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Relationship Between Environmental Sanitation and Dengue Hemorrhagic Fever Incidents

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ABSTRACT

Purpose of the study: The purpose of this study was to analyze the relationship between environmental sanitation and the incidence of Dengue Hemorrhagic Fever in the Unidad de Salud Work Area.

Methodology: The study employed an analytical design using a survey method with a retrospective case-control approach. A total of 50 respondents were purposively sampled, comprising 25 Dengue Hemorrhagic Fever patients and 25 neighbors within ±10 meters who had no history of Dengue Hemorrhagic Fever. Data collection utilized a validated questionnaire (Cronbach's α = 0.803) focusing on environmental sanitation and vector control practices. Data analysis included univariate analysis for descriptive statistics and bivariate analysis using the chi-square test at a 95% confidence level to determine significant associations between risk factors and Dengue Hemorrhagic Fever incidence.

Main Findings: The results of the study showed that there was a significant relationship between the independent variables, namely there was a relationship between house conditions and the incidence of Dengue Hemorrhagic Fever (p-value = 0.023), there was a relationship between water reservoir conditions and the incidence of Dengue Hemorrhagic Fever (p-value = 0.010), and there was a relationship between the waste disposal system and the incidence of Dengue Hemorrhagic Fever (p-value = 0.005) in the Unidad de Salud Work Area.

Novelty/Originality of this study: This study offers a comprehensive approach to identify significant environmental determinants in influencing dengue incidence, which can form the basis for developing community-based interventions to improve the effectiveness of vector control.

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1. INTRODUCTION

Environmentally-based diseases are global health problems that are closely related to the interaction between humans and their environment [1], [2]. One form of this disease is infectious diseases, which can develop into endemic or even become Extraordinary Events [3], [4]. In Mexico, environmental-based diseases such as Dengue Hemorrhagic Fever are a serious threat to public health [5], [6]. This disease is caused by the dengue virus which is transmitted through the bite of the Aedes aegypti mosquito. This virus infects thousands of people every year, especially in tropical and subtropical regions that have warm and humid climates.

Dengue Hemorrhagic Fever has become a major concern in countries such as Thailand and Mexico, which have a high prevalence of this disease [7], [8]. As one of the most sensitive infectious diseases to climate change, Dengue Hemorrhagic Fever often occurs in areas with temperatures and humidity that support the development of vectors [9]-11]. Its distribution covers almost all tropical and subtropical regions, both as endemic and epidemic. In addition to impacting individual health, this disease also puts economic pressure on families and communities [12], [13]. Inappropriate handling can increase morbidity and mortality.

Climate change plays a significant role in the increase in dengue cases in tropical regions. Factors such as high rainfall, humidity, and optimal temperatures allow the Aedes aegypti mosquito to breed rapidly [14]-[16]. In Mexico, coastal areas such as Veracruz and Guerrero often experience a spike in cases during the rainy season. In Thailand, Bangkok is one of the cities with the highest dengue incidence due to high population mobility and inadequate sanitation [17], [18]. With a favorable climate, stagnant water becomes an ideal place for mosquitoes to lay eggs and breed [19], [20].

Unmaintained physical environments are often the main source of mosquito transmission. Places such as bathtubs, water drums, and unmanaged used goods become breeding grounds for Aedes aegypti mosquito larvae. Poor environmental sanitation in many areas of Mexico and Thailand exacerbates the spread of the disease [21], [22]. Social factors such as population density and people's habits in storing water also increase the risk [23], [24]. Therefore, good environmental management is one of the important steps to prevent the spread of dengue fever [25], [26].

Poor environmental sanitation is strongly associated with increased risk of dengue fever in the community [27], [28]. Inadequate waste disposal systems often create breeding grounds for mosquitoes [29], [30]. Waste such as used plastic, tires, and bottles are often found in residential areas and are a serious problem in urban areas such as Mexico City and Chiang Mai. Improper waste management not only increases the risk of disease but also creates a greater environmental burden [31], [32]. Therefore, educating the community about the importance of sanitation is key to controlling the disease.

