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Original Research Article

The relationship between frequency of fogging focus and incidence of dengue hemorrhagic fever cases in Bandung in year 2010-2015

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ABSTRACT

Background: Incidence rate of dengue hemorrhagic fever (DHF) in Bandung city is still considerably high over the years. There is no well-documented example of the effectiveness of fogging focus and there is no data on fogging focus activities that have been undertaken by Dinas Kesehatan Kota Bandung. Therefore, this study aims to analyze the relationship between frequency of fogging focus and incidence of DHF cases in Bandung from year 2010 to 2015.
Methods: An analytical observational study with cross sectional design was conducted from September 2016 to November 2016. Population of this research was all DHF patients in Bandung. Data collected was analyzed using Spearman correlation coefficient.
Results: Correlation between frequency of fogging focus and incidence of DHF cases was significant ($p<0.05$). Correlation coefficient of 0.703 is indicative of a strong positive correlation between the two variables.
Conclusions: Frequency of fogging focus and incidence of DHF cases are positively correlated. This indicates that the higher the frequency of fogging focus, the higher the incidence of DHF cases.

Keywords: DHF, Fogging focus, Incidence of DHF cases

INTRODUCTION

Dengue hemorrhagic fever (DHF) is one of the major public health problems in Indonesia.[1] The first recorded outbreak of a dengue disease compatible with DHF occurred in Surabaya in 1968 with a mortality rate of 41.3%.[1,2] Since then, major outbreaks of DHF with significant mortality have occurred in most of the regions in Indonesia.[2] An important aspect related to dengue virus transmission is the easy accessibility to Bandung city with availability of different types of transportation options.[3] This characteristic of the city has become the main transmission method of dengue virus to every districts or cities of the West Java Province.[3]

DHF control in Indonesia typically involve vector control interventions including the application of adulticides, larviciding with insecticides, the use of biological agents and management of mosquito breeding sites.[4] To reduce the disease burden in Bandung, various control activities have been carried out, for example, enhancing fogging activities and procurement of fogging equipment.[5] Space spraying of insecticides or fogging activities involved the application of small droplets of insecticide into the air in the form of hundreds of millions of tiny droplets ranging from 1-30 μm Volume Median Diameter in an attempt to kill adult mosquitoes.[6,7] Generally, thermal fogs and cold fogs have been commonly used for *Ae. aegypti* control, where both can be dispensed by vehicle-mounted or

hand-operated machines.[6] Early application of space sprays on a sufficiently large scale may reduce the DHF transmission intensity in an epidemic.[8]

Although the abovementioned interventions have been implemented, incidence rate of DHF in Bandung city is still considerably high over the years. This is probably due to the climate changes in Indonesia.[9] Higher temperature tends to increase the density of *Ae. aegypti* population and life cycle as well as the number of mosquito breeding grounds.[9] In addition, high relative humidity may affect the survival of adult mosquitoes and decrease the incubation time for dengue viral transmission.[9] There is no well-documented example of the effectiveness of fogging activities in interrupting an epidemic hence it remains unclear whether the impact of space treatments is epidemiologically significant over a long period of time.[8] Despite this, there is no data on dengue eradication strategy with more emphasis on fogging focus that have been undertaken by *Dinas Kesehatan Kota Bandung*. Therefore, this study aims to analyze the relationship between frequency of fogging focus and incidence of DHF cases in Bandung from year 2010 to 2015.

METHODS

This analytical observational study with cross sectional design was conducted from September 2016 to November 2016 in Bandung city. An ethical clearance letter was obtained from the Ethical Clearance Committee of Faculty of Medicine *Universitas Padjadjaran* before the study proceeded. Population of this research included all DHF patients in Bandung. The total incidence of DHF cases in the study area were used. There was no inclusion and exclusion criteria for the research's subjects.

