# Endemicity of Dengue with Density Figure and Maya Index in Bengkulu City, Indonesia

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## Abstract

**BACKGROUND:** One of the factors contributing to dengue's endemicity is the density of the dengue vector, namely, *Aedes aegypti* as the primary vector and *Aedes albopictus* as the secondary vector. Bentiring and Kandang Limun villages are high endemic areas of dengue.

**AIM:** This study aimed to determine the relationship between dengue endemicity and density figure (DF) and Maya index (MI) in Bentiring and Kandang Limun villages, Bengkulu city.

**METHODS:** This study used a cross-sectional design. The sampling technique used proportionate stratified sampling. The sampling refers to the guidelines for dengue entomology surveys according to the WHO 1999 criteria. A total of 400 ovitraps were installed, 200 ovitraps inside the house and 200 ovitraps outside the house.

**RESULTS:** The results showed that Bentiring and Kandang Limun villages had a high risk of dengue transmission based on entomological parameters, namely, ovitrap index (OI) 56% and 55% (DF 6), house index (HI) 45% and 44% (DF 6), container index (CI) 23% and 23% (DF 6), and BI 96% and 120% (DF 7 and 8). The areas have a high risk of dengue transmission based on the MI 71% and 76%, respectively. There is a relationship between dengue endemicity and entomological index in Bentiring and Kandang Limun villages, Bengkulu city, with a significance value (p = 0.000) and a powerful correlation (r = 1.000).

**CONCLUSION:** There is a relationship between dengue endemicity and the MI in Bentiring village and Kandang Limun village, Bengkulu city, with a significance value (p = 0.014 and 0.058) and a powerful correlation (r = 0.920 and r = 1.000), respectively. The entomological index and DF are predictors for dengue prevention and control environment to minimize mosquito breeding sites and reduce disease transmission.

## Introduction

Dengue is an infectious disease of the dengue virus transmitted to humans through the bite of the *Aedes* sp., namely, *Aedes aegypti* (*Ae. aegypti*) as the primary vector and *Aedes albopictus* (*Ae. albopictus*) as a secondary vector [1]. Dengue infection worldwide is estimated at 50 million cases with 22.000 deaths every year, and 2.5 billion people are living in dengue infection endemic areas [2]. Indonesia is reported as the 2nd country with the largest dengue cases among 30 endemic areas of Southeast Asian countries [3].

Based on data reported by the Indonesian Ministry of Health in 2016, the number of dengue cases in Indonesia increases every year. Outbreaks of dengue in 2016 occurred in 12 regencies/cities, one of which was Bengkulu city. In 2018, Bengkulu Province was the third highest nationally in Indonesia [4], [5]. Muara Bangkahulu district is one of the districts with

the highest number of dengue cases in Bengkulu city, namely, 49 cases in 2017 and 57 cases in 2019. The village with the highest incidence of dengue fever in Muara Bangkahulu district is Bentiring village, followed by Kandang Limun village [6].

Strategies for the prevention and control of dengue fever can be carried out by vector control at both the larval and adult stages [2], [7]. Prevention of the incidence of dengue requires data on the population density of *Aedes* sp., which can be measured using entomological indicators, namely, the larva index (LI), which consists of the container index (CI), house index (HI), and Breteau index (BI). These calculations were compared and categorized based on the vector density number or density figure (DF) from the WHO. The category of the risk of dengue transmission is mild, moderate, and severe based on the DF. The entomological index is very effective in monitoring vulnerable areas where dengue cases often occur to anticipate the emergence of new cases [8]. Taslisia research stated that the

entomological survey in Salido Village, IV Jurai District, Pesisir Selatan Regency obtained HI 57%, CI 22.04%, BI 123%, and larval density of *Ae. aegypti* are at high-density levels. This research is similar to the research conducted by Widjajanti that the results of the study of Jembrana and Karangasem districts are included in the medium-risk category of dengue transmission, while Badung district is included in the category of high risk of dengue transmission [9], [10].

The ovitrap index (OI) is also used to add information on the egg-laying activity of adult female mosquitoes inside and outside the house. The OI can be an alternative to detect mosquitoes from breeding places not accessible from the surrounding area [11]. The OI is used to add information from larval surveys such as the HI, Breteau index (BI), and CI [12]. Wijayanti's research found that the highest OI data were detected at 97.56%. These results can provide information that almost all areas surveyed are infested with mosquitoes and the high risk of dengue transmission in the area [13].

