**The influence of natural environmental condition towards the existence of vector's larva of dengue
hemorrhagic fever: *Aedes Aegypti***

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Abstract

Dengue hemorrhagic fever is a severe and fatal infection that occurs in tropical regions such as Indonesia. In 2014, recorded that dengue morbidity rate was 5.17 per 100,000 inhabitants (approximately 13031 cases) with mortality rate of 0.84% (110 deaths). Demographic and societal changes such as population growth, urbanization, and modern transportation appear to play an important role in the increased incidence and geographical spread of dengue virus. *Aedes Aegypti*, the urban yellow fever mosquito, is also the principal dengue-carrying vector. The *Aedes Aegypti* mosquitoes as a vector of dengue virus normally live and breed in clean water reservoirs that are not directly related to the land such as: bath, bird drinks, water pot, water jars / barrel, cans, old tires, etc. In Indonesia, dengue outbreaks often occur when the seasons change from dry to rain or vice versa (1)

This study aimed to figure out the influence of natural environment and the existence of the vector's larva. A logistic regression was performed to ascertain the effects of temperature, humidity, waste management and the existence of water reservoir on the likelihood of the existence of the vector's larva. The logistic regression model was statistically significant, $p < .005$ and the model explained the predictors of mosquito's larva by 52%. This finding shows that the existence of the mosquito's larva, influenced by temperature, waste management and the existence of water reservoir. Health education about waste management and environmental control are necessary to break the chain of mosquito breeding.

Keywords: environment, mosquito, larva, dengue

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Introduction

Dengue infection is a disease transmitted by mosquitoes (mosquito-borne) which frequently occurs in humans in recent years, and remains a global health problem (2). In the last 50 years, incidence has increased 30-fold with increasing geographic expansion to new countries and, in the present decade, from urban to rural setting. In some tropical and subtropical countries, dengue has been noticed as endemic disease which occurs every year and repeated by season. Dengue is transmitted between people by mosquito vectors named *Aedes Aegypti* and *Aedes albopictus*, which are found throughout the world. The magnitude of the dengue problem has increased dramatically and has extended geographically to many previously unaffected areas.

WHO reported that approximately 1.8 billion (more than 70%) of the population at risk for dengue worldwide live in member states of the WHO South-East Asia Region including Indonesia, which bear nearly 75% of the current global disease burden due to dengue (3). Indonesia is one of the largest countries in the dengue endemic region, with total population more than 250 million. The first was reported in Jakarta and Surabaya region in 1968. Figure 1, shows the incidence rate since 1968 until 2013 reported by Ministry of Health in 2014 (4).

Fig.1. Trends in incidence rate of dengue in Indonesia, from 1968 measured in number of cases per 100.000 person year

The annual incidence rate of dengue continues to increase from 1968 until now. Base on the above graph, the top number of dengue cases identified in 2009 and

dropped significantly in 2010- 2012, moreover the cases was significantly increase again in 2012 – 2013.

Humans are the main amplifying host of the dengue virus. The Dengue virus that circulating in the blood of humans, ingested by female mosquitoes during feeding. The virus then infects the mosquito mid-gut and subsequently spreads systemically over a period of 8--12 days. After this extrinsic incubation period, the virus can be transmitted to other humans during subsequent probing or feeding. The extrinsic incubation period is influenced in part by environmental conditions, especially ambient temperature. Thereafter the mosquito remains infective for the rest of its life. *Ae. Aegypti* is one of the most efficient vectors for arboviruses because it is highly anthropophilic, frequently bites several times before completing oogenesis, and thrives in close proximity to humans (2).

The symptoms of dengue infection or commonly called as Dengue High Fever (DHF), is defined as having at least the first two of the following four clinical manifestations: 1) sudden onset acute fever of 2 to 7 days duration, 2) spontaneous hemorrhagic manifestations or a positive Tourniquet test, 3) hepatomegaly, and 4) circulatory failure, in combination with hematological criteria of thrombocytopenia (< 100.000 cells/mm³) and an $\geq 20\%$ increased hematocrits. Dengue shock syndrome is defined as DHF plus a rapid, weak pulse with narrow pulse pressure or hypotension with cold, clammy skin, and restlessness.

