

# Mosquito Breeding Place and Container Index Are Related to Dengue Hemorrhagic Fever Cases in Uptown Semarang

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## 2 Mosquito Breeding Place and Container Index Are Related to Dengue Hemorrhagic Fever Cases in Uptown Semarang

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5 Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by dengue virus and transmitted by mosquito bites. The DHF endemic status of Semarang City started in 1994 and continued to 2015. The DHF cases in 2015 were found mostly in uptown region or hilly areas. The following research was carried out to determine the relationship between mosquito breeding place, container index, or personal hygienic practice and DHF cases in uptown region of Semarang city from the period of March to May 2016. The DHF sample cases were obtained from several hospitals in Semarang city (n=30), and the control groups were obtained from healthy respondents with matched age, sex, and district location (n=30). The results showed that there were significant correlation between mosquito breeding places (p=0.016; OR=4.6) and Container Index (CI) (p=0.030; OR=4.0) to DHF cases. On the other hand, shower practice (p=1.000; OR=0.8) had no correlation to DHF cases. It can be concluded that the presence of mosquito breeding places and container index increased the probability of a person to have DHF from mosquito bites. It is recommended for community to minimize water containers around the house as it can be used as mosquito breeding places.

**Keywords :** dengue, endemic, mosquito larvae, plastic buckets, shower, *Aedes aegypti*.

### 1. Introduction

Indonesia is the second biggest contributor of dengue cases in the world after Thailand since 1968 to 2009.<sup>1</sup> Semarang was one of DHF endemic cities in Central Java and it was on the third place after Magelang and Jepara in 2015.<sup>2</sup> Incidence Rate of DHF in Semarang in 2013 to 2015 were 134.09 (Case Fatality Rate - CFR = 1.14%); 92.43 (CFR = 1.7%); and 98.61 (CFR = 1.21%) per 100,000 people respectively.<sup>3</sup> According to data from Semarang City Health Office (Dinas Kesehatan Kota Semarang), the highest incidence of DHF were found in hilly area i.e. Tembalang, Ngaliyan and Banyumanik districts.<sup>3,4</sup>

The medical treatment for DHF has not been found yet and the vaccine has only been available recently. However the vector disease remains to be controlled.<sup>1</sup> The mosquitoes *Aedes Aegypti* mostly live in water holding containers which serve as their breeding place.<sup>5</sup> They are anthropophilic mosquito (prefers human blood) and attracted to combined carbon dioxide and volatile skin odors.<sup>6,7</sup> Mosquito attraction to such body chemical components may be associated with personal hygienic practice such as shower. Therefore we carried out the following study to determine the relationship between mosquito breeding place, container index and personal hygienic practice to DHF cases in uptown region of Semarang city.

### 2. Experimental Details

This research was an analytical observational, with case control study. Population was the community of Semarang City and according to Lameshow<sup>8</sup> minimal sampling, a total of 60 respondents were obtained. The Dengue Hemorrhagic Fever sample cases were obtained from

3 hospitals in Semarang city (n=30), and the control groups were obtained from healthy respondents with matched age, sex, and district location (n=30). Data of DHF cases were taken from the period of March to May 2016. The sample cases and control groups lived in uptown region of Semarang City (around 25-400masl), namely Tembalang, Ngaliyan, Banyumanik, Candisari, Gajahmungkur, Mijen, dan Gunung Pati. Primary data were obtained from direct interview and observation. For frequency distribution data were analyzed by Mann Whitney. To determine a relationship between two variables i.e. breeding place, container index, or shower practice and DHF cases Chi-Square tests were used with 95% confidence.

### 3. Results and Discussion

Table 1 showed the distribution of total respondents. It showed that the highest number of DHF cases in uptown region of Semarang City were found in Tembalang (30%, in shades) and the lowest number of cases in Candisari (3.3%, in shades).

**Table 1. Distribution of the number of DHF cases and control respondents according to district location, Semarang, 2016**

Districts	Cases		Control	
	n	%	n	%
Banyumanik	3	10	3	10
Candisari	1	3.3	1	3.3
Gajahmungkur	2	6.6	2	6.6
Gunungpati	2	6.6	2	6.6
Mijen	7	23.3	7	23.3
Ngaliyan	6	20	6	20
Tembalang	9	30	9	30
Total	30	100	30	100

#### Mosquito Breeding Places and Container Index

(Table 2a) showed the frequency distribution of three types of water holding containers i.e. daily container, artificial container, and natural plant container. Total number of examined containers were 1023 (100%), with 537 (52%) in cases and 486 (48%) containers in control group. The largest number of containers type were 289 (28.3%) plastic bucket with 144 in cases and 145 in control group. Total containers which had positive larvae were 46 (100%) with 32 containers (70%) in cases group and 14 containers (30%) in control group. The largest number of containers with positive larvae were 16 plastic buckets, with 12 in cases and 4 in control group.