The emergence of dengue through the concept Epidemiological Triangle proposed by Gordon and Le Richt, namely, that dengue occurs due to an imbalance between the host, the agent, and the environment [14]. *Ae. aegypti* and *Ae. albopictus* transmit the dengue virus. There is no information regarding the density of *Aedes sp.* which can describe the risk of transmission of dengue virus by *Aedes sp.* Information on the density of *Aedes sp.* can be searched using the entomological index, namely, LI, OI, and pupae index. This study aimed to determine the relationship between DHF endemicity and the entomological index in Bentiring village and Kandang Limun village, Bengkulu city. This information can identify the potential risk of transmission and strengthen environmental health to help control dengue effectively.

## Methods

This research has been approved by the Bengkulu University Medical Ethics and Health Sciences Commission No. 224/UN30.14.9/LT/2020. The research design used a cross-sectional study with analytical observational methods. The study was conducted in Bentiring and Kandang Limun villages in October–November 2020. The research location was in the Community Association (RW) in the village with the highest, moderate, and lowest incidence of dengue based on secondary data from the Health Office of Bengkulu City in 2019 to 2020.

The survey sample consisted of 100 houses (100 ovitraps indoor and 100 ovitraps outdoor) in each village. The sample was taken using the proportionate stratified sampling technique, namely, 45 samples of houses in areas with high cases, 35 samples in areas with moderate cases, 20 houses in areas with low cases, and installed ovitrap. The research population is all residents' houses in Bentiring village and Kandang Limun village. The sampling method refers to the guidelines for dengue entomology surveys according to the WHO 1999 criteria, using the number of houses and the HI data at research site (Table 1).

**Table 1: Number of houses inspected by HI**

| Number of buildings | HI | | |
|---|---|---|---|
| | >1% | >2% | >5% |
| 100 | 95 | 78 | 45 |
| 200 | 155 | 105 | 51 |
| 300 | 189 | 117 | 54 |
| 400 | 211 | 124 | 55 |
| 500 | 225 | 129 | 56 |
| 1000 | 258 | 138 | 57 |
| 2000 | 277 | 143 | 58 |
| 5000 | 290 | 147 | 59 |
| 10,000 | 294 | 148 | 59 |
| Unlimited | 299 | 149 | 59 |

Source: WHO, 2011, HI: House index.

Data from larvae and pupa surveys were calculated in entomological indices, namely, the LI (HI, CI, and BI) and Maya index (MI). The relationship between DHF endemicity and the entomological index was analyzed using the gamma correlation test to measure the significance of the relationship (p-value) and the strength of the correlation (r) between two variables with an ordinal-ordinal data scale [15]. The entomological index is calculated using the following formula [2], [16]:

**OI (WHO, 2011)**

$$OI = \frac{Number\ of\ Ovitrap\ with\ egg}{Number\ of\ Ovitrap\ analysed} \times 100\%$$

**LI (WHO, 2011)**

$$HI = \frac{Number\ of\ houses\ infested}{Number\ of\ house\ inspected} \times 100\%$$

$$CI = \frac{Number\ of\ positive\ containers}{Number\ of\ containers\ inspected} \times 100\%$$

$$BI = \frac{Number\ of\ positive\ containers}{Number\ of\ house\ inspected} \times 100\%$$

**MI (Service, 2008)**

$$BRI = \frac{Number\ of\ Controllable\ site\ inside\ the\ houses}{\sum Average\ number\ of\ containers\ inside\ the\ houses}$$

$$HRI = \frac{Number\ of\ disposable\ sites\ inside\ the\ houses}{\sum Average\ number\ of\ containers\ inside\ the\ houses}$$

The MI analysis is carried out by categorizing the observed containers into controllable containers and disposable containers. The hygiene risk index (HRI) and breeding risk index (BRI) can be calculated

for each house inspected from these two categories of containers. The two indicators (HRI and BRI) of each house are categorized into three, namely, high, medium, and low, forming a 3 × 3 table. The grouping of categories and a 3 × 3 (tertile) table is shown in Table 2. The combination of the categorization of the two indicators in the detailed table is called the MI, which is also categorized into three, namely, low, medium, and high [16].

