, filters, reservoirs, drains, and pumps. Rainwater harvested from roofs require little processing before being used for human purposes. For drinking, boiling the water before consumption frees it from pathogenic bacteria, especially coli bacteria that cause diarrhoea. Apart from that, according to Dewata *et al.* (2024), discarding rainwater collected in the early minutes minimises the pollutants that come with it. Prarikeslan *et al.* (2023) added that rainwater contains almost no contaminants, therefore, the water is very clean and free of microorganisms. However, when rainwater comes into contact with dirty harvesting equipment,

there will be physical, chemical, and microbiological contaminants. Respondents who use refillable bottled water assume that it meets health requirements. Umar and Arif (2023) found that refillable drinking water that is more than 24 hours old must be boiled before consumption as a precaution against diseases such as diarrhoea.

Relationship between Latrine Availability and Diarrhoea

The availability of family toilets in Lubuk Basung was found to be at 78.98%, which indicates that this facility is common in the sub-district. This is in line with the study observations, namely that 52 respondents already have a family latrine (a gooseneck latrine that flows into a septic tank) and only one person who does not have a family latrine uses the facilities of nearest neighbour or place of worship. As the installation of lavatories can involve high cost, future researchers should study the relationship between economic factors and the provision of adequate sanitation.

The 52 people who had family latrines were interviewed while 13 other people did not meet the requirement for healthy latrines. This is due to the low level of public awareness regarding latrine cleanliness such as cleaning the latrine only once a week. From these results, the value $P = 0.718 > 0.05$ was obtained, which means that there is no relationship between the availability of latrines and the incidence of diarrhoea in Lubuk Basung in 2023. This is because almost all respondents have family latrines, although not all of them meet the requirements for healthy latrines. In addition, respondents who met the requirements for healthy latrines still experienced diarrhoea > 1 time a year at a higher percentage than those who did not meet the requirements for healthy latrines, so, the availability of latrines was not considered to have a significant relationship with the incidence of diarrhoea in this research.

Relationship between Waste Management and Diarrhoea

Waste management is also one of the basic sanitations matters that need attention because it can influence the spread of disease. In general, the people of Lubuk Basung often throw rubbish into the river, especially organic waste. Many people also dispose of rubbish in temporary shelters or burn it. Most of them do not sort their waste before throwing it away; however, a small number do sort out iron/metal and plastic waste for sale to second-hand goods collectors.

On average, the level of education among Lubuk Basung residents is up to senior high school and almost all of them know about the impacts caused by waste, namely floods and polluted water. Many respondents throw rubbish at landfills temporarily. However, there are still some respondents who have a low level of awareness in managing household waste and simply dispose of it in the river, or burn rubbish piled up for several days. Several others transport waste collected in a bin or plastic bag over a few days directly to a temporary disposal site. This causes the organic waste to decompose first and causes an unpleasant odour that attracts insects and other disease vectors.

According to research by Siregar *et al.* (2024), there is a relationship between waste management and diarrhoeal disease. They found that there are still people who do not have awareness of the proper way to dispose of rubbish and throw it anywhere. Littering has many negative impacts, one of which is increasing the spread of diarrhoeal disease. This is in line with research conducted in Lubuk Basung with a value of $P = 0.03 \leq 0.05$ (there is a relationship). Silva *et al.* (2024) further added that good solid waste management entails having a temporary waste storage receptacle outside the house that is covered, watertight and easy to use, cleaned at least once a week, and transported every day to a disposal area, especially for organic waste which decomposes more quickly and causes odours.

Relationship between Liquid Waste Management and Diarrhoea

On average, respondents in Lubuk Basung do not have good liquid waste storage facilities in the form of drainage. Apart from that, the few available liquid waste channels are not managed properly, leaving them clogged and smelly. Improperly maintained wastewater drains will cause odours, are unsightly, and can become a breeding ground for mosquitoes, flies, and other insects. These conditions can transmit disease, including diarrhoea. The relationship between liquid waste management and diarrhoeal disease shows the results $p = 0.846 > 0.05$, which means that there is no relationship between liquid waste management and the incidence of diarrhoea in Lubung Basung in 2023. This is in line with research by Lestari *et al.* (2024) because all respondents who have good liquid waste management experience diarrhoea more than once a year.

Relationship between Personal Hygiene and Diarrhoea

A total of 37 respondents who met the requirements had awareness about maintaining good hygiene as a disease prevention measure. This includes the washing of hands before eating and after defecating, as well as consuming properly cooked food. This factor was studied considering that diarrhoea can be transmitted via the faecal-oral route. According to Joshi *et al.* (2020), consuming properly cooked food is one of the measures to curb the spread of diarrhoea as the cooking will kill disease-causing pathogens. In Lubuk Basung; however, 16 people had low awareness of the importance of personal hygiene. Diarrhoea is an environmental disease and if environmental factors are unhealthy due to contamination by pathogenic bacteria and unhealthy food, then, diarrhoea can occur. The interviews with respondents on their personal hygiene and sanitation habits obtained a value of $P = 0.032 \leq 0.05$, which means that there is a relationship between personal hygiene and the incidence of diarrhoea in Lubuk Basung in 2023. The graph of the relationship between environmental sanitation and diarrhoea can be seen in Figure 1.