**Table 2a. Frequency distribution of types of water holding containers and total number of mosquito larvae positive containers**

Type of water holding containers	Case		Control		Total		%	
	∑	(+)*	∑	(+)*	∑	(+)*	∑	(+)
<b>Daily Containers :</b>								
Bathtub	29	3	26	4	55	7	5.4	15.2
Plastic Bucket	144	12	145	4	289	16	28.3	34.8
Crock	12	3	14	1	26	4	2.5	8.7
Toilet watertub	3	1	2	0	5	1	0.5	2.2
Drum	9	2	19	0	28	2	2.7	4.3
Water Tank (Tandon)	5	0	13	0	18	0	1.8	0

Continue Table 2a.

Type of Container	Case		Control		Total		%	
	Σ	(+)*	Σ	(+)*	Σ	(+)*	Σ	(+)
<b>Artificial containers :</b>								
Animal drinking containers	50	0	13	0	63	0	6.2	0
Unused utensils	122	10	72	3	195	13	19.0	28.3
Flower vase	0	0	1	0	1	0	0.1	0
Dispenser	12	1	11	1	23	2	2.2	4.3
Refrigerator drainase	13	0	15	0	28	0	2.7	0
Fish pond	2	0	4	0	6	0	0.6	0
Aquarium	8	0	7	0	15	0	1.5	0
<b>Natural plant container :</b>								
Trees cavities	3	0	9	1	12	1	1.2	2.2
Stone cavities	15	0	13	0	28	0	2.7	0
Leaves of plants	1	0	19	0	20	0	2	0
Coconut shell	3	0	6	0	9	0	0.9	0
Banana leaves	69	0	34	0	103	0	10.1	0
Bamboos	37	0	63	0	100	0	9.8	0
<b>Total</b>	<b>537</b>	<b>32</b>	<b>486</b>	<b>14</b>	<b>1023</b>	<b>46</b>	<b>100</b>	<b>100</b>
<b>%</b>	<b>52</b>	<b>70</b>	<b>48</b>	<b>30</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

\* The containers were mosquito larvae positive (+) or they contained mosquito larvae

Plastic buckets were found in largest number (34,8%) as this type of container was convenience and easy to handle for daily household chores (Figure 1). There were 12 in cases group and 4 in control group. Plastic containers are the most potential breeding places of *Aedes sp.* at home and caused mosquito spread rapidly.<sup>9</sup> Unused utensils were found outside the house (not shielded from the roof) and in largest number (28.3%) as artificial containers. Such outdoor environment is the best place for *Ae. aegypti* breeding, especially when the containers filled by rain water.<sup>9</sup> Banana leaves were found in largest number (10,1%) as natural containers. However, no mosquito larvae were found and this could be due to the fact that *Ae. aegypti* preferred to lay their eggs in artificial containers.<sup>10</sup>



Figure 1. Plastic buckets were found in largest number

Correlation analysis between containers or the mosquito breeding places and DHF cases (Table 2b) showed that there was significant correlation between the presence of mosquito breeding places and the number of dengue cases ( $p = 0.016$ ). In our study, plastic bucket were mostly found coverless and had been holding the water for a long time (Figure 1). When they were not covered and emptied regularly, it increased the probability as mosquito breeding places and in rapid DHF transmission. This was consistent with research conducted by Dhina Sari in 2012 ( $p$  value = 0.001)<sup>11</sup> and Cahyani 2015 ( $p$  value = 0.000)<sup>12</sup> who also found a relationship between breeding places and DHF cases. The value of Odds Ratio (OR) for the presence of breeding places (95% CI

= 1.452 to 14.389) was 4.6, which suggested that respondents who had mosquito breeding places had 4.6 times higher risk of contracting DHF than respondents who did not have mosquito breeding places (containers). Container Index calculation is probably the weakest because it only reflects the proportion of larvae positive containers in the area and does not take into account the number of containers per home or per person.<sup>13</sup> Container Index analysis was conducted individually in order to describe how great the risk of DHF contagion due to the percentage of owned containers. A high status of DHF entomology such as House Index (HI), Container Index (CI), Breteau Index (BI), and Resting Index (RI) can be influenced by heavy rain that causes DHF outbreak.<sup>14</sup>

