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*Original Research Article*

# Environmental factors and indices related to dengue vector larva in Rejang Lebong District

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**Dengue fever in Rejang Lebong community is one of the acute infectious disease resulting in serious health problems for individuals, families and communities. This is because dengue fever spreads rapidly to cause out breaks in the community and is characterized by high morbidity and mortality rates. The aim of the research was to view the relationship between environmental factors and larva index of dengue vectors. This observational study was conducted in Rejang Lebong district, Province of Bengkulu, Indonesia from January to December 2014. The highest larva index of *Aedes egypti* at the landfill was House Index (HI) 87.10 %, Container Index (CI) [drum 16.13 %] Breteau Index 72.97 %, df 6.3 at the level of high density and for free larva number on the barrel, there were 14 positive larva of *A. aegypti* (62.16 %). The level of high density and Larva-free Number (62.16%) was below the national level of 95% and thus the area could be categorized as safe however, vigilance is advised because the larva-free number sometimes changes as influenced by climate and weather**

**Key words:** Environmental landfill, *Aedes aegypti,* Larva index.

## INTRODUCTION

Dengue haemorrhagic fever (DHF) in the community is one of the acute infectious disease that causes health problems in individuals, families and communities. This is because it spreads very rapidly and turning into outbreaks in the community causing high morbidity and mortality within a short time.

Indonesia consists of 31 provinces where the disease incident of dengue haemorrhagic fever increased from 117,830 cases with 953 deaths in the year 2008 , to 156.086 cases with 1,358 deaths in 2010 becoming the highest rate in the Assosiation Of Southeast Asian Nation (ASEAN). However, a tremendous decrease occurred in 2011 with a decrease of 49,486 cases and only 403 deaths, and then increased in the year 2012 which recorded 90,245 cases with the death toll reaching 816 people. However, in the middle of 2013 only 48,905 cases were recorded with 376 deaths (Indonesian Ministry of Health, 2013 ).

Looking at the prevalence of dengue haemorrhagic fever in 2011 among four districts of Bengkulu Province, in the western part of Sumatera island, there were 157 cases consisting of 66 cases in Rejang Lebong, 51 cases in Bengkulu Selatan, 24 cases in Central Bengkulu, and only 16 cases in Kepahiang (Bengkulu Provincial Health Office, 2012). Interestingly, an analysis of the cases of DHF in Rejang Lebong district according to the Primary Health Care , Curup shows that there were 7 cases in 2006 which increased to 52 cases in 2007, and then 79 cases in 2008; however, it fell down to 57 cases in 2009, 16 cases in 2010, 19 cases in 2011 and then increased again to 66 cases in 2012. Nonetheless, it dropped down again to 28 cases in 2013. Thus, within eight years the total number of cases was 324 (Rejang Lebong District Health Office, 2013).

Puskesmas Batu Galing Village, Curup District of Central Curup has an area of 3.42 $km^2$ and consists of six villages with a population of 34,709 inhabitants (the highest number of inhabitants among 15 districts), population density of 10.149 per $km^2$ is a potential breeding ground for *Aedes aegypti* larva. However, dengue larva monitoring officer is still lacking in this area. Therefore, it was assumed that this location would serve as the primary source of increasing dengue cases besides the density affected

**Table 1.** Category density Flick

| Density flick | Larva density |
|---|---|
| 6 – 9 | High density |
| 2 – 5 | Medium density |
| 1 | Low density |

*Aedes aegypti* larva density according to (WHO, 2000)

**Table 2.** Density larva of *Aedes aegypti* base indicators

| Depth density | House Index (HI) | Container Index (CI) | Breteau Index (BI) |
|---|---|---|---|
| 1 | 1 -3 | 1 - | 1 – 4 |
| 2 | 4 -7 | 3 – 5 | 5 – 9 |
| 3 | 8 – 17 | 6 – 9 | 10 – 19 |
| 4 | 18 – 28 | 10 – 14 | 20 – 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 + |

Indicators density of *Aedes aegypti* larva according to (WHO, 2000).

population, human mobility and uncontrolled urbanization.

