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Article

Analysis of the Relationship between Residential Environmental Sanitation and the Risk of Dengue Fever (DHF) Incidence in the Moropelang Health Centre Working Area, Lamonga, East Java

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Abstract

Dengue fever (DHF) is a significant health problem in tropical regions, including the working area of Puskesmas Moropelang, Lamongan. Data shows that DHF cases continue to be found in the period 2020-2023. This study aims to analyse the relationship between residential environmental sanitation and the incidence of DHF in the region in 2024. This study used a quantitative approach with an analytical observational design based on the *case-control* method. The study population was 148, with a total sample size of 74 cases and 74 controls. Independent variables included environmental conditions, water reservoirs, and larval density, while the dependent variable was dengue incidence. Data were analysed using the Chi-Square test. The results showed a significant association between environmental conditions (p=0.013), water storage conditions (p=0.003), and the number of free larvae (p=0.004) with the incidence of DHF. Respondents with poor home environmental conditions had a 2.3 times higher risk of DHF, while the risk increased to 2.7 times in poor water reservoirs, and 2.6 times in environments with high larval density. This study concluded that residential environmental sanitation plays an important role in the prevention of DHF. Weekly mosquito nest eradication efforts, community education, and regular monitoring of larvae are recommended to reduce the incidence of DHF and improve environmental health.

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Intruduction

Indonesia is one of the tropical archipelagic countries that is also an endemic area for dengue transmission [1]. Based on the data in Dengue Hemorrhagic Fever Annual Report 2022, at the end of 2022, the number of dengue cases in Indonesia reached 143,000 cases, with the highest incidence from the provinces of West Java, East Java, and Central Java [2]. Data released by the East Java Health Office in 2023 showed that there were 9,443 cases of DHF in East Java with a *case fatality rate* (CFR) of 1.1% while the CFR target was <1% [3]. The number of dengue cases in Lamongan Regency in 2023 was 193 cases, with no deaths [4].

DHF is an environmentally based disease due to community mobility, development, urbanisation, as well as climate change and decreased awareness of environmental hygiene [5]. According to WHO, the disease is caused by the dengue virus and is transmitted to humans through the bite of the *Aedes sp*. Mosquito [6]. This type of mosquito has a black base with white spots on the body, legs, and wings [7]. Some breeding places for Aedes aegypti mosquitoes include crocks, bottles, buckets, plastic drinking water containers, tyres, tanks, and other artificial containers [8]. Female *Aedes aegypti* mosquitoes prefer dark coloured containers with clear water for laying eggs [9].

Dengue fever or DHF is one of the diseases with increasing transmission coupled with the rapid life cycle of the *Aedes aegypti* mosquito [10]. Disease transmission mainly occurs in tropical areas with high humidity and hot weather [11]. Mosquitoes are optimally conditioned to lay eggs faster and mature longer at temperatures between 20 and 30 degrees Celsius. The humidity required for mosquitoes to grow optimally is 70% to 80% [12].

Sanitation based on an explanation from the World Health Organization (WHO) is an effort to prevent disease that observes several aspects of the physical environment for survival [13]. Good environmental sanitation can be achieved if people can maintain and implement healthy living patterns [14]. The residential environment plays an important role in the spread of infectious diseases. Housing situations that do not meet the requirements of healthy homes will have an impact on the spread of non-communicable diseases such as dengue fever [15]. *Aedes Aegypti* as a carrier and spreader of dengue disease likes environments that have poor quality, characterised by densely populated, lack of sunlight, humid, dark, near rivers with garbage [16]. The condition of the home environment is one of the factors that determine the cause of DHF, thus multi-sectoral prevention efforts must be carried out starting from the smallest scope, namely the household [17].

Although data shows that environmental sanitation is correlated with dengue incidence, there are limited studies that specifically address the association in endemic areas. Previous studies have focused more on general transmission patterns without in-depth analyses of sanitation, such as water management and mosquito density in local areas. In Lamongan district, although dengue data is available, there is a lack of research on the effectiveness of environment-based prevention at the household level. This study aims to fill this gap by evaluating residential sanitation and its impact on DHF for control recommendations in Puskesmas Moropelang, Lamongan.