In Mexico and Thailand, vector control programs such as mosquito nest eradication have become part of public health strategies. Education campaigns on the importance of 3M Plus, such as draining, covering, and recycling, continue to be intensified by the government and health organizations [33], [34]. However, challenges such as lack of public awareness and lack of access to sanitation facilities remain major obstacles [35], [36]. To overcome this, an integrated approach involving local communities, governments, and international health agencies is needed [37], [38]. This effort aims to effectively break the cycle of dengue virus transmission.

Research conducted by Syarifuddin and Samosir [39] focused on the relationship between individual health behavior and the incidence of dengue fever in the working area of the Singosari Pematang Siantar Health Center, emphasizing human behavioral factors in disease prevention and control. On the other hand, Hidayani [40] highlighted the relationship between environmental sanitation in general and the incidence of dengue fever in Indonesia, with a broader scope and emphasis on environmental factors as the main determinant. The current study integrates the approaches of both studies by exploring the relationship between environmental sanitation and the incidence of dengue fever in more depth, using a combined perspective that includes environmental factors and the impact of human behavior. This provides a new contribution to understanding the interaction between health behavior and environmental conditions in the context of dengue fever incidence, as well as expanding the scope of previous research with a more comprehensive and systematic approach.

This study offers novelty by integrating in-depth analysis between environmental sanitation and the incidence of Dengue Fever, which has not been comprehensively described in previous studies. This study not only identifies environmental factors such as the presence of unmanaged water reservoirs but also links them to public health behaviors as major risk factors. The urgency of this study lies in the increasing cases of Dengue Fever in various regions of Mexico and Thailand, which shows the need for a multidimensional approach to controlling this disease. The results of the study are expected to be the basis for designing more effective and evidence-based interventions, both in environmental management and public health education, in order to significantly reduce the incidence of Dengue Fever.

The increase in dengue cases in Thailand and Mexico shows that this disease remains a serious threat in tropical regions. Based on data from WHO, Thailand has one of the highest dengue incidence rates in Southeast Asia, while Mexico is also included in the list of countries with significant incidents in Latin America [41], [42]. An unconducive environment, lack of public understanding, and climate change are major factors in the spread of this disease [43], [44]. By involving the community and improving environmental sanitation, more effective prevention measures can be taken. This study aims to analyze the relationship between environmental sanitation and the incidence of Dengue Hemorrhagic Fever in endemic areas.

2. RESEARCH METHOD

2.1. Research Design

This research design is a form of analytical design with a survey method using a case control approach [39], [45]. The case control approach is carried out to compare the case group (Dengue Hemorrhagic Fever sufferers) with the control group (not Dengue Hemorrhagic Fever sufferers) in order to determine the risk factors associated with the occurrence of the disease. The research design is retrospective, namely looking back to evaluate exposure to risk factors before the occurrence of the disease. The stages of the study include identifying research variables, determining research subjects, selecting controls, retrospective measurements, and comparative analysis of proportions between case and control variables [46], [47].

2.2. Population and Sample

The population in this study was all residents in the Unidad de Salud work area who met certain criteria. The target population was individuals who were the target of the study, while the target population included patients and non-patients of Dengue Hemorrhagic Fever recorded at Unidad de Salud in the last one year. The sample consisted of 25 respondents for the case group and 25 respondents for the control group, so the total sample was 50 people. The control group was selected from the closest neighbors to the case group within a distance of ± 10 meters who had no previous history of Dengue Hemorrhagic Fever.

2.3. Sampling Techniques

Sampling was conducted using purposive sampling technique, which is the selection of samples based on previously determined criteria [48], [49]. The criteria for the case group include: suffering from Dengue Hemorrhagic Fever, able to communicate well, willing to participate in the study, and willing to be interviewed. The criteria for the control group include: never suffering from Dengue Hemorrhagic Fever, closest neighbors in the same environment as the case group, and willing to be interviewed. This technique ensures that the sample is representative of the study population.

2.4. Research Instruments

The instrument used was a structured questionnaire that had been tested for validity and reliability. The questionnaire included questions about the relationship between environmental sanitation and dengue fever incidence, such as the condition of water reservoirs, waste disposal systems, and community habits related to vector control. Reliability testing showed a Cronbach Alfa value of 0.803, indicating that the instrument had good internal consistency.

2.5. Data Processing and Analysis Techniques

Data analysis techniques in this study were carried out systematically to ensure valid and reliable results. Data collected through questionnaires were checked for completeness (editing), coded for data categorization (coding), and entered into data analysis software (entry). After that, the data was cleaned (cleaning) to ensure there was no duplication or input errors, then tabulated to facilitate analysis.

