Eduvest – Journal of Universal Studies
Volume 4 Number 03, March, 2024
p- ISSN 2775-3735- e-ISSN 2775-3727

ANALYSIS OF Aedes aegypti LARVAL DENSITY ON THE POTENTIAL TRANSMISSION OF DENGUE FEVER

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ABSTRACT

Dengue hemorrhagic fever (DHF) is caused by the dengue virus transmitted through the Aedes aegypti mosquito. DHF remains a health problem in Indonesia. Based on data from the Ministry of Health, there were 184 cases of the disease in 2022, an increase of 94.8% compared to 2021, which had 73,518 cases. According to the Central Statistics Agency of South Sumatra Province, the number of DHF cases in South Sumatra was 2,854 cases, with the highest number in the city of Palembang at 908 cases. This condition requires serious attention. The aim of this study is to analyze the potential transmission of DHF based on entomological evidence in the Sukarami district of Palembang. The method used in the research is a cross-sectional study conducted in December 2023, involving 92 households in the Sukarami sub-district, with a total of 552 containers. The survey results of larval identification under a microscope showed a Larval Free Index of 45.7%, a Container Index of Aedes aegypti larvae of 56.0%, a house index of 73.9%, and a Breteau index of 152.2%. The results of entomological indices indicate a high density of DHF vector mosquitoes Aedes aegypti, which means that this area has a high risk of DHF transmission, thus requiring the control of Aedes aegypti larvae and the eradication of DHF. breeding sites for the vector.

KEYWORDS *Potential Transmission, Entomological Index, Dengue Fever*

INTRODUCTION

Dengue hemorrhagic fever (DHF) remains a health problem in tropical countries, including Indonesia, transmitted by the Aedes albopictus (Ae albopictus) and Ae. aegypti (Ae. Aegypti) mosquitoes as the main vectors. The spread of vectors and the increase in mosquito populations have made the virus endemic in moderate climatic regions. The incidence of DHF is higher in tropical areas based on geographical characteristics (Siregar FA, Makmur T, 2017).

In early 2020, the WHO declared dengue as one of the global health threats among 10 other diseases. The incidence of dengue has significantly increased

How to cite:	Maria Nuraeni. (2024). Analysis of Aedes Aegypti Larval Density on The Potential Transmission of Dengue Fever. *Journal Eduvest*. *4* (3): 1130-1137
E-ISSN:	2775-3727
Published by:	https://greenpublisher.id/

worldwide. It is estimated that there are 390 million dengue infections annually, with 96 million of them manifesting clinically with varying severity levels. If left untreated, these conditions can lead to outbreaks, severe dengue, and even death (Kemenkes, 2021). According to data from the Ministry of Health in 2022, there were 143,184 cases, representing a 94.8% increase compared to 2021, which had 73,518 cases. Data on the number of DHF cases from the Central Statistics Agency of South Sumatra Province shows that there were 2,854 cases in South Sumatra, with the highest number in Palembang being 908 cases.

Dengue hemorrhagic fever (DHF) is an infectious disease caused by the dengue virus, transmitted by the Ae. aegypti mosquito as the main vector. The adaptability of the dengue vector allows for longer survival and reproduction, leading to a high population of Ae. aegypti mosquitoes and the spread of the dengue virus, resulting in a consistently high incidence of DHF (Calvez *et al*., 2020).

The dengue virus causes infections with various clinical manifestations, resulting in different clinical manifestations. Dengue Hemorrhagic Fever and Dengue Shock Syndrome cause high morbidity and mortality, although most dengue virus infections do not show symptoms or only cause mild illness, severe disease can occur and is characterized by plasma leakage, a physiological process where fluid components leak into surrounding tissues, causing extravascular fluid accumulation. There are four different antigenic serotypes of the dengue virus known to cause human infections (Sharma *et al*., 2018). Dengue fever is a mild clinical form, dengue hemorrhagic fever and dengue shock syndrome are more severe forms that can cause death. In more severe forms, plasma leakage occurs due to increased vascular permeability, which is a pathognomonic sign of DHF and DSS (Keputusan Menteri Kesehatan Republik Indonesia, 2021).

Dengue virus infection and transmission occur through mosquito bites from Aedes mosquitoes. Some studies have shown that Ae. aegypti mosquitoes are more commonly found indoors, while Ae. albopictus mosquitoes are found outdoors. Entomological indices are important indicators of Ae. aegypti larval density in a settlement and are essential for determining effective vector control efforts (Perwitasari et al., 2018). The density of Aedes mosquito larvae can be measured using the house index, container index, Breteau index, and density figure. The house index measures the percentage of houses infested with Aedes mosquito larvae, the container index measures the percentage of containers infested with Aedes mosquito larvae, the Breteau index measures the number of containers infested with Aedes mosquito larvae per 100 houses, and the density figure measures the density of Aedes mosquito larvae per container. Aedes mosquito larva surveys can be conducted by sampling from several households or specific locations (Yusmidiarti, 2021). Density is identified based on adult and pre-adult densities. Adult density includes the density figure per person per hour (man-hour density/MHD), the density figure per person per night/day (man biting rate/MBR), and the resting mosquito figure, while pre-adult density includes the larval free index (ABJ), house index (HI), container index (CI), Breteau index (BI), larva index (LI), and breeding site density (PERMENKES No 50, 2017).

