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RESEARCH **Open Access**

The Density of Aedes aegypti Larvae Density and the Incidence of Dengue Hemorrhagic Fever in the Pesingahan Environment, Pagesangan Barat Village, Mataram

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Abstract
Dengue hemorrhagic fever remains a public health concern in West Nusa Tenggara Province, with the majority of cases occurring in Mataram City and the Pesinggahan Environment of West Pagesangan Village. The density of Aedes aegypti larvae as disease vectors has a strong influence on the high incidence of cases and the spread of dengue hemorrhagic fever. The objective of this study was to identify if there was a relation between the density of Aedes aegypti larvae and the rate of dengue hemorrhagic fever in the Pesinggahan Environment of Pagesangan Barat Village. This study is an analytic observational study with a cross-sectional design. This study's sample size was 56 houses. The data collected included information on the density of Aedes aegypti larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment of Pagesangan Barat Village over the previous year. Descriptive analysis was used to examine data on the density of Aedes aegypti larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan environment. The findings revealed that the density of Aedes aegypti larvae was high (Density Figure (DF) = 6), as was the incidence rate of dengue hemorrhagic fever (0.39%). The statistical analysis between the density of A. aegypti larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment with the chi square test demonstrated indicate that p-value = 0.000 < alpha= 0.05. Based on the results of the study, there was a relationship between the density of A. aegypti larvae and the incidence rate of dengue hemorrhagic fever in Pesinggahan, Pagesangan Barat Village. Further research is required regarding the detection of the dengue virus transmitted by A. aegypti mosquitoes to their offspring (transovarial).

Keywords: Dengue Hemorrhagic Fever, Density of A. aegypti Larvae, Incidence Rate.

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1. INTRODUCTION

Dengue hemorrhagic fever is an infectious disease that is still a public health concern in the West Nusa Tenggara (NTB) province, with the majority of cases occurring in the city of Mataram. In 2015, there were 481 cases of dengue hemorrhagic fever in Mataram City, with a morbidity rate (IR) of 0.12% and a mortality rate (CFR) of 0%, and this increased to 917 cases in 2016, with a morbidity rate (IR) of 0.23% and a mortality rate (CFR) of 0.76% (Dinas Kesehatan NTB, 2015), (Dinas Kesehatan NTB, 2016), (Dinas Kesehatan Kota Mataram, 2015), (Dinas Kesehatan Kota Mataram, 2016).

Pagesangan Village is one of Mataram City's sub-districts with the highest number of dengue hemorrhagic fever cases. In 2015, there were 58 cases of dengue hemorrhagic fever with a morbidity rate (IR) of 0.62% and a mortality rate (CFR) of 0%, which increased to 172 cases in 2016 with an IR of 1. 84% and a mortality rate (CFR) of 0.58% (Dinas Kesehatan NTB, 2015), (Dinas Kesehatan NTB, 2016), (Dinas Kesehatan Kota Mataram, 2015), (Dinas Kesehatan Kota Mataram, 2016).

. Pesinggahan is an environment in Pagesangan Barat Village that has a high incidence of dengue fever (Kelurahan Pagesanagan Barat, 2016).

The density of disease vectors has a strong influence on the high incidence of cases and the spread of dengue hemorrhagic fever (Sambel, 2009). The observation of the *Aedes aegypti (A. aegypti)* vector is critical, particularly in determining the distribution, density, and primary habitat of the larvae, the potential risk of transmission, the level of sensitivity of mosquitos to insecticides, and prioritizing the location and timing of eradication (Sunaryo & Pramestuti, 2014). The presence of *Aedes aegypti* larvae in a location indicates the presence of *Aedes aegypti* mosquito populations in that location (Purnama & Baskoro, 2012). In comparison to egg and adult mosquito surveys, the larval survey is the most commonly used. The larval survey employs three indices: the House Index (HI), Container Index (CI), and Bretaue Index (BI) (World Health Organization, 2002).

