

# Risk Of Dengue Transmission In Urban Areas Of Malang, Indonesia

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## Research article

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# Abstract

**Background.** Larvae monitoring through community participation is one of dengue prevention programs to control mosquito larvae. Entomology index could be an indicator of the existence of mosquito larvae in an area. This study aimed to determine the entomology index in the urban areas in Malang city and key container which could be the breeding ground of mosquito.

**Methods.** This study was a surveillance study conducted in five subdistricts in Malang city from November 2017 to April 2018. A semi-structured questionnaire delivered using interviews to 400 respondents was used to explore the practice of Dengue prevention behavior. Observations were performed to examine the mosquito larva existence among the houses of health volunteers.

**Results.** Density figure in Malang was indicated as moderate density that had range 2-5 . Blimbing subdistrict had the highest House Index (HI) value, which was 30.3% with Container Index (CI) value of 10.6% and Breteau Index (BI) value of 36,3 %. The most common positive Controllable Containers were bathroom tub/container (8.5%) and the water reservoir of a refrigerator (3%).

**Conclusion.** Urban area in Malang has a moderate risk of transmitting dengue fever whose highest risk area was Blimbing subdistrict. There is need health promotion more or strict policy to the community also health volunteers to observe bathroom containers and water reservoir of refrigerator.

## Background

Dengue is a severe arthropod-borne viral disease that affects human health across the world <sup>(1-3)</sup>. The manifestation of dengue is varied, ranging from a flu-like disease dengue fever (DF) to dengue hemorrhagic fever (DHF), which can progress to be a fatal type of dengue syndrome shock (DSS). More than 3.6 billion population live in tropical and subtropical countries where dengue viruses spread the disease. A total of 3.97 billion people living in 128 countries were at risk of dengue; in detail, 824 million people lived in urban residences, and 763 million people lived in peri-urban houses in 2012. Approximately 50–200 million dengue infections, 500,000 severe dengue cases (DHF/DSS), and more than 20,000 mortality cases were reported annually <sup>(4)</sup>.

Dengue remains a health problem in Malang, which is the second-largest city in East Java Province, Indonesia. Urban areas in Malang are generally affected by dengue fever, with an increasing number of cases each year <sup>(5)</sup>. Data showed that dengue cases are higher in urban than in rural area. It was supported by surveillance study in Malang in 2010 that urban areas were at highest risk for larvae finding than the rural area, which is potential to transmit dengue <sup>(6)</sup>. According to the Public Health Official of Malang, the dengue cases increase every year. There were 160 dengue patients with one mortality case in urban areas in 2014. Further, three mortality cases occurred among 181 dengue patients from January to December 2015 <sup>(5,7)</sup>.

Ministry of Health of Indonesia has several strategies and programs to control the spreading of dengue infection. Since 1992, the Ministry has launched several approaches, including surveillance system, case management, vector control, and behavior intervention. Vector control and behavior intervention are combined with the surveillance system. This program is a must to be carried out periodically by the public and known as 3M plus that are *menguras bak mandi* (clean the water tub/container), *menutup* (cover the water container), *membakar atau mendaur ulang* (bury or recycle the water container). Meanwhile, the 'plus' means to combat mosquito nests<sup>(8-10)</sup>. In 2016, Indonesia had a Healthy Indonesia program that is the strategy used to strengthening health services through a family approach. The role of the family is to continuously improve the Eradication of Mosquito Nest movement that is to monitor, inspect, and eradicate mosquito larvae. This concept is called "*Satu Rumah Satu Jumantik*" (One House One Larva Inspector)<sup>11</sup>. The success of mosquito nest eradication activity can be measured using free larva index. When the free larva index is higher or equal to 95%, it is expected that the transmission of dengue fever could be prevented. This popular index is the opposite of House Index.

Health volunteers have an essential role in controlling dengue. They are members of the larva monitoring team to observe larva in every home and public places, provide health promotion to families and public, and record and report the results of periodic larval results weekly and monthly. Besides, they also have to record and report the incidence of dengue cases to either cluster heads or Primary Health Care (Puskesmas)<sup>10,12</sup>.

*Aedes aegypti* breeding ground is usually in a pool of clean water. This breeding ground can be divided into three that are temporary, permanent, and natural. This mosquito can live in water drains, flower vases, used tin cans, used bottles, bathtubs, water barrels, and places where there are standing water<sup>12</sup>. Entomology Index is a measure of *Ae. aegypti* larvae density indicators in one particular settlement and serves as an essential consideration in determining effective vector control efforts. Successful implementation of larvae monitoring is in terms of the value from the House Index (HI), Container Index (CI), and Breteau Index (BI) because the entomology index is used to monitor the population density of *Ae. aegypti* in the spread of dengue virus. The index in dengue vector mosquito larvae is expressed in three types of indices determined by the World Health Organization (WHO) namely HI, CI, and BI. An area is said to be at high risk of DHF transmission if  $CI \geq 10\%$  and  $HI \geq 5\%$ , and it is said to have high potential of DHF transmission if BI is higher than<sup>13</sup>. Therefore, this study aimed to identify the risk of dengue transmission in the urban areas of Malang and the key container which could be the breeding ground for mosquito.