Previous studies on Ae. aegypti larval density in the Kenali Asam Bawah Sub-district found a Density Figure of 5.3 with an HI value of 30%, CI 19.5%, and BI 74%, categorizing the area as red and requiring immediate control (Lesmana & Halim, 2020). Another study in the Kandang Sub-district of Bengkulu City found an HI of 90.6%, CI 70.98%, and BI 78.23% (Widada et al., 2021). The impact of participatory model development on larval control resulted in a significant increase after the development of participatory counseling models. Cognitive and affective abilities significantly improve mosquito larval control behaviors, as evidenced by a decrease in mosquito larval population density from high to moderate density in the Sukarami sub-district of Palembang (Zalili, 2015).

Risk factors associated with DHF include environmental factors as breeding grounds for dengue vector mosquitoes. This study aims to analyze the potential transmission of dengue fever using the entomological index of the presence of Aedes aegypti larvae in the Sukarami sub-district to estimate the potential transmission of dengue hemorrhagic fever in the area.

RESEARCH METHOD

This research is an observational descriptive study, using a cross-sectional approach, with measurements and observations conducted at a specific point in time. The sampling technique used was purposive sampling, based on the researcher's judgment of samples that met the criteria (ABD. Nasir, Abdul Muhith, 2019). Sampling was also done through simple random sampling, resulting in a sample size of 92 households. Research ethics were ensured through the completion of informed consent as evidence of the homeowners' agreement to participate in the mosquito larvae survey in their water storage areas. Data collection was conducted in December 2023 in households around the Fikes UKMC campus, located in the Sukarami sub-district of Palembang.

The water storage containers observed were categorized as controllable sites (CS) and disposable sites (DS). Controllable sites are water storage areas that can be controlled to prevent vector breeding, while disposable sites are neglected areas or those located outside the home that have the potential to become mosquito breeding sites.

Larval inspection was performed using the single larva method. Larvae found were examined under a microscope in the Laboratory of the Faculty of Health Sciences at Musi Charitas Catholic University. Entomological indices were calculated based on the larval-free index, which is the number of houses where no Ae. aegypti or Ae. albopictus larvae were found. The container index is the number of positive larvae containers per container inspected, the house index is the number of houses with positive larvae per house inspected, and the Breteau Index is the number of positive larvae containers per house inspected. These indicators were used to determine the potential transmission of DHF based on larval density or density figure (DF). The calculation of larval density follows WHO guidelines as shown in Table 1.

Table 1. Density Figure

Density Figure	House Index	Container Index	Breateau Index	Category
1	1-3	1-2	1-4	Low
2	4-7	3-5	5-9	Moderate
3	8-17	6-9	10-19	Moderate
4	18-28	10-14	20-34	Moderate
5	29-37	15-20	35-49	Moderate
6	38-49	21-27	50-74	High
7	50-59	28-31	75-99	High
8	60-76	32-40	100-199	High
9	>77	>41	>200	High

RESULT AND DISCUSSION

The study was conducted in the housing complex of Musi Charitas Catholic University, Sukarami District, with 92 households as our research site. Based on the presence of Aedes aegypti larvae in residents' homes as shown in Table 2.

Table 2. Distribution of vector presence in households

Vector Presence for DHF	Frequency	Percentage
Present	68	73,9%
Absent	24	26,1%
Total	92	100%

Data in Table 2 indicates that out of 92 surveyed households, the majority had Aedes aegypti mosquito larvae, with 68 households comprising 73.9%. Aedes aegypti larvae were found both inside and outside homes, based on the breeding site's location for dengue fever virus proliferation, as seen in Table 3.

Table 3. Distribution of breeding site locations in households where Aedes aegypti larvae were found

Location	Frequency	Percentage
Inside House	32	35 %
Outside House	36	39 %
Total House	92	100%

Data in Table 3 shows that the majority of vector larvae were found in breeding sites outside the house, at 39%. The presence of Aedes aegypti mosquito larvae, based on the type of breeding site, as shown in Table 4.

Table 4. Distribution of breeding site types containing Aedes aegypti larvae

Breeding Site Type	Total Containers		Presence of Aedes aegypti larvae			
			Yes		No	
	f	%	f	%	f	%
Bath Tubs	92	16,7%	26	4,7%	66	12,0%
Water Storage Containers	85	15,4%	6	1,1%	79	14,3%
Food and Beverage Containers	202	36,6%	24	4,3%	178	32,2%
Other Used Goods & Tree Leaves	173	31,3%	12	2,2%	161	29,2%
Total	**552**	**100,0%**	**154**	**12,3%**	**398**	**87,7%**

Note:
f = Frequency
% = Percentage

Based on the data from Tables 2, 3, and 4, the mosquito entomological indices can be calculated. Out of 92 households surveyed with 552 containers, it was found that 48 households (52.2%) and 154 containers (12.3%) were breeding sites for Aedes aegypti, the DHF vector. Based on this data, entomological indices were calculated as shown in Table 5.