Data analysis was carried out in two main stages. First, univariate analysis was used to describe the characteristics of each variable descriptively. The frequency and percentage distributions of the independent and dependent variables were presented in tabular form to provide an initial overview of the data pattern. Second, bivariate analysis was conducted to test the relationship between the independent and dependent variables using the chi-square test. This test was conducted with a significance level of 95% ($\alpha = 0.05$) to determine whether or not there was a meaningful relationship. The results of the bivariate analysis provide information on whether risk factors such as environmental sanitation have a significant effect on the incidence of dengue fever. With this combination of analysis, the study can provide strong conclusions regarding the relationship between environmental sanitation and the incidence of dengue fever.

3. RESULTS AND DISCUSSION

3.1. Univariate Analysis

Univariate analysis here presents the characteristics of respondents based on the dependent variable, namely the incidence of dengue fever. The independent variables are house conditions, water reservoir conditions, and waste disposal systems. The frequency distribution of respondents based on house conditions is shown in table 1.

Table 1. Frequency distribution of respondents based on home conditions

House Condition	Percentage (%)	Frequency
Good	46.0	23
Bad	54.0	27
Total	100.0	50

In table 1, the distribution of respondents based on house conditions shows a difference in proportion, showing that out of 50 respondents, the majority of respondents have poor house conditions, as many as 27 respondents with a percentage of 54.0%. Meanwhile, the frequency distribution of respondents based on the condition of the water reservoir is shown in table 2.

Table 2. Frequency distribution of respondents based on water storage conditions

Water Reservoir Condition	Percentage (%)	Frequency
Good	44.0	22
Bad	56.0	28
Total	100.0	50

In table 2, the distribution of respondents based on the condition of the water reservoir, there is a difference in proportion, showing that out of 50 respondents, the majority of respondents have poor water reservoir conditions, as many as 28 respondents with a percentage of 56.0%. Meanwhile, the frequency distribution of respondents based on the waste disposal system is shown in table 3.

Table 3. Frequency distribution of respondents based on waste disposal system

Waste Disposal System	Percentage (%)	Frequency
Good	46.0	23
Bad	54.0	27
Total	100.0	50

In table 3, the distribution of respondents based on the waste disposal system shows a difference in proportion, indicating that out of 50 respondents, the majority of respondents have a poor waste disposal system of 27 respondents with a percentage of 54.0%. Furthermore, the frequency distribution of respondents based on the incidence of dengue fever is shown in table 4.

Table 4. Frequency distribution of respondents based on dengue fever incidence

Dengue Hemorrhagic Fever Incident	Percentage (%)	Frequency
Control	50.0	25
Case	50.0	25
Total	100.0	50

In table 4, the distribution of respondents based on the incidence of dengue fever, the proportion shows that out of 50 respondents, with the number of control cases, 25 respondents with a percentage of 50.0%.

3.2. Bivariate Analysis

Bivariate analysis aims to determine the relationship between independent variables and dependent variables using statistical tests. The statistical test used in this study is the chi-square test with a significance level of 0.05. The results of the bivariate analysis of the relationship between home conditions and the incidence of dengue fever are shown in table 5.

Table 5. Relationship between housing conditions and the incidence of dengue fever

House condition	Occurrence of Dengue Hemorrhagic Fever				Total		OR (95% CI)	p-value
	Case		Control					
	N	%	N	%	N	%		
Good	7	30.4	16	69.9	23	100.0	4.751 (1.383-15.109)	0.023
Bad	18	66.7	9	33.3	27	100.0		
Total	25	50.0	25	50.0	50	100.0		

Based on table 5, the results of the chi-square test to determine the relationship between the variables of house conditions and the incidence of dengue fever, it is known that respondents in the case group who have poor house conditions are 18 respondents (66.7%) and respondents who have good house conditions are 7 respondents (30.4%). While respondents in the control group who have poor house conditions are 9 respondents (33.3%) and respondents in the control group who have good house conditions are 16 respondents (69.6%).