Materials and Method

Subject of thestudy. The population in the study was 148 with a total sample of 74 respondents. The sample for this study is the entire population set at 74 respondents for the case group and a total of 74 respondents for the comparison and control groups. The population in the study was 148 with a total case and control sample of 74 respondents.

This study utilised quantitative research with the type of Analytical Observational research**.** This study utilised survey research with a *case-control* approach design, as a research design that compares the case group to the control group in determining the proportion of events based on the presence or absence of exposure [18].

Instrument and Equipment. This research instrument uses observation sheets and interview guidelines used in assessing the condition of the house, the condition of the water reservoir location and measuring the larvae in the working area of the Moropelang Health Centre, Lamongan Regency. The observation sheet has been tested for validity and reliability.

Data Collection Methods. The sampling technique for this study utilised total sampling to obtain 74 respondents. Data collection techniques utilise observation sheets and interviews.

Data Analysis. Data obtained were analysed by univariate as well as bivariate. Bivariate analysis to determine the relationship between the behaviour of primary school-aged children and the incidence of diarrhoea, using the Chi-square test.

Results

This study describes the distribution of Dengue Fever (DHF) incidence in the Moropelang Health Centre working area, Lamongan, in 2024, and the association between environmental conditions, water reservoirs, and mosquito larvae density with the incidence of the disease. Data were collected from 148 respondent households, comprising 74 case and 74 control groups, and included assessments of the home environment, cleanliness of water reservoirs, and mosquito larvae density. The following table presents the frequency distribution of DHF incidence and the results of the analysis of the variables studied to provide an overview of the sanitary condition of the residential environment in the study area.

Table 1. Frequency Distribution of DHF Events

Variable	Category	Frequency	Percentage (%)
Incidence of DHF	Suffered (Cases)	74	50
	Not Suffering (Control)	74	50
	Total	148	100
Home Environment Condition	Good	64	43.92
	Less	83	56.08
	Total	148	100
Condition of water reservoirs	Good	70	47.29
	Less	78	52.71
	Total	148	100
Mosquito Density Free Number of Larvae	*Aedes Aegepty* larvae present	89	60.14
	No *Aedes Aegepty* larvae	59	39.86
	Total	148	100

In the table, it is known that the incidence of DHF in the Moropelang Health Centre working area is 50% (74 people) in the case and control groups in a 1:1 ratio. The results of the assessment of home environmental conditions show that the majority of home environmental conditions are in the "Less" category as much as 56.08% (83 houses). In the assessment of the condition of the water reservoir category "Less" as much as 52.71% (78 houses). In the Mosquito Density Calculation Free Number of Larvae obtained in thecategory of no*Aedes Aegypti* as many as59 respondents with a percentage of39.86%.

The following is a frequency distribution table of the number of larvae according to the presence of *Aedes Aegypti* larvaein the Moropelang Health Centre Working Area.

Table 2 Frequency distribution of the number of larvae according to the presence of Aedes aegypti larvae

House Inspected	HI	CI	BI	DF
148 homes	**60,1**	**25,5**	**69,5**	**6**

The results of the calculation of table 2 are aligned with the Aedes aegypti mosquito larvae density table into a scale of 1-9 and adjusted by drawing a straight line so that the Dencity Figure (DF) is obtained. With the above equation to analyse the mosquito population rate, the value of the Mosquito Free Number, *Hause Index* = 60.1%, *Container Index* = 25.5%, *Bretau Index* = 69.5% was obtained.