**Table 2: 3×3 matrix of BRI and HRI components on MI**

|  | BRI | | |
| --- | --- | --- | --- |
|  | Low | Medium | High |
| HRI |  |  |  |
| Low | Low | Low | Medium |
| Medium | Low | Medium | High |
| High | Medium | High | High |

Source: Service, 2008. BRI: Breeding risk indicator, HRI: Hygiene risk indicator, MI: Maya index.

The OI for *Aedes* sp. can be classified into four levels, which reflect the level of *Aedes* sp. infestation, namely, Level 1 OI <5% (mosquito attack is not widespread in the surveyed area), Level 2 5% OI <20% (mosquito attack is slightly more area in the surveyed area), Level 3 20% OI< 40% (mosquito attack > 1/5 of the surveyed area), and Level 4 OI 40% (almost half of the surveyed area is infested with mosquitoes) [17].

**Table 3: Larval/pupae density according to the WHO**

| DF | HI | Container index | Breteau index |
| --- | --- | --- | --- |
| 1 | 1–3 | 1–2 | 1–4 |
| 2 | 4–7 | 3–5 | 5–9 |
| 3 | 8–17 | 6–9 | 10–19 |
| 4 | 18–28 | 10–14 | 24–34 |
| 5 | 29–37 | 15–20 | 35–49 |
| 6 | 38–49 | 21–27 | 50–74 |
| 7 | 50–59 | 28–31 | 75–99 |
| 8 | 60–76 | 32–40 | 100–199 |
| 9 | >77 | >41 | >200 |

Source: WHO, 2003. DF: Density figure

The World Health Organization determines the density of larvae or pupae (DFs) in three categories, is shown in Table 3, namely: DF 1 (Low larva/pupa density), DF 2–5 (medium larva/pupa density), and DF 6–9 (high larval/pupae density) [18]. The pupae/person index has a DHF transmission threshold value of 0.5–1.5 with an optimal air temperature of 28°C [19]. The percentage of larvae index (HI, CI, and BI) interpreted the level of risk of transmission according to the criteria in Table 4.

**Table 4: Categories of entomological parameters on the risk of dengue transmission**

| Entomological parameter | Transmission risk |
| --- | --- |
| HI>5% | High risk |
| HI<5% | Low risk |
| CI>10% | High risk |
| CI≤10% | Low risk |
| BI≥50% | High risk |
| BI<50% | Low risk |

Source: WHO, 2003. CI: Container index, HI: House index, BI: Breteau index.

# Results

The incidence rate (IR) of dengue in Bentiring village in 2020 was recorded at 7.6/10,000 residents in Bentiring village and 13/10,000 residents in Kandang Limun village [20]. According to Dinata, regions with an IR >5/10,000 population are urban villages that experience dengue fever with high endemicity [21]. In this study, 400 ovitraps were installed in both villages. There were 113 eggs that positive ovitraps (56%) of the 200 installed in Bentiring village (OI=56%) included in Level 4. Kandang Limun village had 110 eggs that positive ovitraps (55%) of the 200 installed ovitraps, thus OI =55% (level 4). The results of the complete OI are shown in Table 5.

**Table 5: OI in Bentiring and Kandang Limun villages, Bengkulu city, Indonesia**

| Location | Indoor | | | Outdoor | | | Total | | | Classification |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (+) | (−) | Total | (+) | (−) | Total | Ovitrap | (+) | OI (%) | (level) |
| Bentiring | 49 | 51 | 100 | 64 | 36 | 100 | 200 | 113 | 56 | 4 |
| Kandang Limun | 38 | 62 | 100 | 72 | 28 | 100 | 200 | 110 | 55 | 4 |

OI: Ovitrap index.

A sample of 100 houses in Bentiring village contained 45 positive larval houses HI in Bentiring village was 45%. Of the 419 containers examined, 96 containers were positive for larvae, and 323 were not found with mosquito larvae, with a CI value of 23% and the BI value of 96%, respectively. The entomological parameters (HI, CI, and BI) were converted to obtain the DF value. The entomological parameters in Bentiring village had HI values of 45% (DF 6), CI 23% (DF 6), and BI 96% (DF 7); in Kandang Limun village had HI values 44% (DF 6), CI 22% (DF 6), and BI 120% (DF 8). The result is shown in Table 4.