## Methods

### Study design and sample

This study collected data among 400 health volunteers. This study was a surveillance study conducted in five subdistricts in Malang city from November 2017 to April 2018. Malang city is divided into five subdistricts, and each subdistrict is divided into several villages. In this study, one village with the highest

prevalence and one random village were selected from each subdistrict. From each village, 40 respondents were recruited randomly into the study. This study enrolled health volunteers who were aged 18 years or older, lived minimum one year in Malang city, and has been health volunteer for more than five years.

### Data collection and analysis

Data were collected to explore dengue prevention behavior using semi-structured questionnaire through face to face interview. The questionnaire was developed and pre-tested. Reliability test used was the Cronbach alpha coefficient and resulted in an alpha score of 0.61. Presence of mosquito larva in houses was found out by visual observation after the interview.

Maximum prevention behavior score was 30. The practice was categorized as good practice if the score is higher than 22 and categorized as average if the scores are 6 to 22. Mosquito larva was determined by presence or absence from observing containers such as bathroom tub/containers, the container behind the refrigerator, flowers vase or pot, pedestal flower pot, aquarium, pool, pet drinking container, and drums.

Entomology Index was measured by<sup>14</sup>:

- House (premise) index: percentage of houses infested with larvae and/or pupae.
- Container index: percentage of water-holding containers infested with larvae or pupae.
- Breteau index: percentage of positive containers in inspected houses.

Density figure Density figure (DF) was obtained from combining the HI, CI, and BI, and it consists of a 1–9 scale as showed in Table 1. The DF is categorized into three categories; DF = 1, low density; DF = 2–5, moderate density; DF = 6–9, high density <sup>15</sup>.

Table 1  
Density figure of mosquito population

Density	Container Index (CI)	House Index (HI)	Breteau Index (BI)
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	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

## Ethical Consideration

This study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Brawijaya, Malang through decree No. 404/EC/KEPK/12/2017.

## Results

Respondents most likely to practice good prevention behavior were found in Klojen subdistrict (53%). Meanwhile, Sukun subdistrict was the area where respondents tend to rarely practice good behavior compare other subdistricts, which only 24% (Table 1).

In general, positive mosquito larvae were found in 63 houses (15.8%). The highest number of mosquito larva found was in Blimbing subdistrict, which was in 24 houses. Meanwhile, the lowest subdistrict that only four houses were found positive larva was in Lowokwaru subdistrict (Table 2). Mosquito larvae were found mainly in the controllable containers, such as bathroom container (89.5%) and the container behind the refrigerator (65.25%). As many as 27 mosquito larvae were collected during observation. The results showed that three of them were Culex species, and the majority were Aedes Aegypti species.

The calculation of the entomology index in the Malang city is presented in Table 3. In the table, Blimbing subdistrict has the highest House Index (HI) value, which is 30.3%, with Container Index (CI) value of 10.6% and Breteau Index (BI) value of 36,3%.

Table 2  
Distribution prevention behavior in subdistricts in Malang

Subdistrict	Average (%)	Good (%)	Total
Blimbing	51 (68%)	24 (32%)	75
Kedungkandang	49 (60%)	32 (40%)	81
Klojen	18 (47%)	20 (53%)	38
Lowokwaru	33 (52%)	30 (48%)	63
Sukun	60 (76%)	19 (24%)	79
	<b>211</b>	<b>125</b>	<b>336</b>

Table 3  
The Practice of Dengue Prevention Behavior

Activities			Respondent's answer
	n	%	
1. Clean the bathroom container at least once a week	259	65,2	Always
2. Cover the containers, besides bathroom container or drinking container	217	54,3	Always
3. Clean water container, besides bathroom container	192	48	Always
4. Use mosquito spray	148	37	Never
5. Use mosquito repellent	222	55.5	Never
6. Monitor the larva in the surrounding environment	209	52,3	Always

Table 4  
The Number of Houses with Mosquito Larva

House	Blimbing	Kedungkandang	Klojen	Lowokwaru	Sukun	Total
Mosquito larva positive	24 (38%)	11 (17%)	5 (8%)	4 (6%)	19 (30%)	63 (15.8%)
Mosquito larva negative	56 (17%)	70 (21%)	74 (22%)	76 (23%)	61 (18%)	337 (84.2%)

Table 5  
Entomology Index in urban areas of Malang

SUBDISTRICT	CI	HI	BI	Density Figure	IR (2017)
Sukun	8.5	23.8	30	4	0.15
Klojen	3.4	6.3	11.4	2	0.23
Kedungkandang	5.1	13.6	17.3	3	0.04
Blimbing	10.6	30	36.3	5	0.11
Lowokwaru	1.9	5	6.3	2	0.11