Based on data from the Pagesangan Health Center in November 2016, the value of the larvae-free rate in the Pesinggahan Environment was 86.81%, where this figure was still below the National Standard, which is > 95%, while the HI value: of 13.18% and CI: 8.74%, which is based on WHO standards, that is if HI ≥ 10% and CI ≥ 5%, it indicates you are at high risk of transmitting dengue hemorrhagic fever, but no research has been conducted on the *Aedes aegypti* larvae density and dengue fever incidence in the Pesinggahan Environment as data that can be used in taking dengue hemorrhagic fever preventive actions (Data Puskesmas Pagesangan, 2016), (World Health Organization, 2016). Dengue hemorrhagic fever prevention is critical because there are currently no available vaccines or drugs to treat the disease. According to Kusriastuti & Sutomo (2005), the lack of vaccines and medicines made vector control the best option for community prevention and control of dengue hemorrhagic fever. According to Zuhriyah, Habibie, & Baskoro, (2012), vector density, vector identification, and vector breeding site are all necessary for effective vector control. The objective of this study was to determine the relationship between the density of *A. aegypti* larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment of West Pagesangan Barat Village.

2. RESEARCH METHOD

This research is an analytic observational study with a cross-sectional research design. The sample size in this study was 56 houses, with the sampling technique in this study employing a proportionate random sampling technique, in which the number of samples in RT 1 Pesinggahan was 14 houses, in RT 2 was 16 houses, in RT 3 was 14 houses and RT 4 is 12

houses. Meanwhile, the morbidity rate of dengue hemorrhagic fever in Pesinggahan administers secondary data obtained from the Pagesangan Health Center.

The tools and materials employed in this study were bowls, glass containers, glass objects, cover glasses, pipettes, tissue, microscopes, and water. The *Aedes aegypti* larvae survey was conducted using the single larva method, and larvae samples collected from the Pesingahan community water reservoir were identified utilizing the direct method using a microscope to determine the type of *Aedes aegypti* larvae. Following identification, the density of *Aedes aegypti* larvae was measured by calculating the values of the House Index, Container Index, and Bereteu Index, which were then adjusted to the Density Figure value based on WHO guidelines.

Meanwhile, the morbidity rate for dengue hemorrhagic fever was calculated using data from the Pagesangan Health Center on the number of dengue hemorrhagic fever incidents in the Pesinggahan area. The morbidity rate for dengue hemorrhagic fever was then calculated and adjusted for high, medium, and low categories using data from the Indonesian Ministry of Health's Data Center and Epidemiological Surveillance.

3. RESULTS AND DISCUSSION

Table 1. The House Index (HI) in Pesinggahan Environment.

Environment	Number of houses	Number of Houses that Positive Larvae	House Index (HI) (%)
RT 1	14	6	43%
RT 2	16	7	44%
RT 3	14	6	43%
RT 4	12	5	42%
Pesinggahan	56	24	43%

RT= Rukun Tetangga

House Index (HI) was employed as an indicator for dengue transmission by The Pan American Health Organization (Sanchez et al., 2006). Based on Table 1, the House Index (HI) was revealed that in RT 1 of the 14 houses examined 6 houses were positive for *Aedes aegypti* (*A. aegypti*) larvae, thus, the House Index (HI) value at RT 1 was 43%, in RT 2 of the 16 houses examined, 7 houses were positive *A. aegypti* larvae, the HI value in RT 2 was 44%, in RT 3 of the 14 houses examined, 6 houses were positive *for A. aegypti* larvae, the HI value in RT 3 was 43% and in RT 4 of 12 of the houses examined, 5 houses were positive for *A. aegypti* larvae, hence, the HI value in RT 4 was 42%, thus, overall in the Intersection environment of the 56 houses examined, 24 houses were positive for *A. aegypti* larvae, hence, the HI value in the Environment The stopover is 43%. The HI in this study is nearly identical to the results of a study conducted by Sudarmaja et al., (2022), who obtained an HI of 40% in 10 DHF patient houses equipped with ovitraps in Denpasar, Bali.

Table 2. The Container Index (CI) in Pesinggahan Environment.