The water reservoirs inspected in Bentiring village were 419 containers, of which 96 containers (22.9%) were positive for *Aedes* **sp**. There were 348 controllable sites (CSs) and 67 containers (19%) positive for *Aedes* **sp**. The container with the highest number of positive larvae is a bucket with 193 and 47 positive (24%). In contrast, the number of disposable sites (DSs) is lower than CS, 71 containers with 29 containers (40%) positive for larvae. The type of DS with the highest number of containers is used buckets with 55 and 25 positive (45%). Similarly, in Kandang Limun village, 508 containers were found with 120 positive containers for *Aedes* **sp**. larvae (23.6%). The percentage of CS (97.6%) was greater than that of DS (2.4%), the percentage of larval positive CS containers was 23.9%, and the percentage of DS positive containers was 25%. The distribution of the types of containers that are positive for larvae is shown in Figure 1.

In this study, mosquito larvae were identified to distinguish *Aedes* sp. from other mosquito species. Identification of larvae used the single larvae method, namely, by taking one larva in each container containing larvae for further identification under a light microscope. This study identified the larvae of *Ae. aegypti* (5% and 19%) and *Ae. albopictus* (95% and 81%) in Bentiring and Kandang Limun villages, respectively. This result aligns with Bentiring village and Kandang Limun village, which are still surrounded by plantations. The habitat of *Ae. albopictus* is the most common in settlements on the outskirts of forests and plantations [22].

The results of the relationship analysis between dengue endemicity and larvae index (HI, CI, and Breteau index) in Bentiring and Kandang Limun villages obtained p = 0.000 and correlation strength (r) = 1.000, which means statistically. There is a significant relationship with a powerful correlation between dengue endemicity and larvae index (HI, CI, and Breteau index) (Table 6).
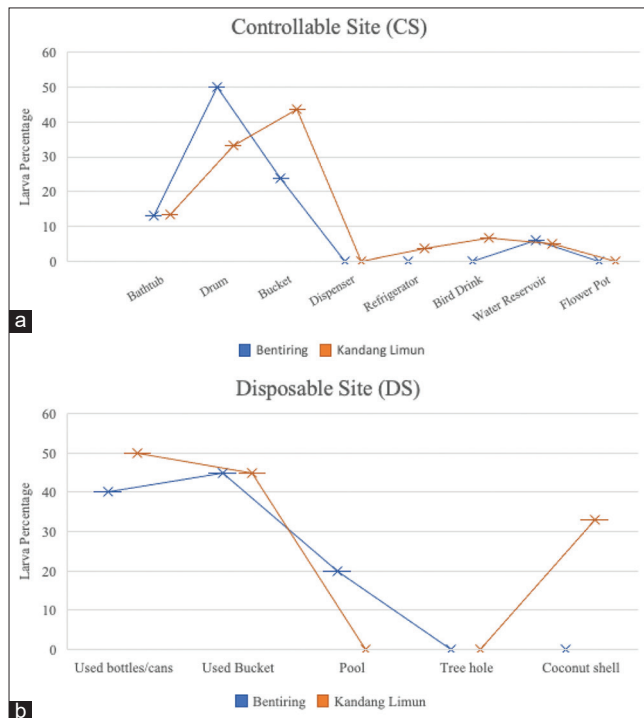


Figure 1. (a and b) Types of positive containers for Aedes sp. Larva

MI classified 100 houses sampled in the two villages in the form of HRI and BRI. In Kandang Limun village, the highest calculation is in the medium category, with an HRI value of 84% and a BRI value of 77%. Bentiring village has an HRI value of 77% in the medium category and BRI 61% in the high category. The data are shown in Table 6.

Table 6: Association of dengue endemicity with OI, HI, and CI

| Ovitrap | OI | | | | p-value | r |
|---|---|---|---|---|---|---|
| | Bentiring village | | Kandang Limun village | | | |
| | n | OI (%) | n | OI (%) | | |
| Positive | 113 | 56 | 110 | 55 | 0.000 | 1.000 |
| Negative | 87 | | 90 | | | |
| Total | 200 | | 200 | | | |
| House | House index | | | | p-value | r |
| | Bentiring village | | Kandang Limun village | | | |
| | n | HI (%) | n | HI (%) | | |
| Positive | 45 | 45 | 44 | 44 | 0.000 | 1.000 |
| Negative | 55 | | 56 | | | |
| Total | 100 | | 100 | | | |
| DF | | 6 | | 6 | | |
| Container | CI | | | | p-value | r |
| | Bentiring village | | Kandang Limun village | | | |
| | n | CI (%) | n | CI (%) | | |
| Positive | 96 | 22.9 | 120 | 23.6 | 0.000 | 1.000 |
| Negative | 323 | | 388 | | | |
| Total | 419 | | 508 | | | |
| DF | | 6 | | 6 | | |
| Container | Breteau index | | | | p-value | r |
| | Bentiring village | | Kandang Limun village | | | |
| | n | BI (%) | n | BI (%) | | |
| Positive | 113 | 96 | 110 | 120 | 0.000 | 1.000 |
| Negative | 87 | | 90 | | | |
| Total | 200 | | 200 | | | |
| DF | | 7 | | 8 | | |

CI: Container index, HI: House index, DF: Density figure, OI: Ovitrap index.

