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Research Article

Improvement to Early Warning System of DHF Transmission through Controlling Vector Breeding Places of *Aedes sp.* In Klaten District, Central Java

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Abstract

***Background*:** The presence of potential breeding places can be used to measure the risk of DHF transmission in Klaten. This result can be used by the community to eradication of mosquito breeding place on terget and can improve to early warning system through effective methods for vector control. The aim of the study is to know effective methods for vector control to improve early warning system.
***Methods*:** Type of study was analytic with cross-sectional study. The study was conducted in 104 households with simple random sampling technique. Data analysis used three stages: univariate, bivariate (Chi-square, Kolmogorov Smirnov, Spearman rank) and multivariate test (multiple logistic regression) with α=5%.
***Results*:** The density of larvae based on the value of CI, HI, and BI amounted to 1,6%, 19.2%, 27.9%. The potential place for larvae breed based on Maya Index of 76%. Containers of open wells with groundwater sources, the volume of water is more than 1 liter and the material from cement can be the preferred place for mosquitoes to breed. Multivariate analysis shows that open wells are strongly related and has a risk of 1,556 (CI: 1,199-2,019) increasing the density of larvae compared with other variables.The density of larvae based on who's standards indicates BI is a high category, HI is a moderate category and CI is a low category.
***Conclusions*:** The condition is influenced by the presence of open wells made of cement and can hold water in large quantities. Improve to early warning system of DHF transmission through effective methods for vector control in this area are to close the wells at the household level and conduct regular monitoring on the Controllable Sites.

***Keywords*:** *Breeding Place; Aedes sp; DHF*

Background

Dengue Hemorrhagic Fever (DHF) has spread across the world including three member states in the WHO region of the United States (PAHO), Southeast Asia (SEARO) and the Western Pacific (WPRO). Indonesia is a SEARO categorical country that ranks first in the highest case of DHF from 1990-2015.[1] One of the provinces in Indonesia with DHF is Central Java because based on data the morbidity rate of this case has increased from 36.2 per 100,000 population in 2014 to 47.9 per 100,000 population by 2015. The mortality rate based on CFR is above the national standard of 1.6% (national target <1%).[2] All districts in Java Province have reported cases of DHF one of them is Klaten District which is in moderate endemic category with number of cases in 2015 amounted to 45.22 per 100,000 populations. Mortality based on CFR is very high from the National target of 4.77%.[2]

Approximately 3.6 billion people currently have a potential risk of outbreak[3] due to changes in demographic factors, urbanization, inadequate water supply, population migration[4], and mobility into new areas through international travel. Other factors such as climate change of a region[5], environmental changes, immunological profile population and transmission of DHF outbreaks show inherently dynamic spatial and temporal patterns.

Predictors that have non-homogeneous and unstable properties in the distribution will make it difficult to assume that epidemiological changes are a single factor. Although it has a high complexity, but analysis of related variables, vector distribution and DBD case identification can be a useful tool to produce a dengue outbreak response scenarios[6]. Distribution of vectors in a region is strongly influenced by the presence of potential breeding places of Aedes spp mosquitoes. This factor will be a measure in the application of vector surveillance systems to improve the early warning system against infection and local outbreak in the district of Klaten.

Some types of research that characteristics such as type of controllable container sites (CS) which is most commonly found larvae are bath and types of disposable sites (DS) is used tires[7]. Another characteristic proves that the most potential containers of larval breeding are plastic, colored red and located inside the house[8].

Other studies have suggested that the most common type of container found in larvae is the covered well[9] due to the dark lighting conditions and mosquitoes have the ability to past the cracks of the cover.[10] The volume of containers is also considered to be closely related to the presence of instar larvae 3.[11] The results of the study underlying the need for research to obtain specific conditions affecting the behavior of vectors in Klaten District, so the results can be used by the community to eridication of mosquito breeding place on terget and can improve to early warning system through effective methods for vector control.

Methods

The type of this research is analytic with cross sectional design, where place and population come from house that spread in Gergunung Village as many as 104 houses and 1.832 containers. The determination of the samples using a test power (1-β) = 95% and Confident Interval (CI) = 95%. Variables in this research are container type, container location, container cover, container volume, container color, container base material, water source, and entomology indicator.

The research instruments used are: 1) observation sheet, 2) tool for monitoring and picking larva, 3) funnel trap i.e. larvae trap at well and 4) meter to measure container volume have been calibrated at Institute of Integrated Research Development (LPPT) UGM and measured 3 times. Data analysis with 3 levels are descriptive, bivariate (chi square, fishers exact test and spearman rank) and multivariate with logistic regression using probability value (p) = 0.05.