Environment	Number of Containers	Number of Containers that Positive larvae	Container Index (CI) (%)
RT 1	29	7	24%
RT 2	35	9	26%
RT 3	29	7	24%
RT 4	25	5	24%
Total	118	29	24%

RT= Rukun Tetangga

Based on Table 2, the Container Index (CI) was revealed that at RT 1 of the 29 containers examined, there were 7 containers positive for *Aedes aegypti* (*A. aegypti*) larvae,

thus, the Container Index (CI) value at RT 1 was 24%. At RT 2 of the 35 containers investigated, there were 9 containers positive for larvae *A. aegypti*, the CI value at RT 2 was 26%. At RT 3 of the 29 containers observed, there were 7 containers positive for *A. aegypti* larvae, hence, the CI value at RT 3 was 24% and at RT 4 of 25 containers examined, there were 5 containers positive for *A. aegypti* larvae. Meanwhile, the CI value at RT 4 was 24%, hence, overall in the stopover environment of the 118 containers calculated, 29 containers were positive for *A. aegypti* larvae, thus, the CI value in the stopover environment was 24%.

Table 3. The Breteu Index (BI) in Pesinggahan Environment.

Environment	Number of Containers	Number of Containers that Positive larvae	Breteu Index (BI) (%)
RT 1	14	7	50%
RT 2	16	9	56%
RT 3	14	7	50%
RT 4	12	5	50%
Total	56	29	50%

RT= Rukun Tetangga

According to Table 3, the Breteu Index (BI) in Pesinggahan Environment revealed that in RT 1 of the 14 houses examined, 7 containers were positive for *Aedes aegypti* larvae, thus, the Breteu Index (BI) value at RT 1 was 50%. At RT 2 of the 16 houses investigated, there were 9 containers positive for *A. aegypti* larvae, the BI value at RT 2 was 56%. At RT 3 out of 14 houses observed, there were 7 containers positive for *A. aegypti* larvae. Meanwhile, the BI value at RT 3 was 50% and at RT 4 out of 12 houses measured, there were 5 containers which were positive for *A. aegypti* larvae. Meanwhile, the BI value at RT 4 was 50%, hence, overall in the Intersection environment of the 56 houses calculated, there were 29 containers positive for *A. aegypti* larvae, thus, the BI value at RT 4 was 50 %.

Based on the House Index (HI), Container Index (CI), and Breteu Index (BI) values of *A. aegypti* larvae Density at RT 1 were 43%, 24%, and 50%, at RT 2 the HI, CI, and BI values were 44%, 26%, 56%, at RT 3 the HI, CI, BI is 43%, 24%, 50%, and in RT 4 the values HI, CI, BI were 42%, 24%, 50%. Hence, in the Intersection Environment the values HI, CI, BI were 43%, 24%, 50%. The HI, CI, and BI values in this stopover environment are adjusted to the WHO Density Figure table to determine density, and the HI, CI, and BI values have a Density Figure (DF) = 6 (House Index = 43%, Container Index = 23%, Breteau Index = 50%), indicating a high density of *Aedes aegypti* larvae. *Aedes aegypti* larvae were abundant (Density Figure (DF)). After determining the density of *Aedes aegypti* larvae, the study proceeded by analyzing the incidence rate of dengue hemorrhagic fever to provide an overview of the disease's transmission, which was associated with the density of Aedes aegypti larvae.

Table 4. The Incidence Rate of Dengue hemorrhagic fever in Pesinggahan Environment.

Year	RT	Population	Number of Incidences (person)	Incidence Rate (%)
2016	RT1	645	1	0, 16%
	RT2	700	4	0, 57%
	RT3	670	2	0, 30%
	RT4	561	3	0, 53%
	Total	2576	10	0, 39%

RT= Rukun Tetangga

According to Table 4, the incidence rate of dengue hemorrhagic fever in RT 1 was 0.16%, RT 2 was 0.57%, RT 3 was 0.30%, and RT 4 was 0.53%, and the total of the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment was 0.39%, indicating that the incidence rate of dengue hemorrhagic fever in the Pesinggahan District is high. The high density of *Aedes aegypti* larvae is directly proportional to the high incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment of Pagesangan Barat Village, implying that the density of *Aedes aegypti* larvae has a close relationship with dengue fever incidence rate in the Pesipihan Environment of Pagesangan Barat Village. This is noteworthy because, contrary to research, free larva index value high incidence rate cases of dengue fever should be low. According to the reuslt of a study conducted in Jember Regency, the index of free larvae was inversely proportional to dengue fever cases (Kurniawati et al., 2015). The findings of this study were also corroborated by Widyanto (2007), who discovered that the presence of the dengue vector *Aedes aegypti* influenced the incidence of dengue hemorrhagic fever.