The relationship between dengue endemicity and MI (HRI and BRI) in Bentiring and Kandang Limun villages obtained p = 0.058 and 0.014 and correlation strength (r) = 0.920 and 1.000, respectively. A significant relationship with a powerful correlation between Dengue Endemicity with Maya Index.

Table 7: Association of dengue endemicity with MI

| Areas | Category | HRI | BRI | Maya index (%) | p-value | r |
|---|---|---|---|---|---|---|
| Bentiring | Low | 0 | 13 | 1 | 0.058 | 0.920 |
| | Medium | 77 | 26 | 28 | | |
| | High | 23 | 61 | 71 | | |
| | Total | 100 | 100 | 100 | | |
| Kandang Limun | Low | 0 | 8 | 8 | 0.014 | 1.000 |
| | Medium | 84 | 77 | 76 | | |
| | High | 16 | 15 | 16 | | |
| | Total | 100 | 100 | 100 | | |

HRI: Hygiene risk index, BRI: Breeding risk index, MI: Maya index.

## Discussion

The OI of Bentiring village describes the high mosquito population density in both areas with an OI result of 40% belonging to Level 4. This OI provides information that almost part of the surveyed area is infested with *Aedes* sp. Research conducted by Wahyuningsih reported that the total number of eggs in areas with high dengue cases was the most compared to areas with low dengue cases. Although the egg phase still has to go through several stages to become an adult mosquito, to become a competent vector for transmitting the dengue virus, the OI number can describe the density of mosquitoes in producing eggs and laying their eggs on the surface of the container. The level of mosquito density is not always relevant to describe the number of dengue cases in an area. However, the description of mosquito density in an area can illustrate the precautions that must be taken to prevent and control the transmission of dengue disease [13], [23], [24].

Positive ovitraps outside the home had a higher percentage than those inside the home (Table 3). Based on these results, *Aedes* sp. tend to lay their eggs in containers outside the house, which means that water reservoirs outside the home can be a breeding ground for mosquitoes, primarily used items outside the home such as used buckets and cans that will fill with water when it rains. Hence, it has the potential as a breeding ground for mosquitoes. Eradication of mosquito nests must continue to be encouraged to minimize water reservoirs used as breeding places for mosquitoes. These results are in line with the research of Judhi in 2019 that the OI value outside the home has a higher percentage than inside the house, with the OI value in Makassar city, which is 66.7%, the mosquito eggs are higher outside the house (44.44%) compared to inside the house (37.22%). These results are in line with the research of Wijayanti which states that the OI value outside the home has a higher percentage than inside the house in Kranji village, the working area of the East Purwokerto Health Center II. The number of eggs

outside the house was higher related to the mosquito species, namely, *Ae. albopictus*, which has a habitat outside the house [13], [25].

The relationship between DHF endemicity and OI in Bentiring village is statistically significant with p = 0.000 and correlation strength (r) = 1000, which indicates a powerful correlation. Statistically, there is a significant relationship with a powerful correlation between DHF endemicity and OI, and this result is in line with the OI survey value in both outputs. In the area surveyed, there are many adult mosquitoes, so they have the potential for dengue transmission.

The larval survey was used to obtain the value of the LI, which consisted of the HI, CI, and Breteau index. The HI in Bentiring village and Kandang Limun village 45% and 44% is equivalent to DF 6, which means that Bentiring village has a high density of *Aedes sp.* larvae. Determination of the risk of transmission based on HI values >5% is included in the high HI criteria, meaning that the density of larvae in Bentiring and Kandang Limun villages has a high risk of transmission dengue disease. One of the factors causing the high value of HI in both villages in the community's behavior and participation, which is still lacking in mosquito breeding eradication (PSN) activities. According to the Indonesian Ministry of Health, the 3M Plus PSN program includes draining, closing, utilizing used goods, carrying out larvicidation, biological control by raising larvae eating fish, and personal protective equipment as mosquito nets and mosquito repellents.