Results

Vector Density

Description of Larva Density based on Entomology Indicators

Description of the larva density in Klaten Regency, Gergunung Village can be measured with 3 indicators namely Container Index, House Index, and Breteau Index. The value of HI in Gergunung Village is 19.2% when compared with the density figure table has moderate risk (scale 4) to the spread of DHF. The CI score of 1,6% when compared with the density figure table has a low risk (scale of 1) to the dengue vector density vector. BI value of 27.9% when compared with density figure table has a high risk (scale 5), where this value is an indicator of the ineffectiveness of dengue disease control program, especially in Gergunung Village.[12]

Potential Proliferation of Potentials of Larvae based on Maya Index (MI)

MI is one of the factors used to determine the risk of an environment against the potential for dengue vector breeding to observe the amount of Controllable Sites (CS) and Disposible Sites (DS) [13]. Description of potential sites for dengue vector breeding in this region can be measured by calculating the value of Breeding Risk Index (BRI) through the identification of Controllable Sites type in the community.

The results of these measurements show the level of risk of an environment in providing a potential place of larvae proliferation, namely: 1) High BRI> 4.41; 2) Moderate BRI : 1.16 - 4.41; 3) Low BRI <1.16. Hygiene Risk Index (HRI) through the identification of Disposible Sites type in the community. The results of this measurement can indicate the low level of cleanliness of an area that also has the potential to be a larval breeding place, namely: 1) High HRI > 1,64; 2) Moderate HRI: 0,30-1,63; 3) Low HRI < 0,31.

The comparison of the two values shows that the community in Gergunung Village has quite a lot of containers with the type of waste (Moderate BRI) and which is still used in daily activities (Moderate HRI) on vector breeding of 52%. Cross tabulation values between HRI and BRI can be observed in the table 1.

Table 1. Cross tabulation components Breeding Risk Indicator (BRI) and Hygiene Risk Indicator (HRI)

Category	BRI 1 (Low)	BRI 2 (Moderate)	BRI 3 (High)
HRI 1 (Low)	0 (0.0%)	0 (0.0%)	0 (0.0%)
HRI 2 (Moderate)	24 (24.0%)	52 (52.0%)	10 (10.0%)
HRI 3 (High)	1 (1.0%)	10 (10.0%)	17 (17.0%)

Container Characteristics

The result of bivariate analysis showed that the potential container characteristic of larva density in Gergunung Village with P-value <0,05 are container type which can be controlled, inside the house, has volume 21 L -100 L, with water sourced of the open well. Based on the value of the closeness of the relationship can be seen that the characteristics container which more influence on the density of larvae in Gergunung Village is the source of water used daily from the open wells.

Tabel 2. The Corellation between Container Characteristics with Larva Density

Container Characteristics	Larva Density				Total		P-Value	95% CI
	Positive (+)		Negative (-)					
	n	%	n	%	n	%		
Type								
Controllable Site	29	3.8	733	96.2	762	100	0,000	0.149
Disposible Site	0	0.0	1070	100.0	1070	100		
Container Volume								
< 1 L	6	0.5	1241	99.5	1247	100	0.000	0.141
2 L-20 L	10	2.7	362	97.3	372	100		
21 -100 L	2	7.9	35	92.1	38	100		
> 100 L	10	5.7	165	94,3	175	100		
Existence of the Cover								
Exist	4	2.3	167	97.7	171	100	0.340	0.119
Nothing	25	1.5	1636	98.5	1661	100		
Container Location								
Inside	23	3.5	630	96.5	653	100	0.000	0.115
Outside	6	0.5	1173	99.5	1179	100		
Container Color								
Dark	17	1.4	1241	98.6	1258	100		
Light	12	2.2	524	97.8	536	100	0.927	0.037
Clear	0	0.0	38	100.0	38	100		
Container Material								
Cement	4	2.5	155	97.5	159	100		
Clay	0	0.0	240	100.0	240	100	0.187	0.056
Plastic	17	1.3	1276	98.7	1293	100		
Glass	0	0.0	2	100.0	2	100		
Ceramics	7	10.3	61	89.7	68	100		
Rubber	0	0.0	62	100.0	62	100		
Tiles	1	12.5	7	87.5	8	100		
Water Source								
PAM	3	2.2	131	97.8	134	100	0.000	0.153
Open Well	10	5.6	167	94.4	177	100		
Pump Well	15	3.3	434	96.7	449	100		
Rainwater	1	0.1	1071	99.9	1072	100		

Variables used in multivariate analysis are independent variable having p value <0,25 that is container type, container volume, container location, container material and container water source. The variables are simultaneously selected using multiple logistic regression test with enter method, with the result:

Table 3. Multivariate Modeling Final Stage

Model	**B**	**Wald**	**Sig**	**Exp (B)**	**95% CI**	
					Lower	Upper
Volume	0.689	10.354	0.001	1.506	0.334	0.766
Material	0.306	3.883	0.049	1.436	0.543	0.998
Water Sources	0.442	11.043	0.001	1.556	1.199	2.019
Constant	4.791	29.703	0.000	120.467		

The results of the analysis based on the above table indicate that water sourced from an open well made of cement and has a large volume (> 100 L) shows the risk of high larva density in Gergunung Village.