Ministry of health Republic of Indonesia, reported that in 2014, dengue morbidity rate was 5.17 per 100,000 inhabitants (approximately 13031 cases) with mortality rate of 0.84% (110 deaths) (4). Demographic and societal changes such as population growth, urbanization, and modern transportation appear to play an important role in the increased incidence and geographical spread of dengue virus (5). A study conducted by Carvajal & Watanabe (2014) revealed that environmental condition such as temperature and the presence of water play a big role in the mosquito

development and its spread (6). The prevalence of Dengue cases tend to repeat and increase in rainy season. One can assume that, the increasing number of rainy water reservoir tend to increase the mosquitos breeding places which may increase the mosquitos population. *Aedes* mosquitoes live and breed in clean water reservoirs that are not directly related to the land surface.

Fig. 2 The distribution of Dengue cases in Indonesia

According to the West Java Health Profile, the number of dengue cases in West Java province in 2014 reached 19,138 cases, lower than in 2013 as many as 23 118 cases (7). Dengue morbidity cases are found in 12 districts, with the average morbidity rate of 41.3/100,000. West Bandung district is one of the district with dengue endemic with high morbidity. In 2014, reported 890 dengue cases with five people confirmed dead, then increased to 1232 cases with one person died by 2015 (8).

The existence of *Aedes Aegypti* larva in a particular area is an indicator of the presence of *Aedes Aegypti* mosquito populations. Study conducted by Syukur (2012) and Carvajal & Watanabe (2014) revealed that the presence of larva is associated to physical environment that consists of water reservoirs, air temperature, water pH, altitude, rainfall, humidity. This study aimed to figure the influence of natural environment and the existence of the vector's larva.

Method

This study conducted in cross sectional design whereas the cases and causes identified in the same time. This study conducted on June 2015 in Soreang sub District. This area has been identified as is one of the endemic area for Dengue in West Java. There are of 14 villages covered by this town administrative.

The subject of this study selected based on the consideration of the number of dengue cases being reported. According to the report from the local government, Cingcin Village has the largest number of dengue fever in 2015. A total of 769 household were selected as study population. The number of sample in this study were counted as follows :

$$n = \frac{N}{1+N(d^2)} = \frac{769}{1+769(0,05^2)} = \frac{769}{2,922} = 263 \text{ household}$$

Based on this measurement a total of 263 household selected as study participant using simple random sampling method.

This study selected the presence of mosquitos larva selected as dependent variable. Direct observation conducted to measure the existence of mosquito's larva. Temperature, humidity, waste management and the existence of water reservoir selected as independent variable. Direct measurement and observation conducted to gain the primary data.

Temperature and humidity measurements conducted using thermo-hygrometer, carried out on spots which frequently occupied by the family member, such as living room, bathroom and bedroom. Measurement conducted at 08.00 until 10:00 pm. The presence of water reservoir measured based on direct observation, while the Waste management measured by questionnaire about the frequency of waste disposal in the household in a week.

Results

Total of 263 data collected from the household were analyzed in this study. The distribution of the measurement result shown in table.1. The results showed that 89% of the housing are in normal

temperature (in 25⁰C – 27⁰C) and the humidity of the house was recorded as 83% of the housing were in normal humidity $\geq 60\%$, approximately 55% of the household have artificial water reservoir which liked by mosquitos.

The temperature measurement showed that the average room temperature of the respondents houses are 25.6⁰C with a maximum temperature of 28.4⁰ C and a minimum temperature of 24.6⁰ C. Humidity measurement results showed that the average house's humidity was 62.6%, with a maximum humidity 73% and minimum 52%. Artificial water reservoir found in 55,5% of the household while the 54.7% of the household doing frequently change the water reservoir.