**Table 2b. Correlation Analysis Between Breeding Places, Container Index and DHF Cases**

Variables	Case f	Case %	Control F	Control %	P	OR	95% CI	Note
The Presence of Mosquito Breeding Places (containers)	16	3.3	56	20.0	0.016	4.6	1.4-14.4	Significant
Container Index								
Dense	15	50.0	6	20.0	0.030	4.0	1.3-12.6	Significant
Sparse	15	50.0	24	80.0	0.030			

Correlation analysis (Table 2b) showed a significant relationship between Container Index and the number of DHF cases in Semarang City ( $p=0.030$ ; 95% CI=1.3 to 12.6). This finding was in line with research conducted by Surya who also found relationship between Container Index and dengue cases ( $p$  value = 0.000) in endemic areas Mengwi, Badung regency in 2012.<sup>15</sup> The value of OR was 4.0 which suggested that the respondents with dense Container Index had 4 times greater risk to contract DHF than the respondents who had sparse Container Index. Container Index status was influenced by several factors. The presence of higher number of containers increased the probability of the presence of *Ae. aegypti* larvae and it increased Container Index. The presence of the larvae in the container also depends on the container types (such as unused glass aquarium, ceramic utensils, rubber tires, and plastic sheets).<sup>16</sup>

### Shower Practice

(Table 3a) showed the respondents shower practice. Respondents who bathed twice a day were 76.7% in cases group and 86.7% in control group. Respondents who shower when sweating were 23.3% in cases group and 30.0% in control group. Respondents who washed hair less than or 2 days once in one week were 40.0% in case group and 36.7% in control group. The proportion of respondents who sweat much during their activity or working were 73.3% in case group and 66.7% in control group.

It appeared that the percentage of respondents who had more shower were higher in control group than in cases group. Higher percentage of sweating was also higher in cases group. Mosquitoes are capable of detecting a human target using olfactory neurons around their mouth to sense emanated carbon dioxide and body odor.<sup>17,18</sup> Carbon dioxide plume is the first cue which activates mosquitoes attraction.<sup>18</sup> The ankle is a preferred site for mosquito bites due to odors from feet.<sup>19</sup> Another study suggested that individual genetic make up played role in mosquito attraction.<sup>20</sup> Sweat alone was not known as an attractant for mosquitoes bites.

**Table 3a. Shower practice**

Contents of Questions	Group					
	Case		Control		Total	
	f	%	f	%	f	%
Shower Frequency per day :						
Once	1	3.3	0	0	1	1.7
Twice	23	76.7	26	86.7	49	81.7
> 2 times	6	20.0	4	13.3	10	16.7
Shower when sweating :						
Yes	7	23.3	9	30.0	16	26.7
No	23	76.7	21	70.0	44	73.3
Washing hair frequency in a week :						
≤2 days once	12	40.0	11	36.7	23	38.3
> 2 days once	18	60.0	19	63.3	37	61.7
Sweat intensity :						
Much	22	73.3	20	66.7	42	70.0
Little	8	26.7	10	33.3	18	30.0

Correlation analysis results (Table 3b) showed that shower practice was not related to DHF cases in Semarang (p value = 1,000) with OR value of 0.8 and 95% CI of 0.3 to 2.5. It suggested that shower practise could not be considered as a risk factor nor a protective factor.

**Table 3b. Relationship between Shower Practice to Dengue Hemorrhagic Fever Cases in Uptown Region of Semarang City**

Variables	Case		Control		P	OR	95% CI	Note
	f	%	F	%				
Shower practice								
Bad	9	30.0	10	33.3	1.000	0.8	0.3-2.5	Not Significant
Good	21	70.0	20	66.7				

Most of respondents had showered quite well but their true daily bathing behavior could not be obtained accurately by limited interviews. Further study involving carbon dioxide and body odour emanation, ambient temperature, and daily clothing which may attract *Ae. aegypti* could be taken.

#### 4. Conclusion

It can be concluded that the presence of mosquito breeding places and the Container Index had a significant relationship to DHF cases in Semarang City.

#### Recommendation

It is recommended for community to minimize water containers around the house as it can be used as breeding places of *Ae. aegypti*.

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