Efforts to eradicate the vector by using insecticides have been carried out by the local government through the Department of Health, Rejang Lebong but the community was not satisfied. This is besides the main problems of vector resistance and environmental pollution. Therefore, it is interesting to evaluate landfill environment, especially to find out the relationship between environmental factor and the larva index of *A. aegypti* as the vector of such a disease (Table 1). Furthermore, it is expected that the society should be more proactive to maintain and improve environmental health, prevent disease risks, protect themselves from the threat of disease, as well as actively participate in the movement of public health through health promotion (Soekidjo, 2003).

## RESEARCH METHODS

The study design used observational methods (Nursalam, 2003) at the landfill and the Laboratory of Parasitology Unit, General Hospital Mohammad Hoesin Palembang. The study was conducted from January 2013 to December 2014 in Rejang Lebong .

Questionnaires were used to elicit data upon interviewing respondents to assess the environmental relationship with larval indices. Larva survey was conducted randomly in 100 homes in Puskesmas Housing, Rejang Lebong according to the method used by the Indonesian Ministry of Health (2013).

Increasing the active role of the community and family members in the prevention and control of dengue disease is the key to the success of efforts to combat the disease. Based on the above, this research aims to determine the relationships between environmental factors and the larva index in Rejang Lebong.

The purposes of the research are to determine the larva index of House index (HI), Container Index (CI), Breteau Index (BI), Density Figure (DF) and Larva-free number, the water environment shelter (Table 2).

### Research variables

Independent variables include environmental factors such as shelter and water reservoirs inside and outside the home as well as outdoors while the dependent variables include larva index HI, CI, BI, DF and Larva-free Number.

### Sample

The sample, 36, for the research was obtained from 324 suspected dengue infected persons. All samples were observed and photographed in their water or shelter environment.

## METHODOLOGY

Larva were collected from water reservoirs and not a reservoir of water in and outside the home as well as outdoors using flashlight, small nets, clear jar, white glass plates, pipette sucker and vial bottle. Bottles containing

**Table 3**. Frequency distribution index of Aedes aegypti larva in the presence of water reservoirs type in Rejang Lebong

| Environmental Landfill | Amount | Flick the existence of Aedes aegypti in landfill | | HI (%) | CI (%) | BI (%) | DF | Level | Larva-free Number (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | (+) | (-) | | | | | | |
| Bathub | 5 | 25 | 12 | 80.64 | 6.13 | 67.57 | 6 | KT | 32.43 |
| Bucket | 3 | 19 | 18 | 61.29 | 9.68 | 51.35 | 5.6 | KS | 8.65 |
| Drum | 5 | 18 | 19 | 58.06 | 16.13 | 48.65 | 5.6 | KS | 51.35 |
| Crock | 4 | 19 | 18 | 61.29 | 12.90 | 51.35 | 6 | KT | 48.65 |
| Gentong | 3 | 14 | 23 | 45.16 | 9.68 | 37.84 | 4.7 | KS | 62.16 |
| Aquarium | 4 | 23 | 14 | 74.19 | 12.90 | 2.16 | 4.3 | KS | 37.84 |
| Basin | 4 | 27 | 10 | 87.10 | 12.90 | 72.97 | 6.3 | KT | 2.70 |
| Tedmond | 2 | 19 | 18 | 61.29 | 6.45 | 51.35 | 5 | KS | 48.65 |
| Ablution tub | 4 | 22 | 15 | 70.97 | 12.90 | 59.46 | 6 | KT | 40.54 |
| Toilet tub | 2 | 17 | 20 | 54.84 | 6.45 | 45.94 | 5 | KS | 54.05 |
| **Amount** | **36** | **203** | **167** | | | | | | |

10% formalin were labelled with plasters corresponding to where the larva were collected (Indonesian Ministry of Health, 2013).