Discussion

Vector Density

Description of Larva Density based on Entomology Indicators

Based on the observation results obtained a low CI value, due to this research conducted in the dry season is July-September, so that many containers found in dry conditions. Low humidity factors also affect the value of CI, in accordance with the results of research conducted by Anwar and Rahmat, which states that high Container index can be influenced by high humidity.[14]

The value of House index in Gergunung Village is in the moderate category due to mosquito populations found in many areas of the garden and wet rice fields, so it is very supportive to become a breeding ground for mosquitoes. Another factor found in the field is that the lighting in the area is quite dark, in accordance with Soedarto 2012 research, which states that mosquitoes are very fond of dark places, such as wells. Based on the observation in the field, it is known that the BI value is in the moderate category because it is influenced by one of the factors because most of the houses in Gergunung Village have a very close distance to the bush.[15]

BI value can also be a morning indicator of puskesmas to reevaluate activities related to vector control by community and cadres, such as larva monitoring (Jumantik Program) and eradication of mosquito breeding activities.

Potential Proliferation of Potentials of Larvae based on Maya Index (MI)

The value of Maya index in Gergunung Village is in medium category which means that the area is at risk of DHF case spread. The value can be affected because most homes have containers that can be controlled (CS) and still in daily use, potentially for mosquito breeding especially during the dry season, where people have a habit of collecting water in the containers.

This result is in accordance with Prasetyowati and Ginanjar research which states that the maya index in the community is in the moderate category because there are many container type controllable sites.[13] BRI in this study is in the medium category, which means Gergunung Village at moderate risk as a breeding ground for mosquitoes.

HRI in this study is also in the medium category. This means that the research location has a relatively low environmental hygiene status. According to Miller, et al, 1992 that high BRI means more CS is found and has a high risk for larval breeding or vice versa.[16] The higher the HRI value means more DSs are found, so the area can be declared dirty or otherwise.[17]

Container Characteristics

Container characteristics associated with the density of larvae in the village Gergunung are: container type which can be controlled, inside the house, has volume 21 L -100 L, with water sourced of the open well. There is a relationship between CS type container type and larva density. This is because the number of containers filled with water most commonly found is a container that was in the house, while the dry season makes the number of DS in dry and little condition so there is no potential for mosquito breeding.

Soedarto 2012 research results stated that containers in the house are very potential for mosquitoes to breed, because it likes a dark place. In addition, the use of containers such as bathtubs can be a breeding ground for larvae because it has a moderate volume so it always holds water for a long time.[15]

There is a relationship between the volume of the container and the density of the larvae. The volume of containers that contributes most to the density of the larvae is> 20 L, according to a statement from Nani research, 2017 that Aedes aegpty Mosquitoes are fond of places with large amounts of water and quiet as well as the tub and well.[18] Large container volumes have the potential to breed larvae, because they will be difficult to clean when filled with water.[19]

This result is also supported by Riandi, Hadi and Soviana, 2017 study which states that there is a difference of proportion between containers whose volume is less than 1 liter, 1 to 20 liters, and more than 20 liters.[20]

There is a relationship between the locations of containers in the house with the density of larvae in Gergunung Village because the type of container is most commonly found in larvae. This is because *Aedes aegpty* mosquitoes prefer to be in a dark and calm atmosphere, such as well containers located within the house.[21] There is a relationship between the Container water sources from the well with the presence of larvae; this result is in accordance with Fauziah 2012 assertion that the Dug Well which has no cover has the potential for mosquito to lay its eggs.[21] Other studies say that wells have the highest percentage of larval existence of 14.29%, thus potentially affecting the spread of DHF.[19]

There is no correlation between light container color, based on ceramic and in closed condition has no effect on the presence of larvae. Mosquitoes prefer dark-colored containers because of the safe taste and sunlight cannot penetrate the container walls, so it is suitable for larval breeding sites.[22] Ceramic containers are found less larvae because it has a slippery wall that is not preferred by mosquitoes.[20]

The result of multivariate analysis showed that the dominant factor influencing the density of the larvae was an open well with cement material and had a larger volume of water. This means that the open well has a strong relationship with the density of the larvae, and has a risk of 1.199-2.019 times greater to increase the larval density than the other variables.

The condition of the open well in Gergunung Village is deep, dark and humid. In addition, there are only a few houses that have open wells while others have wells that are closed. In this research obtained low lighting, and high humidity. It allows mosquitoes to enter and multiply in it.

Risk factors that affect the density of larvae in the open well in addition to the above factors are the depth of the well, well pH, well use. It based on the results of research Fauziah 2012 note that the depth of the well digging ≤ 15 meters potentially become a breeding ground *Aedes aegypti* mosquitoes.[21] A well that has a neutral pH (Ph = 7) can potentially serve as a breeding ground for Aedes aegypti mosquitoes. Mosquitoes are very fond of stagnant water that has potential as a place for larval breeding.[21]

Conclusions

Blood lead levels in pregnant women in the northern coastal area of Brebes district have exceeded the standard set by the CDC (<5 μg/dL). The dominant source of exposure is the habit of consuming food with newspaper wrapper every week and passive smoking.

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Ethics approval and consent

Ethical clearance was obtained from Ethic Commission. All subjects signed informed consent to join the study

Competing interest

The author reports no conflicts of interest in this work.

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