The results of data processing using the chi-square test can be seen from the continuity correction sig (2-sided) because the value of 0 cells <5 indicates that the p value is 0.023 (p <0.05) which means that there is a relationship between house conditions and the incidence of dengue fever. These results are supported by the OR value (95% CI) = 4.571 (1.383-15.109) which means that respondents who have poor house conditions have a 4.571 times greater risk of contracting dengue fever.

The condition of a house that meets the requirements is a house that has wire mesh on the ventilation and windows, mosquito nets on the bed, and the availability of water drainage [50], [51]. A building or house that has ventilation and windows that are not installed with wire mesh will make it easier for mosquitoes to enter the building to bite humans, a place to rest, and get a place to breed. There is a significant relationship between the condition of the house and the incidence of dengue fever [52], [53]. There is a significant relationship between environmental sanitation of the house and the incidence of dengue fever [40], [54]. There is a relationship between the condition of the house and dengue fever. Healthy home conditions are physical and biological conditions inside the house, in the home environment, and housing so that residents or the community can obtain maximum health [55], [56].

Based on the results of the study, it was shown that respondents who had poor house conditions in the case group, this was because most respondents were still less concerned about the condition of the house, especially not installing wire mesh on the ventilation and windows of the house, not installing mosquito nets on the bed, and there were still open water drains so that they could cause a breeding ground for mosquito larvae. While respondents who had good house conditions in the case group, this was because respondents had implemented good house conditions such as having closed water drains, having wire mesh on the house ventilation, and using mosquito nets on the bed. Respondents who had poor house conditions in the control group, this was because the condition of the house was good, but some of the respondents' houses did not have wire mesh on the house ventilation and there were still open water drains. While respondents who had good house conditions in the control group, this was because most respondents cared about the condition of the house such as the availability of wire mesh on the house ventilation, installing mosquito nets on the bed, and the availability of closed water drains. If the community is aware and cares about the condition of the house, it will create a clean, comfortable, and good house condition.

The results of the bivariate analysis of the relationship between the condition of water reservoirs and the incidence of dengue fever are shown in Table 6.

Table 6. Relationship between water reservoir conditions and dengue fever incidence

Condition of Water Reservoir	Occurrence of Dengue Hemorrhagic Fever				Total		OR (95% CI)	p-value
	Case		Control					
	N	%	N	%	N	%		
Good	6	27.3	16	72.7	22	100.0	5.630 (1.648-19.232)	0.010
Bad	19	67.9	2	32.1	22	100.0		
Total	25	50.0	25	50.0	50	100.0		

Based on table 6, the results of the chi-square test to determine the relationship between the variable of water reservoir conditions and the incidence of dengue fever, it is known that respondents in the case group who have poor water reservoir conditions are 19 respondents (67.9%) and respondents who have good water reservoir conditions are 6 respondents (27.3%). While respondents in the control group who have poor water reservoir conditions are 9 respondents (32.1%) and respondents in the control group who have good water reservoir conditions are 16 respondents (72.7%).

The results of data processing using the chi-square test can be seen from the continuity correction sig (2-sided) because the value of 0 cells <5 indicates that the p value is 0.010 (p <0.05) which means that there is a relationship between water reservoir conditions and the incidence of dengue fever. These results are supported by the OR value (95% CI) = 5.630 (1.648-19.232) which means that respondents who have poor water reservoir conditions have a 5.630 times greater risk of contracting dengue fever.

Houses that have water reservoirs are at greater risk of contracting dengue fever because the large number of water reservoirs allows Aedes aegypti larvae to breed [57], [58]. The existence of water reservoirs plays a major role in the density of Aedes aegypti larvae because the denser the Aedes aegypti mosquito population, the higher the risk of being infected with the dengue virus with a faster spread time so that the number of dengue cases increases rapidly which can ultimately result in an outbreak of dengue fever.

There is a relationship between water reservoirs and Dengue Hemorrhagic Fever incidents, which states that water used for daily needs must be provided in sufficient quality, quantity and consistency to reduce the use of water storage containers that become habitats for larvae, such as drums, tanks, jars and others. To avoid mosquito larvae in water reservoirs, people must drain them at least once a week so that mosquito larvae cannot breed. The condition of water reservoirs that are rarely drained and cleaned such as bathtubs, refrigerator water reservoirs, dispensers and aquariums will create mosquito breeding grounds that support the occurrence of Dengue Hemorrhagic Fever in the community.