Relationship between Environmental Conditions, Water Containment Conditions and Mosquito Free Number of Larvae **Density with the Incidence of Dengue Fever (DHF) in the Moropelang Health Centre Working Area in 2024.**

Table 3 Relationship between environmental conditions, water reservoir conditions and mosquito larvae density with the incidence of Dengue Fever (DHF) in the Moropelang Health Centre Working Area, 2024

Variable	Category	Incidence of DHF				Total		*p-value*	OR 95% CI
		Case		Control					
		n	%	n	%	n	%		
Neighbourhood Condition	Good	25	38.5	40	61.5	65	100	0.013	2.306
	Less	49	59.04	34	40.96	83	100		(1.187-4.480)
	Total	74	50	74	50	148	100		
Condition of water reservoirs	Good	26	37.1	44	62.9	70	100	0.003	2.708
	Less	48	61.5	30	38.5	78	100		(1.392-5.269)
	Total	74	50	74	50	148	100		
Free Number of Larvae	Meet	21	35.6	38	64.4	59	100	0.004	2.664
	Does not meet	53	59,6	36	40,4	89	100		(1.349-5.262)
	Total	74	50	74	50	148	100		

The results of chi-square testing in Table 3 variable Environmental Conditions has a *p-value = 0.013* (<α = 0.05) with the meaning of the relationship between Environmental Conditions and the Incidence of Dengue Fever (DHF). These results are supported by the OR value = 2.306, with a 95% CI value = (1.187-4.480), meaning that respondents who have poor home environmental conditions have a 2.306 times greater risk of *dengue* hemorrhagic fever.

The chi-square results on the Water Shelter Condition variable have a p-value = 0.003 (<α = 0.05), meaning that there is a relationship between the Water Shelter Condition and the Incidence of Dengue Hemorrhagic Fever (DHF). These results are supported by the OR value = 2.708 with a 95% CI value = (1.392-5.269), meaning that respondents who have poor water storage conditions have a 2.708 times greater risk of *dengue* hemorrhagic fever.

The chi-square results on the larval density variable have a p-value = 0.004 (<α = 0.05) which means that there is a relationship between larval density and dengue fever cases in the Moropelang Health Centre Working Area in 2024.These results are supported by the OR value = 2.664 with a 95% CI value = (1.349-5.262), meaning that respondents who have an insufficient density of larvae have a 2.664 times greater risk of *dengue* hemorrhagic fever.

Discussion

The criteria for a healthy home is that it can fulfil all the needs of the physical environment of the house and can avoid the transmission of disease vectors. Based on the results of this study, it is known that poor environmental conditions will increase the risk of dengue haemorrhagic fever transmission. The assessment of environmental conditions carried out includes the installation of wire mesh for home ventilation, the behaviour of hanging clothes, the installation of mosquito nets for beds, as well as the presence of water drains. Respondents who have poor environmental conditions are due to the fact that in general respondents still do not pay attention to the condition of the home

environment, especially there are still respondents' houses that do not use wire mesh in the vents and windows of their homes, do not use mosquito nets in their beds, still have the habit of hanging clothes after use, and there are still open drains.

The results of this environmental condition assessment are in accordance with research by Rochmawati, et al. which explains the relationship between home environmental sanitation and the presence of DHF disease [19]. Based on research conducted by Fadrina, et al. The condition of a qualified house is a house with wire mesh for windows, the presence of a drain, and the installation of mosquito nets for beds [20]. A building or house that does not have ventilation that has wire mesh can make it easy for mosquitoes to enter the building and make it easier for mosquitoes to breed. In research by Samal, et al. it is said that the condition of sewerage is one of the risk factors for DHF incidence in Temamaung Village, Makassar City in 2021. Unqualified drains are not necessarily the cause of DHF. Aedes aegypti mosquitoes like clean water free from soil to serve as egg-laying sites. Therefore, as a preventive measure, water channels should be closed [21].

The results of this study show that poor water storage increases the risk of DHF transmission. The results of this study are also in accordance with research conducted by Mawaddah, et al. who said that water reservoirs that are less than adequate have a 7.48 times risk of DHF than water reservoirs that meet the provisions [22]. Observations showed that respondents rarely drained water reservoirs, supported by respondents' statements that they rarely drained bathtubs. One of the factors affecting the presence of *Aedes aegypti* larvae is the water reservoir (TPA), because the presence of landfill around the residence has the potential as a breeding ground for *Aedes aegypti* mosquitoes. This research is in accordance with research by Febrianti, et al. which explains the relationship between water containers and the incidence of DHF [23].