The study by Triana in Bengkulu city showed that the entomological parameters for HI, CI, and container pupa index (CPI) in Jalan Gedang village and Lingkar Barat village were estimated: 7%, 12% for HI and 1.97%, 3.43% for CI, and 5%, 2% for CPI, respectively [26]. A similar study by Khairunnisa in the city of Semarang obtained an HI value of 44% equivalent to DF 6, which means that it has a high mosquito density so that it has a high enough risk for transmission of dengue disease [23]. Another similar study by Cahyani (2019) in Magetan district, Magetan Regency, obtained an HI value of 53% who had high HI criteria and had a high risk of DHF incidence [27]. Research conducted by Anggraini showed a significant relationship between the presence of larvae in water reservoirs and the incidence of dengue fever in Koduru village, Surabaya city [28].

The CI value in Bentiring and Kandang Limun villages is 23% or equivalent to DF 6, has a high larval density, and a high risk of DHF transmission, which means Bentiring sighs (Table 4). According to the WHO, the CI describes the number of positive water reservoirs for larvae from the number of water reservoirs examined. The CI is an entomological indicator used to determine the risk of transmission based on mosquito density by adding up the positive larval containers divided by the total number of containers and multiplied by 100%. If an area has a CI > 5%, it has a high risk, whereas if

the CI is less than 5%, it has a low risk of transmitting dengue disease [18]. The results of this study are in line with Taslisia's research (2017) which found that the CI value in Salido village, IV Jurai, Pesisir Selatan district was 22.04%, including the category of having high risk. Another research by Firmansyah showed a 34% CI value in Patunas Village, Tanjung Jabung Barat Regency, equivalent to DF 8, which has a high larval density and has a high risk of dengue transmission [29].

Container characteristics can also affect the presence of *Aedes* sp. The container characteristics include the material, the location, the presence of the cover, the volume, the water source, and the color of the container. In addition, Agustin mentions that *Ae. aegypti* can breed in clean water that is not in contact with groundwater. The mosquito vector *Aedes* sp. from the egg phase to the imago can be influenced by biotic or abiotic environmental factors [30]. Supporting research results by Sumantri showed a significant relationship between the habit of closing the landfill and the incidence of dengue [31], [32].

The research results in Bentiring and Kandang Limun villages found that the BI values were 96% (DF 7) and 120% (DF 8). This research illustrates that the two villages have a high larval density and have a high risk of DHF transmission. The Breteau index is an entomological indicator used to determine the risk of transmission based on mosquito density by determining the number of positive water reservoirs for *Aedes* **sp**. with the number of houses surveyed. According to the WHO, a BI value >50% has a high risk and a BI <50% low risk for DHF transmission. According to the WHO, a BI value >50% has a high risk for dengue transmission [18], [33]. Supporting research by Taslisia, the BI value was 123% in the Salido Pesisir Selatan village, and the research of Novita in Korong Gadang obtained a BI value of 102% [3], [9].

In Kandang Limun village, there were 496 controlled containers (CS), with 117 of them (23.9%) positive for larvae. In comparison, the uncontrolled containers (disposable site) were 12 containers, with 3 of them (25%) positive for *Aedes* sp. larvae. The percentage of containers at possible sites in Kandang Limun village is higher than the CSs. The high percentage of DSs that are positive for larvae is because DSs are a type of landfill that cannot control and are usually found outside the house and cannot use in households. However, when filled with rainwater, they can become mosquito breeding sites if not cleaned or buried. The results of this study are like those of Taslisia, 432 CSs, of which 81 (18%) were positive for larvae and 126 DSs of which 42 (33%) contained *Aedes* sp.

Positive container for *Aedes* sp. in Bentiring village consists of 63 (66%) containers outside the house and 33 (34%) containers inside the house. The results showed that most of the larvae of *Aedes* sp. found in containers located outside the house. There were 348 CSs in this study, with 67 (19%) positive for larvae. In

contrast, the DSs were 71 containers with 29 (40%) positive for *Aedes* sp. larvae containers outside the house is a type of landfill that cannot be DS. The DSs are not used routinely in households, and the open conditions can become a breeding ground for mosquitoes when filled with rainwater. This condition is presumably because containers outside the house tend to be neglected and rarely cleaned, which can be a medium for the attachment of *Aedes* sp. mosquito eggs at the landfill.