Based on the results of the study, it shows that respondents who have poor water reservoir conditions in the case group, this is because most respondents have cloudy water reservoir conditions, no lids, and most respondents drain the water reservoirs once a month. While respondents who have good water reservoir conditions in the case group, this is because the condition of the respondent's water reservoir does not have a lid, so it will be easy for mosquito larvae to breed in the water reservoir to breed mosquitoes. Respondents who have poor water reservoir conditions in the control group, this is because there are still respondents who rarely drain the water reservoir, this is because there is still a sense of laziness to drain the water reservoir and a lack of concern for cleanliness. While respondents who have good water reservoir conditions in the control group, this is because most respondents care about cleanliness such as draining the water reservoir once a week and the availability of a closed water reservoir.

The results of the bivariate analysis of the relationship between the waste disposal system and the incidence of dengue fever are shown in Table 7.

Table 7. Relationship between waste disposal system and dengue fever incidence

Condition of Water Reservoir	Occurrence of Dengue Hemorrhagic Fever				Total		OR (95% CI)	p-value
	Case		Control					
	N	%	N	%	N	%		
Good	6	27.3	16	72.7	22	100.0	5.630 (1.648-19.232)	0.010
Bad	19	67.9	2	32.1	22	100.0		
Total	25	50.0	25	50.0	50	100.0		

Based on table 7, the results of the chi-square test to determine the relationship between the waste disposal system variable and the incidence of dengue fever are known that respondents in the case group who have a poor waste disposal system are 19 respondents (70.4%) and respondents who have a good waste disposal system are 6 respondents (26.1%). While respondents in the control group who have a poor waste disposal system are 8 respondents (29.6%) and respondents in the control group who have a good waste disposal system are 17 respondents (73.9%).

The results of data processing using the chi-square test can be seen from the continuity correction sig (2-sided) because the value of 0 cells <5 indicates that the p value is 0.005 (p <0.05) which means that there is a relationship between the waste disposal system and the incidence of dengue fever. These results are supported by the OR value (95% CI) = 6.729 (1.939-23.356) which means that respondents who have a poor waste disposal system have a 6.729 times greater risk of contracting dengue fever. There is a relationship between the waste disposal system and the incidence of dengue fever [40], [59]. Waste such as used cans, bottles, drums, and used tires can be a breeding ground for Aedes aegypti mosquitoes because these used goods can become puddles if waste management is not carried out properly and correctly.

Based on the results of the study, it shows that respondents who have a bad waste disposal system in the case group, this is because most respondents have not implemented the 3M Plus action and are still piling up waste which is disposed of once in 3 days. While respondents who have a good waste disposal system in the case group, this is because respondents already understand and understand the correct waste disposal such as sorting organic and inorganic waste [60], [61]. Respondents who have a bad waste disposal system in the control group, this is because respondents have not sorted organic and inorganic waste. While respondents who have a good waste disposal system in the control group, this is because most respondents have sorted organic and inorganic waste, respondents dispose of waste once a day, and respondents have implemented good household waste management by recycling plastic waste to minimize waste.

This study has a significant impact in strengthening the understanding of the relationship between environmental sanitation and Dengue Hemorrhagic Fever incidence, which can be the basis for designing more effective public health policies. These findings have the potential to help governments and health organizations in identifying intervention priorities, such as community education and improving sanitation infrastructure. However, this study has several limitations, such as the limited area coverage so that the results may not fully represent conditions in other areas. In addition, the study approach that relies more on quantitative data may not describe qualitative factors such as community perceptions and culture regarding sanitation. Further studies with a wider scope and a more holistic approach are needed to overcome these limitations.

4. CONCLUSION

Based on the results of the study, it can be concluded that there is a significant relationship between the condition of the house and the incidence of dengue fever. There is a significant relationship between the condition of the water reservoir and the incidence of dengue fever. And there is a significant relationship between the waste disposal system and the incidence of dengue fever. For further researchers, the researcher suggests that further research be conducted to deepen the questions in the questionnaire regarding the relationship between environmental sanitation and the incidence of dengue fever. Further research is recommended to expand the scope of the study area to ensure the generalizability of the findings to various geographic and social contexts. In addition, a mixed-method approach can be used to dig deeper into qualitative factors such as community perceptions and cultural influences on environmental sanitation-related behavior.

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