The statistical analysis of the density of *Aedes aegypti* larvae and the incidence rate of dengue hemorrhagic fever (Table 5) in the Pesinggahan Environment with the chi square test revealed that $p = 0.000 < \alpha = 0.05$, indicating that there is a relationship. There is a relationship between the density of Aedes aegypti larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment, thus, the density of *Aedes aegypti* larvae has a relationship with the morbidity rate of dengue hemorrhagic fever. Widyanto, (2007) conducted research which revealed that the presence of the dengue vector Aedes aegypti influenced the incidence of dengue hemorrhagic fever.

Table 5. Statistical Analysis between Density of *A.aegypti* Larvae and Incidence Rate of Dengue Hemorrhagic Fever.

Chi Square	**X^2**	**2 Tailed P**
Uncorrected (MH)	18.1988	0.0000199006
Corrected (MH)	16.6422	0.0000451351

The high density of *Aedes aegypti* larvae in the Pesingahan environment can be attributed to several factors, one of which is the climate, as this research was conducted during the rainy season, which caused an increase in mosquito breeding sites such as previously dry water reservoirs to be filled with rainwater and become mosquito breeding grounds, thereby increasing the population of dengue hemorrhagic fever vectors. This is consistent with Wirayoga (2014)'s research in the city of Semarang, which discovered that high rainfall can increase mosquito breeding sites, increasing the density of their larvae.

The high density of *Aedes aegypti* larvae is also influenced by the knowledge factor of the people in the area, where the people in this stopover have less knowledge about dengue hemorrhagic fever, causing the environment to become a breeding ground for *Aedes aegypti* mosquitos as dengue hemorrhagic fever vectors. The fact that there are still many places where the disease's vector can develop, such as stagnant water and garbage, demonstrates the low level of public knowledge about DHF in the Pagesangan area. According to the description of dengue cases in Mataram, they are closely related to settlement conditions that provide vector breeding places, such as standing water and plastic waste (Sazali & Astuti., 2018). Low public awareness of DHF will increase DHF, as stated in the statement that knowledge influences the incidence of dengue hemorrhagic fever (Shanti et al. 2012).

The Pesinggahan environment incorporates 4 RTs (Neighborhood Association), in which each RT owns a high density of *A. aegypti* larvae. The highest density of *A. aegypti* larvae is discovered in RT 2 with a HI value of 43%, a CI of 26%, and a BI of 56%. The high HI, CI, and BI scores were obtained as RT 2 is an area in the Pesinggahan that possesses the most number of houses compared to other RT in the Pesinggahan. The home environment in the Pagesangan area is not good, such as the presence of piles of garbage and standing water which

enhances the development of *A. aegypti*. Sazali & Astuti., (2018) mentioned that the Pagesangan environment owns a lot of standing water and garbage dumps which allow for the development of*A. aegypti*. According to the findings of Masruroh, Wahyuningsih & Dina., (2016), there is a relationship between the presence of breeding places, such as places that can hold water, and the occurrence of DHF. A lot of standing water and garbage dumps in the Pagesangan environment can be affected by people who do not follow the 3M plus program, such as people who do not routinely clean their water reservoirs, resulting in a high number of *Aedes aegypti* mosquito larvae. This is supported by Yudhastuti & Vidiyani., (2005) research, which discovered a relationship between community behavior and the presence of *Aedes aegypti* larvae.