Factors that can affect the high value of the LI (HI, CI, and BI) in Bentiring village are the behavior and participation of each house that is still lacking in breeding site eradication (PSN) activities. The characteristics of the container can also affect the presence of *Aedes* sp. A similar study conducted by Leri in Kupang city showed that active community participation had an important influence in reducing larval density [34]. According to the Ministry of Health of Indonesia, the 3M Plus PSN program is draining, closing, and utilizing used goods or recycling, larvicidation, biological control by raising larvae eating fish and using personal protective equipment, mosquito nets, and mosquito repellents [35].

A total of 89% of houses that were positive for larvae did not use larvicides. In this study, the *Aedes* sp. larva more eggs in containers that do not contain larvicides. Normal distribution of larvicides accompanied by evaluation of the effectiveness of insecticide is one solution to reduce the population of *Aedes* sp. The results of Jaya's research showed that a significant difference between the declines in larvae after abatement was carried out in dengue-endemic areas in the Somba Opu district, Gowa Regency.

The characteristics of containers in both villages are dominated by containers made of plastic (71.8%), plastic containers that are positive for *Aedes* **sp**. larvae as much as 87%. The use of water storage containers in the two villages has shifted from using bathtubs to buckets that are more practical, lighter, easier to move, and easier to obtain. In this study, positive containers for larva were dominated by dark-colored containers, which was 79%. Containers that contain lots of water are a favorite place for *Aedes* sp. Because it can provide a sense of security and calm to lay the eggs, containers that can hold much water also make the water's surface darker. The dark color of the container also affects the density of larvae because dark containers are preferred as a breeding ground for light-colored ones; dark-colored containers tend to be places that make mosquitoes comfortable to lay eggs [36].

Most respondents collect as much clean water as possible for their daily needs in water reservoirs such as buckets, bathtubs, and drums. According to the WHO, stagnant clean water can be a breeding ground for *Aedes sp*. *Aedes sp*. can incubate their eggs in water reservoirs to become larvae. Tightly closing the water reservoir is essential in reducing the number of *Aedes sp*. larvae in the landfill. The results of a similar study by Sumantri showed a significant relationship between the habit of closing the landfill and the endemicity of dengue [32].

The survey results in the field showed that the percentage of positive larvae was higher in houses whose water source came from pump well water than houses whose water source came from government drinking water companies. There were 47% of containers with pump well water sources from 96 positive containers of larvae. Larval growth of *Aedes* sp. requires organic substances in the water as food and coupled with a temperature that supports the temperature of 20-30°C. This container is fulfilled from dug/artistic well water, which contains a lot of organic substances produced by bacterial activity in the soil layer [37].

The determination of the MI category relates to the number of CSs and DSs that determine the house is clean/unclean and high/low risk as a breeding ground for mosquitoes [38]. The number in each house is proportional to the BRI and HRI values, so the higher the BRI value, the higher the risk as a breeding ground for mosquitoes, and the higher the HRI value, the dirtier the status of the area. The higher the MI, the higher the potential for dengue incidence in the area.

Statistically, there is a significant relationship between the incidence of dengue and the MI in Bentiring and Kandang Limun villages. In this study, many residents' houses in the two villages have medium and high HRI and BRI values, have a high number of CS, and are at risk as mosquito breeding places. It is necessary to pay attention to the cleanliness of water reservoirs from both CSs and DSs. This result is like Novia Rokhmawanti's research in Tegal Sari village, which shows a relationship between the MI and the incidence of DHF in Tegal Sari village. Eradication of mosquito nests must continue to be improved to minimize water reservoirs used as breeding places for mosquitoes. Therefore, reducing the number of water reservoirs outside the home can significantly reduce mosquito population density [40], [41], [42].

The limitation of this study is that the research area is not wide because this is a preliminary study to build a vulnerability index of an area and spatial distribution to dengue [38], [43]. One of the factors that influence dengue cases is environmental factors.

## Conclusion

In summary, based on the entomological parameters and Maya Index, Bentiring and Kandang Limun villages have a high risk of dengue transmission. Increase education about potential places for mosquito breeding, especially in wild places, because it can increase dengue cases. Suggestions to the community

to further increase environmental awareness and promote cooperation regularly to eradicate mosquito nests both inside and outside the home as a step to prevent dengue transmission.

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