### Larval index formula

Data collection was undertaken using the formulae thus:

$$\text{House Index (HI)} = \frac{\text{No. of houses with larva (-)}}{\text{No. of homes inspected}} \times 100\ \%$$

$$\text{Container Index (CI)} = \frac{\text{No. of containers with larva (+)}}{\text{No. of containers examined}} \times 100\ \%$$

$$\text{Breteau Index (BI)} = \frac{\text{No. of containers with larva}}{\text{No. of homes inspected}} \times 100\ \%$$

$$\text{Larva free number} = \frac{\text{No. of homes without lalrva}}{\text{No. of homes inspected}} \times 100\ \%$$

## RESULTS

The distribution frequency of the relationship between larval index in a landfill environment with the presence of type of *A. aegypti* larva in Rejang Lebong is shown in Table 3. The Table shows that the highest House Index (HI) results for land fill was negative for 27 larva of *A. aegypti* in the basin. The highest Container Index (CI) results was positive for 18 *A. aegypti* mosquito larva on drums and a small portion (16.13%); and the highest index results for Brateau Index (BI) was found positive for 27 *A. aegypti* mosquito larva (72.97%), in the basin number density figure (6.3). The level of high density and the highest index results on landfill figures found there were 14 positive larva of *Aedes aegypti* majority (62.16%), on the barrel, stillsafe category. However, vigilance is advised ause the Larva-free Number (62.16 %) it is just under National Figures 95%, according to the Indonesia Ministry of Health (2008).

## DISCUSSION

Water reservoirs (WR) with the results of positive index larvae of *Aedes aegypti* are found in the basin House Index (87.10%), drum Container Index (16.13%) basins Brateau Index (72.97%), numbers density figure (6,3) at the level of high density and value of Larva-free Number (62.16%) inferred that this area's category is still safe due to the below-95% as a National Larva-free Number, but it remains vigilant since it would increase sometimes influenced by the climate and weather.

According to the WHO (2001), several countries, including Indonesia which have remained emergence countries within the last three to five years otherwise have continued to be hyper endemic. Factors that led to the emergence of the epidemic of dengue, among others include: fast growth in human population, unplanned urbanization and control, solid waste management, environmental management inside and outside the home with a drain, closing and hoarding and mosquito eradication have not been managed properly. In addition, water supply is inadequate which increases the spread of vector mosquito, lack of effective mosquito control, an increase in the spread of dengue virus as well as the deterioration of public health infrastructure.

Results of the study agree with Budiyanto (2008) where of 182 containers found to contain water, as many as 54 containers were found positive for *A.* aegypti larvae. Majority (91%) of the larva found were *Aedes aegypti*, thus it is advisable to seek routine cleaning of containers, so that they do not seem dark arising from dirt/mildew.

In other aspects, according to WHO (2012), Bruteau flick

Index is the most informative index because it shows the positive relationship between the house with shelter. This index is particularly relevant to focus its efforts on the management, control and destruction of the habitats of the mosquitoes and orientation towards educational messages in the activities undertaken by the community. Dengue vector control can be done by improving environmental sanitation to minimize vector breeding sites.

WHO (2003) stated also that House Index is one of the indicators used to calculate the risk of the spread of disease. This index gives the percentage of positive houses and instructions for the proliferation of human populations at risk of dengue fever. Containers index reveals the percentage of positive containers of *A. aegypti* larva. Areas that have little positive containers larvae are epidemiologically important because they produce larva in large quantities and vice versa therefore, cause less risky outbreak. Of the three indices, the Breteau index is the best estimate of density priority because it combines both the home and container.

The results of Fibriana (2004) shows that there is a relationship between the presence of *A. aegypti* larva with the incidence of dengue haemorrhagic fever. Thus, there is a relationship between the implementation of the action close, drain and pile up with the incidence of dengue haemorrhagic fever; it is therefore recommended that people do activities such as mosquito eradication regularly.

Furthermore, Yudhastuti (2005) showed that the density of *A. aegypti* mosquito larvae in Wonokusumo Village as measured by the parameters; HI= 58%, CI = 30,6%, BI = 82% and DF = 7; indicates faster and easier transmission of dengue haemorrhagic fever.

Environmental conditions that have a relationship with the presence of *A. aegypti* mosquito larvae is humidity. While the air temperature has no association with the presence of *A. aegypti* larvae, the type of container used by the public does. It is therefore suggested that the community play a more active role in the eradication of dengue haemorrhagic fever through mosquito eradication efforts, especially in draining reservoir of water, brush the base and walls regularly and abate sprinkling powder into a container that can not be drained.