Due to the high density of *Aedes aegypti* larvae, the larvae reproduce into pupae, which develop into adult mosquitoes, with the adult *Aedes aegypti* mosquito serving as the primary vector of dengue hemorrhagic fever transmission. Infection with *Aedes aegypti* mosquitos by the dengue virus can occur through biting people whose bodies contain the virus or through transovarial transmission (Frida, 2006). This study supports the findings of Purnama & Baskoro (2012), who discovered a relationship between the House Index and the incidence of Dengue Hemorrhagic Fever (DHF), indicating that houses with positive *Aedes aegypti* larvae are more likely to contract DHF than those without Aedes aegypti larvae. The results of this study were corroborated by research which stated that the larvae of the *Aedes aegypti* mosquito were a risk factor for transmission of dengue hemorrhagic fever in Bali (Leri et al., 2021).

The infection of the *A. aegypti* mosquito by the dengue virus then infects healthy people resulting in an increase in the incidence of dengue hemorrhagic fever in an area as was the case in a study conducted in the Pesinggahan Environment where high incidence of dengue fever was obtained, where in every RT in the Pesinggahan, there is one person or more who suffers from dengue hemorrhagic fever, the highest incidence of dengue hemorrhagic fever occurs in RT 2 where in this RT there are as many as 4 people who have experienced dengue hemorrhagic fever, this high incidence of dengue hemorrhagic fever results in high morbidity rates of dengue fever dengue in the Pesinggahan environment because the morbidity rate is obtained from the incidence rate divided by the number of residents multiplied by one hundred percent, this is in accordance with the theory stated by Widoyono, (2011) which states that the morbidity rate is obtained from the number of dengue hemorrhagic fever incidents divided by the number of people at risk multiplied by 100%. The results of other studies also show a significant relationship between water reservoirs containing larvae and the incidence of DHF, with the risk is 8.8 times greater than that of respondents whose water reservoirs do not have larvae (Sucipto et al., 2015).

The Pesinggahan environment of Pagesangan Barat Subdistrict has a high incidence rate of dengue hemorrhagic fever, which is caused by the proximity of residents' houses and the high population density in the Pesinggahan, resulting in *Aedes aegypti* larvae that have grown into adult mosquitoes and are infected with the virus. Due to the short flight distance of the *Aedes aegypti* mosquito, which is 100 meters, this dengue easily spreads dengue virus from one person to another, increasing the risk of transmission of dengue hemorrhagic fever. Because a house with positive larvae and many positive larvae water reservoirs increases the risk of contracting Dengue Hemorrhagic Fever, the house index variable has a significant relationship (DHF) (Cahyani et al.,2018). Sari, (2005) asserts that higher population density and closer distances between houses in an environment will result in easier transmission of dengue hemorrhagic fever due to the mosquito's short flight distance of 100 meters (Sari, 2005), (Candra, 2010). According to statistical analysis, there is a significant relationship between population density and the number of dengue cases in both Sawah and Gambir sub-districts (Afira & Mansyur, 2013). A study conducted by Komaling, Sumampouw & Sondakh, (2020)

discovered a positive relationship between population density and the incidence of DHF in South Minahasa Regency, in which the higher the population density, the higher the DHF cases or vice versa.

4. CONCLUSION

The density of Aedes aegypti larvae in the Pesinggahan environment had a House index of 43%, a Container Index of 24%, and a Breteu Index of 50%. The incidence rate of Dengue hemorrhagic fever in Pesinggahan is high, at 0.39%. There is a correlation between the density of Aedes aegypti larvae and the incidence rate of dengue hemorrhagic fever in the Pesinggahan Environment, Pagesangan Barat Village ($p = 0.000 < \alpha = 0.05$). The high density of Aedes aegypti larvae can be a risk factor in the incidence of dengue hemorrhagic fever in the Pesinggahan Environment of West Pagesangan Village, so it is necessary to take preventive measures to reduce the density of Aedes aegypti larvae, such as implementing the 3 M action.

The Public Health Center and the Mataram City Health Office are hoped to increase periodic larvae inspection activities and promote the 3M plus program in the surrounding environment so that it can be used for monitoring. More research is required to detect the dengue virus transmitted by Aedes aegypti mosquitos to their offspring (transovarial).

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