The graph in Figure 1 shows the relationship between several environmental sanitation variables and the incidence of diarrhoeal disease based on the P-value. The P-value is a statistical indicator used to determine the significance of the results. If the P-value ≤ 0.05, then, there is a significant relationship between sanitation variables and diarrhoeal disease. Conversely, if the P-value is > 0.05, there is no significant

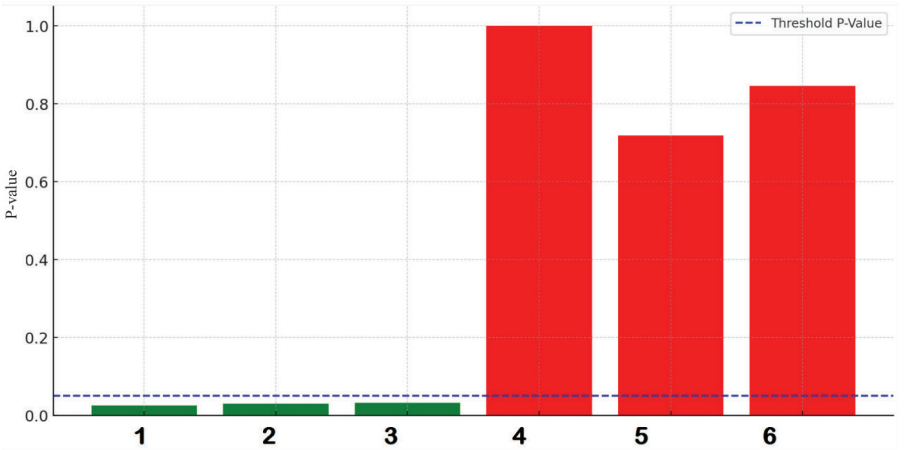

Figure 1: The relationship between environmental sanitation and diarrhoeal disease [Description: (1) Providing clean water for bathing, washing, and toileting; (2) source of drinking water; (3) availability of latrines; (4) waste management; (5) liquid waste management; and (6) personal hygiene]

relationship. The following is an explanation of the results from the graph.

(1) Source of drinking water (p = 0.025). Green colour: There is a significant relationship between drinking water sources and the incidence of diarrhoeal disease. This shows that poor-quality drinking water sources can increase the risk of developing diarrhoea. Water that is not suitable for drinking such as rainwater that has not been properly treated or refilled water that has not been boiled can contain bacteria or pathogens that cause diarrhoea.

(2) Waste management (p = 0.03). Green colour: There is a significant relationship between waste management and the incidence of diarrhoeal disease. Poor waste management such as throwing rubbish carelessly or not sorting it can cause a dirty environment and become a breeding ground for bacteria that cause diarrhoea.

(3) Personal hygiene (p = 0.032). Green colour: There is a significant relationship between personal hygiene and the incidence of diarrhoeal disease. Personal hygiene habits such as washing hands before eating and after using the toilet are very important to prevent the spread of pathogens that cause diarrhoea. Lack of awareness of personal hygiene can increase the risk of diarrhoeal infections.

(4) Clean water provision (p = 1,000). Red colour: There is no significant relationship between the provision of clean water for BWT purposes and the incidence of diarrhoea. Although clean water is important for general hygiene, in this context, the provision of clean water does not show a direct influence on the incidence of diarrhoea. This could be because the water used is clean enough or other factors are more influential.

(5) Availability of latrines (p = 0.718). Red colour: There was no significant relationship between the availability of toilets and the incidence of diarrhoeal disease. This may be because almost all respondents have family latrines, although not all of them qualify as healthy latrines. The availability of latrines alone is not enough to prevent diarrhoea without being accompanied by good maintenance and cleanliness.

(6) Liquid waste management (p = 0.846). Red colour: There is no significant relationship between liquid waste management and the incidence of diarrhoeal disease. Although poor liquid waste management can lead to an unhealthy environment, in the context of this study, liquid waste management did not show a significant effect on the incidence of diarrhoea. This could be due to other factors being more dominant or a lack of variation in liquid waste management among respondents.

These results show that drinking water sources, waste management, and personal hygiene have a significant relationship with the incidence of diarrhoea. This means that interventions to improve drinking water quality, waste management, and increased awareness of personal hygiene can effectively reduce the risk of diarrhoeal disease. Meanwhile, the provision of clean water for BWT, availability of latrines, and liquid waste management do not show a significant relationship in this context, which may require a different or more specific approach to assess their impact on health.

This is in line with research conducted by Dieleman *et al.* (2024), according to him, a person's hygiene is influenced by personal, social, and cultural factors. Usually, the issue of personal hygiene is not paid enough attention to and is considered trivial. One of the habits related to personal hygiene that is important in the transmission of bacteria that cause diarrhoea is the washing of hands. Washing your hands with soap, especially after going to the toilet, before preparing food, and before eating can break the chain of disease spread. The habit of washing hands influences the occurrence of diarrhoea, especially in toddlers who are still very susceptible to disease-causing microorganisms. In addition, the food utensils

used must be washed with clean water and soap. Then, stored in a clean place to prevent contamination.

Conclusions

Based on research on the relationship between environmental sanitation and diarrhoeal disease in Lubuk Basung, which has been carried out, it can be concluded that basic sanitation plays an important role in preventing the transmission of disease, one of which is diarrhoea. Three variables have a relationship with diarrhoea, namely the provision of drinking water sources, waste management, and personal hygiene while the other three variables have no relationship with diarrhoea, namely the provision of clean water for BWT, the availability of latrines, and liquid waste management. Furthermore, it is hoped that we can further examine factors that cannot be studied further, such as the relationship between economic factors and the provision of environmental sanitation for diarrhoeal diseases.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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