Table 5. Calculation and Categorization of Entomological Indices Based on Aedes aegypti Larvae Species

NO	Index Entomology	Value	Category
1	House Index	73,9%	High
2	Container Index	56,0%	High
3	Breateau Index	152,2%	High
4	Angka Bebas Jentik	45,7%	Low

The entomological index values for the DHF vector Aedes aegypti fall into the high category. The research data found a high HI value, indicating widespread Aedes aegypti distribution and a high risk of DHF transmission by the Aedes aegypti vector. Larval density levels are related to water containers as mosquito breeding sites. The Container Index value from the research results indicates a high-density category. Open containers without covers have a high potential for Aedes mosquito breeding, as open breeding sites make it easier for DHF vectors to lay their eggs. The presence of Aedes aegypti mosquito larvae found by container location revealed that larvae were more abundant in containers outside the house than inside. This is because outdoor containers are often neglected, such as food and beverage containers that collect rainwater, especially during the rainy season. The house index is a commonly used indicator to monitor mosquito attack levels. The HI value measures the percentage of houses positive for vector breeding, helping to identify potentially at-risk populations.

The Breteau Index value falls into the high category for Aedes aegypti mosquitoes. BI represents the number of positive larval tanks per house inspected, indicating a combination of residential tanks and water tanks. Mosquitoes breed in clean water storage containers, where rainwater, taps, and wells are ideal habitats for Aedes aegypti mosquitoes (Thia Prameswarie *et al*., 2023). Aedes aegypti larvae in breeding sites require nutrition for growth and development. Water containers that serve as good media for DHF vector growth are stagnant and non-flowing, with high levels of phosphate and ammonia. Therefore, it is important to pay attention to the quality and condition of water storage.

Regular mosquito control and management efforts are necessary to control DHF mosquito populations. Ammonia can enter water as a result of organic decomposition and aquatic organism metabolic waste products. Ammonia (NH_4) is a liquid nitrogen compound. Ammonia exists as free ammonia or non-ionized (NH_3) and ammonia ion (NH_4^+) (Muryanto, 2020). The Larval-Free Index in the Sukarami district is low at 45.7% < 95%. Achieving an ABJ value ≥ 95% is essential to declare an area free of larvae and DHF. Community awareness is important for implementing 3M Plus activities at breeding sites, especially during the rainy season (Bedah & Hartandi, 2020). The Density Figure entomological index for the DHF vector Aedes aegypti falls into the high category. This figure indicates that the area has a high potential for DHF incidence. Some factors influencing the presence of DHF vectors in an area include temperature, ranging from 25-27°C (Torres et al., 2022). The temperature range in Palembang city, based on BMKG data, had an average maximum temperature of 32.1°C in December 2022. The average minimum temperature in December 2022 was 24.4°C. The lowest minimum temperature was 22.2°C on December 31, 2022, and the highest minimum temperature was 25.6°C on December 11, 16, and 20, 2022. (BMKG, 2022). The aquatic stage development rate increases to 35°C and decreases after this threshold. Aedes aegypti development in water is significantly influenced at high diurnal temperatures exceeding the 35°C threshold. Aedes aegypti development is affected by diurnal temperature fluctuations and has a significant impact on the adult mosquito population in a population with high average temperatures, greater than 32°C (Carrington et al., 2013).

In addition to temperature, air humidity can also affect Aedes mosquito larval development. Increased temperature and air humidity can accelerate the development time from eggs to adult mosquitoes, thereby increasing the potential for disease transmission carried by vector mosquitoes. Increased temperature and air humidity can affect the aquatic stage development of Aedes aegypti, and temperature and air humidity can accelerate the development time from eggs to adult mosquitoes, thereby increasing the potential for disease transmission by Aedes aegypti mosquitoes as DHF vectors. Temperature affects larval development time, larval survival, and adult reproduction (Carrington *et al*., 2013) Aedes aegypti mosquitoes. require water for breeding, so the environment must be humid and wet. The average relative humidity in December 2022 was 87%. The average relative humidity was lowest at 80% on December 26, 2022, and the average absolute value was 93% on December. (BMKG, 2022).

CONCLUSION

The Larval-Free Index obtained was 45.7%. The DHF vector, Aedes aegypti species, exhibited a Container Index value of 56.0%, a House Index of 73.9%, and a Breteau Index of 152.2%. Based on the entomological index results, the Density Figure with the Aedes aegypti vector falls into the high category. This indicates that the area has a high potential for DHF transmission events.

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