Based on these findings, it is recommended that the community should more regularly drain and clean water containers, at least once a week, to prevent the breeding of Aedes aegypti mosquito larvae that have the potential to cause DHF. This effort can be supported by community empowerment through periodic socialisation by health workers, especially in areas with a high number of DHF cases. In addition, the use of lids on water reservoirs can also help prevent mosquitoes from laying eggs. People can also utilise larvae-eating fish in bathtubs or ponds to reduce the population of mosquito larvae naturally.

Based on the results of the calculation, the larvae-free rate in the Moropelang Community Health Centre working area is 60.81%, according to Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023 explains the Free Number of Larvae in the house must be >95% [24]. According to research by Sukendra, et al. areas that have a high Free Number of Larvae (≥95%) indicate a low density of larvae in an area, on the other hand, areas that have a low Free Number of Larvae (≤95%) indicate a high density of larvae and the population of Aedes aegypti mosquitoes as vectors of dengue virus transmission in the community. The non-achievement of the Free Number of Larvae target indicates that periodic monitoring of larvae is still weak as an effort to reduce the risk of DHF reaching outbreaks with high morbidity and mortality rates [25].

The presence of *Aedes aegypti* larvae in an area is an indicator of the presence of *Aedes aegypti* mosquito population in the area. A high density of Aedes aegypti mosquitoes has a high risk of mosquito transmission for dengue transmission. Breeding sites of *Aedes aegypti* mosquitoeshave an influence on the level of larval density. The larvaldensity of 60.81 was caused by the presence of mosquito larvae in the respondents' water reservoirs. The condition of open water reservoirs and infrequent draining can increase the potential for *Aedes aegypti* mosquitoes to breed in these water

reservoirs. Mosquito larvae in water reservoirs will become larvae and then become adult mosquitoes, causing DHF incidents by biting humans.

This study is consistent with research conducted by Murzella, et al. in Takalar District in 2020, where the Free Number of Larvae results show a value below 95%. The Free Number of Larvae value indicates that there is a great opportunity for mosquitoes to make Takalar District a hotbed for the spread of dengue fever [26]. Other research conducted by Khotafiatun, et al. in Jeruksari Village, Tirto Sub-district, Pekalongan Regency, the House Index value was 32.1%, Container Index 13.7%, Breteau Index 32.1%, and Free Number of Larvae 68%, indicating that the village was categorised as a high risk dengue transmission [27].

The non-achievement of the Free Number of Larvae target indicates a high potential for breeding Aedes aegypti mosquitoes as a vector of DHF disease. The presence of larvae in open and rarely cleaned water reservoirs indicates a lack of effective prevention efforts in reducing the risk of dengue transmission. Therefore, efforts to increase the Free Number of Larvae through regular monitoring of larvae, as well as increasing public awareness about the importance of maintaining environmental hygiene, are needed to reduce the incidence of DHF and prevent potential outbreaks in the future.

Conclusions

This study proved that residential environmental sanitation has a significant association with the incidence of dengue fever (DHF) in the working area of Puskesmas Moropelang, Lamongan, in 2024. The main findings showed that substandard housing conditions, poor water reservoir management, and low larva-free counts significantly increased the risk of DHF incidence. Respondents with poor home environments had a higher risk of DHF, while water reservoirs that were rarely cleaned acted as potential habitats for Aedes aegypti mosquitoes. In addition, a low larva-free rate reflects a high population density of larvae, which contributes to the spread of the disease.

This study highlights the importance of collaboration between the community and the Puskesmas in encouraging healthy behaviours, such as routine mosquito nest eradication (PSN), improved environmental hygiene, and water reservoir management. The implementation of integrated and community-based environmental health programmes is expected to reduce the incidence of DHF. For future research, it is recommended to examine other factors such as climate change, urbanisation patterns, and population mobility that may affect the distribution and prevalence of DHF. In addition, the development of technology-based intervention models, such as digital larva monitoring and education through apps, could be an important focus for more effective and sustainable dengue prevention efforts.

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Informed Consent Statemen

Informed consent was obtained from all subject involved in the study.

Conflicts of Interest

The authors declare no conflict of interest.

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