Data used in this study contained secondary data of frequency of fogging focus and incidence of DHF cases in Bandung from year 2010 to 2015 sourced from *Dinas Kesehatan Kota Bandung*. Data was collected with permission and analyzed with a bivariate correlation test. Significance of correlation between frequency of fogging focus and incidence of DHF cases in Bandung from year 2010 to 2015 was determined by Spearman's rank correlation. P values reported represent the two-tailed test of statistical significance. Results are considered statistically significant when $p<0.05$.

RESULTS

Bivariate correlation test using Spearman coefficient was performed to determine the relationship between the independent variable (frequency of fogging focus) and the dependent variable (incidence of DHF cases in Bandung from year 2010 to 2015).

Frequency of fogging focus was not normally distributed but the incidence of DHF cases was normally distributed. To calculate the p-value, Kolmogorov-Smirnov test was used for both of the variables (Table 1).

Significant value of 0.000 showed that correlation between frequency of fogging focus and incidence of DHF cases was significant. Correlation coefficient of 0.703 indicates a strong positive correlation between the two variables. This proves that the higher the frequency of fogging focus, the higher the incidence of DHF cases (Table 2).

Figure 1 was obtained by scatter plot using Spearman's rank correlation. In Figure 1, both variables moved in the same direction, demonstrating a positive correlation between frequency of fogging focus and incidence of DHF cases (Figure 1).

Table 1: Tests of normality for frequency of fogging focus and incidence of DHF cases in year 2010-2015.

Variables n=72	Kolmogorov-Smirnov test statistics (p-value)	Mean	SD
Frequency of fogging focus *	0.116 (0.018)	51.00	8 - 174
Incidence of DHF cases	0.058 (0.200)	346.39	149.318

Table 2: Correlation between frequency of fogging focus and incidence of DHF cases in year 2010-2015.

		Frequency of fogging focus	Incidence of DHF Cases
Correlation coefficient	Frequency of fogging focus Incidence of DHF cases	1.000 0.703	0.703 1.000
Sig. (2-tailed)	Frequency of fogging focus Incidence of DHF cases	. 0.000	0.000 .
N	Frequency of fogging focus Incidence of DHF cases	72 72	72 72

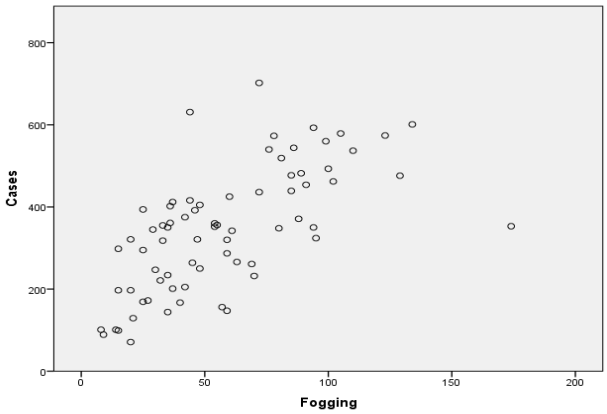

Figure 1: Scatter plot of the correlation between frequency of fogging focus and incidence of DHF cases.

DISCUSSION

Based on the data provided by *Dinas Kesehatan Kota Bandung*, the number of DHF cases in Bandung city from year 2010 to 2015 were 3435, 3901, 5096, 5736, 3132, and 3640 cases respectively. According to the data given, Bandung city is the region with highest number of DHF cases in West Java province from year 2010 to 2015. Dengue prevention and control programs have failed to reduce the number of DHF cases probably because of lack of adequate resources and over-emphasis on adult mosquito control.[10,11] Furthermore, allocation of funds for larval control and source reduction through community participation is still insufficient.[11]