Table 6  
Distribution of Positive Containers with Mosquito Larva

No	Container	Mosquito larva (+)	
		n	%
1	Bathroom container / bucket 1	34	8.50
2	Bathroom container/ bucket 2	8	2.00
3	Bathroom container / bucket 3	3	0.75
4	Bathroom container / bucket 4	1	0.25
5	Water reservoir at water dispenser	7	1.75
6	Water reservoir behind refrigerator	12	3.00
7	Water of flower vase	1	0.25
8	Water of flower pots	3	0.75
9	Pedestal of flowerpot	1	0.25
10	Pool	1	0.25
11	Aquarium	1	0.25
12	Water container	8	2.00
13	Pet drinking container	1	0.25

## Discussion

According to the previous study<sup>16</sup>, *Ae. aegypti* larvae prefer to live in a water container, especially in water whose volume is large, humid, and calm, like a bathroom tub/container. Previous studies also reported that mosquito larvae were mainly found in bathroom container<sup>17,18</sup>. The results of this study showed that the water reservoir of the refrigerators and the water reservoir of the water dispenser showed the most results positive for larvae after bathroom container. It is because many respondents forget to throw away the puddle and unaware that both areas can become larval growth. According to WHO (2004)<sup>18</sup> *Ae. aegypti* mosquitoes have a habit of laying the eggs in a dark open area and on the spot that is protected from sunlight. Therefore, if the eggs are in those waters, it will hatch into larvae.

In this study, controllable containers, one of which is bathroom containers, were found positive of mosquito larva. Controllable Container is a container that can be controlled by humans by cleaning it to break and prevent the development of vector mosquitoes<sup>19</sup>. Bathroom containers are the most likely to contain larvae because the volume is higher than that of other containers. The raw material for landfill

that has the potential to affect larvae density is the rough or slippery landfill. A large number of ceramic-based bathroom containers found at the study site causes larvae to breed very quickly. Another factor is the lack of control of cleaning the tub that may allow the growth of larva eggs<sup>16</sup>. These findings would support the mosquito larva monitoring program for encouraging people to inspect these containers in their own houses.

Generally, the urban areas in Malang have medium risk dengue transmission based on range density index of 2–5. Blimbing subdistrict was the urban area in Malang that is highly found positive of mosquito larva. This area has the highest density index. Sukun subdistrict was the second highest. Furthermore, based on dengue prevention behavior, only 32% of respondents have good prevention practices in Blimbing and 24% respondents in Sukun. Sukun subdistrict has the second-highest population among other subdistricts in Malang in 2016 and 2017. Indeed, in 2016 the population density in Blimbing and Sukun were 10,049 and 9,133, respectively<sup>17</sup>. This condition may increase the risk of dengue transmission in those subdistricts. Public Health Office of Malang mentioned that Sukun subdistrict was the area that had the highest dengue cases in 2016<sup>7</sup>.

WHO mentioned that an area is considered high risk of dengue transmission if HI > 10%, and it is at low risk if HI < 10%. The HI values of all subdistricts in Malang were > 10%, except Klojen and Lowokwaru. It could be concluded that Malang has a high risk of dengue transmission. This showed that there are many larvae with a high spread of *Aedes* sp. in these areas and cause a high risk of dengue transmission. These results were the same as research conducted in Jakarta with high HI result<sup>18</sup>.

The density of *Aedes* sp. larvae based on BI is the number of positive water reservoirs per 100 houses. BI is the best index to estimate vector density because it combines both houses and containers. Regarding WHO, vector density is considered high if the score is more than 5%. The results of this study showed that the BI range was 6.3%– 30%. This indicates high risk of dengue transmission that the number of containers that function as a source of larvae per 100 houses is classified as high, and this situation may increase the risk of dengue transmission. Further, the previous study showed BI could be used to predict dengue transmission<sup>20</sup>. As a result, this study showed that the highest BIs were in Blimbing and Sukun subdistricts which also have higher density indexes than other subdistricts in Malang. These results may benefit from undertaking a thorough dengue surveillance program in these subdistricts. However, in general based on density figure, it showed range was 2–5 which indicated that density larva in urban area, Malang was medium.

## Conclusion

The type of positive containers were mostly the bathroom tub/containers and the water reservoir of the refrigerator. Urban area in Malang has a moderate risk of transmitting dengue fever whose highest risk area was Blimbing subdistrict.

## Abbreviations

DHF = Dengue hemorrhagic fever

DSS = Dengue shock syndrome

WHO = World Health Organization

3M = menguras, menutup, mengubur atau mendaur ulang (Indonesian)

DF = density figure

HI = house index

CI = Container index

BI = Breteau index

## **Declarations**

### **ETHICS**

This study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Brawijaya, Malang through decree No. 404/EC/KEPK/12/2017.

### **CONSENT OF PUBLICATION**

Before conducting this study, respondents were given informed consent that included consent of publication.

### **AVAILABILITY OF DATA AND MATERIAL**

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

All data generated or analysed during this study are included in this published article [and its supplementary information files].

### **COMPETING INTEREST**

There is no competing interest in this study.

### **FUNDING**

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### **AUTHOR'S CONTRIBUTION**

ANR : methods. data collection, analysis, and writing

LZ : methods, analysis, and writing

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## Supplementary Files

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- [Questionnaire.docx](#)