Table 1.1 Distribution of environmental variable

Environmental factor	Frekuensi	
	n	%
Temperature		
Comfortable for mosquito breeding (25° C - 27° C)	234	89,0
Uncomfortable for mosquito's breeding (< 25° C or > 25° C)	29	11,0
Humidity		
Normal ($\geq 60\%$)	220	83,7
Humid ($\leq 60\%$)	43	16,3
Artificial water reservoir		
Presence	146	55,5
Not presence	117	44,5
Waste management		
Frequent	149	54.7
Rare	114	43.3

In order to figure out the influence of temperature, humidity, waste management and the presence of artificial water reservoir, we conducted a multiple linear regression analysis, as shown in table.2. The model showed a statistically significant ($p < 0.01$) and the predictor able to explain approximately 52% of the entire predictors that influence the existence of mosquito's larva in the living environment. Whereas the waste management identified as the biggest predictor ($\beta = 0.521$), followed by the presence of water reservoir ($\beta = 0.316$) and temperature ($\beta = 0.091$).

Table 2. Predictor's model for the presence of larva

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
Temperature	.061	.029	.091	2.081	.038
Humidity	-.004	.006	-.029	-.665	.507
Waste management	.373	.034	-.521	11.101	.000
Artificial water reservoir	.251	.037	.316	6.723	.000
$R^2 = 52\%$, $\alpha < 0.05$					

Discussion

This study shows that the predictor model that consist of temperature, humidity, waste management and the existence of water reservoir were 52% explain the presence of mosquito's larva in the household.

Waste management has been identified as the biggest predictor for the presence of mosquito's larva in the household. Those who frequently dispose their household waste tend to have lesser mosquito's larva compare to those rarely. Waste disposal is part of breeding place eradication in dengue eradication program in Indonesia. According to the Ministry of Health RI, the current dengue outbreak is mainly caused by inappropriate activities in breeding place eradication in the communities (9). Poor waste management creates a breeding ground for *Aedes* mosquitoes. Thus, waste management in household level has an impact on the presence of *Aedes* mosquitoes breeding that may increase dengue transmission. In this study, a frequency of waste management is negatively correlated with the presence of mosquito's vector in the household environment. this finding is in line with a study conducted by Siregar et.al (2015), in North Sumatra study that waste management is associated with dengue transmission (10). Community awareness in breeding place eradication is mainly caused by the lack of knowledge about the important of breeding places eradication.

Moreover, the presence of artificial water reservoir

is another predictor of the existence of the dengue larva. the presence of artificial water reservoir in the household may become a potential breeding place for *Aedes Aegypti*. According to Syukur (2012), the female mosquito interested in the watery dark container located in places that are protected from sunlight to lay her egg. One can assume that the presence of water reservoir is may increase the number of breeding places for the mosquitos. A study conducted by Carvajal and Watanabe (2014), in the community in Metro Manila revealed that artificial water reservoir can serve mosquito's niche as it complete its life cycle. Culture and habits of the people in Indonesia are using the water tank in the bathroom to store their shower water. This activity may increase the breeding place for the mosquitos. A proper management of household owner who hold these containers to be very vigilant in physical control such as removal of water container are recommended.

This study also found that the in-house temperature significantly influence the presence of mosquito's larva. A study conducted by Syukur (2012), revealed that the optimum temperature for mosquito's growth is $25^{\circ}\text{C} - 27^{\circ}\text{C}$. This study found that the average temperature of the household 25. C with a maximum temperature of 28.40 C and a minimum temperature of

24.60 C. Approximately 89% of the respondent's houses are in the temperature range that comfortable for mosquito's breeding. Syukur (2012) also identify that the indoor temperature is one of the environmental factors that affect the lives of *Aedes Aegypti* (11).

Conclusion

This study has confirmed that the environmental factor such as temperature, household waste management and the presence of artificial water reservoir are identified as the predictors for the presence of mosquito's larva in household level.

Garbage littered around the houses needs proper waste disposal management. This important information should be disseminated to all concerned parties. Community awareness is mosquito breeding eradication particularly important in dengue eradication.

Appropriate communication information and education may change the community behavior in breeding eradication. Lack of knowledge will have an impact on the practice of dengue prevention, as actions based on knowledge are more effective than those without knowledge.

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