Recent studies have demonstrated that fogging focus had little impact on reducing mosquito populations and dengue virus transmission.[6] According to the study by Gubler DJ, the concept of space spraying of insecticides using the new ultra low volume technology which was initiated in the early 1970s has been a complete failure as the whole of the tropical world has become hyperendemic for dengue since 1970.[12] A journal from Ministry of Public Health Thailand and University of Washington also stated that mosquito vector control strategies such as fogging malathion have only short term effects.[13] Insecticidal sprays in an attempt to kill existing infective mosquitoes are not usually effective unless they are used indoors.[14] Fogging focus does not seem effective in the view of the fact that fogging only kills adult mosquitoes and it is only a temporary measure with no residual effect.[15] Regular applications of fogging may be repeated as necessary to obtain desired reduction in adult mosquitoes.[15] Although fogging can initially reduce adult mosquito populations rapidly, the mosquitoes that emerge after an initial insecticide spray treatment may still be infective.[16] Moreover, the impact of fogging activities is highly dependent on climatic factors like wind velocity, wind direction, humidity and temperature of the surrounding environment.[15] There are several considerable reasons to restrict the use of space spraying for mosquito control.[17] Apart from the high cost of fogging programs, using insecticides extensively often leads to health concerns in the society.[17] The irresistible impact on beneficial insect species and the risk of insecticide resistance among target mosquito species must also be considered.[17]

However, in the absence of specific treatment and vaccine for dengue fever, the prevention and control programs of DHF currently depend exclusively on principal mosquito vector control.[10,11,14,16] Vector control efforts often include a chemical control approach which is referred to as spraying of insecticides or fogging applications.[16] In spite of the limitations associated with fogging, this strategy has been found useful to achieve rapid knockdown and eventual mortality of the adult mosquito vectors, particularly in the outbreak situations.[7,15] Space spraying is recommended in situation where habitat source reduction has failed to limit the mosquito population and the risk of dengue transmission is high.[7] Effective fogging operation requires proper application technique, suitable fogging equipment, appropriate operator training program as well as good planning and management of space treatment.[15] As a consequence**,** fogging operation is not a preferred conventional strategy for vector control due to its transient killing effect and uncertain efficacy.[15] There is no clear evidence for recommending fogging focus as a single control intervention thus it is best applied as part of an integrated vector management strategy.[16] Fogging activities must be implemented only in clearly identified area over a limited period.[15]

Ideally, fogging activities should begin in the breeding season of mosquitoes.[18] Space spraying operation is usually performed in the early morning or evening hours.[8,15,18,19] These time periods are relatively suitable considering the peak flight activity of mosquito vectors as well as the stable atmospheric and climate conditions.[8,15,18,19] Space treatment should be performed every 2-3 days for 10 days when rapid reduction of vector population is crucial, for instance, in an dengue outbreak.[8] Subsequently, further applications should then be implemented once or twice a week for successful suppression ofmosquito populations**.**[8] Thermal fogging should be applied only when the weather conditions are favorable, notably the wind velocity ought to be less than 6km/h to ensure the produced fog remains close to the ground.[18] Fogging operation during daytime is not recommended because warm air near the ground rises through the atmosphere causing the fog to move upward with air currents.[18]Based on the criteria mentioned in the guidelines from Ministry of Health Government of Pakistan, outdoor fogging operation should not be implemented when wind speed is >10km/h, day time heat is >28°C, wind speed is <3km/h and relative humidity is >85%.[20]

Although this research has reached its aims, there were some unavoidable limitations. First, there are many

variables related with DHF outbreaks such as population density, population mobility, transportation access, season and world climate exchange, environment sanitary and healthy living behavior as well as the antigenic types of dengue viruses.[21] These confounding factors may have influence in the transmission of dengue thus causing the increase in DHF cases. Therefore, it is imperative that similar studies including other confounding factors be conducted in order to obtain more precise results. A second limitation was the difficulty in analyzing all the interventions that have been implemented by *Dinas Kesehatan Kota Bandung*. This study primarily focuses on fogging activities due to time constraints. Additionally, it is the most complete and practical data set provided by *Dinas Kesehatan Kota Bandung*.

CONCLUSION

In conclusion, there is a strong positive correlation between frequency of fogging focus and incidence of DHF cases in Bandung. This indicates that the higher the frequency of fogging focus, the higher the incidence of DHF cases. The application and effectiveness of fogging focus should be further evaluated in order to reduce the number of DHF cases so as to prevent the emergence of dengue fever.

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