Ririh (2012) showed the density of *A. aegypti* mosquito larva in Wonokusumo Village as measured by the parameters HI = 58%, CI = 30.6%, BI = 82% and DF = 7 indicating the faster and easier transmission of dengue disease by mosquito. Environmental conditions related to the presence of larva of *A. aegypti* is humidity. There is no relationship between air temperature and type of container with the presence of *Aedes aegypti* mosquito larvae. It is therefore suggested that the community is expected to play a more active role in the eradication of dengue haemorrhagic fever through mosquito eradication efforts, especially in draining the landfill by brushing the base and walls regularly and abate sprinkling of powder into containers that can not be drained.

Woongkon's (2007) analysis reported a larva-free number of 87.1%. Variables associated with the presence of larvae are the behavior and health of the environment. Multivariate analysis showed the more influential behavioral variables. Factors related to knowledge and attitudes are not statistically significant. It can be concluded that efforts to change behaviors that support mosquito eradication is still needed in community health centers therefore there is the need to increase health promotion on the dangers of dengue and its prevention, coordination across relevant sectors and the performance of larva monitoring to improve the mosquito larvae eradication behavior of households, resulting in increased morbidity, larva-free number and a drop in dengue haemorrhagic fever.

According to Muchlastriningsih (2005), the relatively low larva-free number of less than 95% can increase the chances of virus transmission of dengue haemorrhagic fever. The results of the study by Fathi (2005) obtained using Fisher's Exact test of p-value of 0.002 ($p < 0.005$) shows that the existence of larva has a significant relationship with the occurrence of dengue haemorrhagic fever.

Based on this research's results: the number density of larvae with House index of 5% and the Container Index of 4%: there is a correlation between the presence of *Aedes aegypti* larva with the incidence of dengue ($p = 0002$) and there is a relationship between the implementation of the action close, drain, pile up, with the incidence of dengue hemorrhagic fever ($p = 0.047$). It is therefore recommended that people perform sustainable activities such as action close, drain and pile up activities regularly for mosquito eradication.

Prastyowati (2013) reported *Aedes aegypti* entomology with House Index of 29.8%, Breteau Index 47.7%, while the Container Index and free number of larva were 61.4% and 70.2%, respectively. Types of containers were found to include dispensers, buckets for bathing, which lies outside the shelter and water reservoirs. The study also discovered the evening activity of *Aedes aegypti* from 18:00 to 3:00 hours, inside and outside the home.

Zuckerman (2009) stated that area having HI greater than 20% would have an increased risk of transmission of dengue haemorrhagic fever.

Zulkarnaini (2008) also notes that sanitary conditions influence unfavorable environment (62.7%). There were 88 positive containers of *Aedes aegypti* larva found in the house; of the 509 containers, 52 containers were found outside the home. House Index (HI) 86.27%, Container Index (CI) 28%, and the number Bruteau Index (BI) 137%. There is a correlation between environmental sanitation in households with mosquitoes in dengue prone areas. Therefore, the most dominant prevention/control the dengue vector mosquito is a mosquito nest eradication.

The success of the residential environmental health/public places (in the indicator Healthy Indonesia 2010) reported a coverage of at least 95%. The results of the study showed that the House Index larva found were 27 positive larva of *Aedes aegypti* in the basin which is almost all of the respondents (87.10%) and the highest index

results in container larva found were 18 positive index larva of *Aedes aegypti* in the drum, a small portion (16.13%); while the highes Brateau index was 27 positive index larva of *Aedes aegypti* (Ministry of Health, 2000).

The highest House Index (75%) and Brateau index (72.97%) was found in the basin. Because it is difficult to get water, family members accommodate water in the old basin. When the water is drained, it results in high larva presence in water reservoirs. Container index of 13.89% was found in the tub and drum. Information from family members showed that because of the difficulty of getting water, water is stored in the tub and the drum containers and are rarely drained.. In reservoirs of water like a bathtub, drum container, barrel and basins and other water reservoirs, abate powder can be sprinkled to control mosquito larvae as it does not endanger the health of family members. Therefore, it is still on the verge of safe under a larva-free number of 95%.

## Conclusion

The positive larva of *Aedes aegypti* in water reservoirs were found in the basin with House Index (87.10%), drum with Container Index (16.13%) basins with Brateau Index (72.97%), number density figures (6.3) at the level of high density and with Larva-free Number (62.16%) below the National value of 95% could categorized the area as safe. However, vigilance is advised because the Larva-free number sometimes changes as influenced by the climate and weather.

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## Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of the paper

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