Mosquito Indices in Outdoor Spatial Spraying Treated Area, Banyumas Regency, Indonesia

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ABSTRACT

Outdoor spatial spraying (OSS) or usually called fogging is the most common method for adult mosquito control which applied by local health officer. A concern has been raise that the application of outdoor spatial spraying could discourage people from routine practice for mosquito breeding site eradication. The aims of this study is to find out mosquitoes indices in OSS treated area in Banyumas Regency. This is a descriptive study with cross sectional design. 300 house of respondents in three treated area with OSS (Purwanegara, Karangpucung and Arcawinangun) were selected as the area of study. Larvae inspection in each houses was conducted to find out mosquitoes indices in the area of study. Mosquito Indices such as House Index (HI), Breteau Index (BI), Container Index (CI) and Free Larvae Index (FLI) were analysed. Results of this study revealed that among three areas, Arcawinangun showed highest HI (14%), while Karangpucung showed the lowest HI (10%). Based on mosquitoes indices, all three areas were categorized in medium mosquito density, which indicated those area showed a medium risk of dengue virus transmission. This result supported the need of awareness of people in treated area of OSS, that they still should conduct routine mosquito breeding site eradication in their area to reduce mosquito population.

Keywords: dengue virus, water container, Aedes sp, mosquito

1. INTRODUCTION

Dengue Virus (DENV) infection is the most common arbovirus disease, particularly in tropical countries. Between 1990 and 2013, the number of dengue cases are more than doubling every 10 years. The number of cases increased from 2.2 million in 2010 to 3.2 million in 2015. Dengue disease also responsible for 1.14 million (0.73 million–1.98 million) disability-adjusted life-years (DALY) in 2013 [1]. This disease is transmitted by the bite of
female mosquito *Aedes aegypti* as primary vector and *Aedes albopictus* and secondary vector. The extent of dengue transmission also depends on the distribution of its vector [2]. Clinical manifestation of dengue could be vary such as, flu-like illness, high fever or more severe dengue due to plasma leakage [3]. Several factors influence the risk of DENV infection in community such as demography, socioeconomy, human mobility [4,5].

Currently, the most common method for adult *Aedes sp* mosquito control is application of Outdoor spatial spraying (OSS) using ultra-low volume (ULV) fogging which applied by health officer to stop dengue transmission [6]. Type of insecticides which usually used for OSS such as synthetic pyrethroids or organophosphat [7]. Several studies stated that OSS in the field was ineffective to break the reproductive lifecycle by decreasing mature female Aedes mosquitoes [8,9]. Currently, the World Health Organization (WHO) recommends restricting application of OSS only for emergency situations such as dengue outbreak. The frequent use of insecticide of OSS could lead insecticide resistance [10]. It is also raise a concern that OSS application could discourage people for conducting routine dengue prevention due to a “false sense of security”[6]. Indeed, it is interesting to find out mosquito population in the area which treated by OSS. Mosquito indices could be use as parameter to describe mosquito population in certain area [11]. Since OSS only killed adult mosquito, and immature mosquito are still alive and when people in treated area did not carried out routine dengue prevention, *Aedes sp* mosquitoes could still continue their life cycle. The information about the impact of OSS application in Indonesia are still limited, eventhough implementation of OSS had been carried out in many part of Indonesia. Results of this study could provided information about mosquito population in OSS treated area, therefore the health officer and community could conduct dengue prevention and control effectively.

2. MATERIAL AND METHODS

2.1. Study Area

This research located in three villages in Banyumas Regency, in the southwest of Central Java Province, Indonesia. Location of this study were three villages in endemic dengue area which minimum once per year treated by OSS in three consecutive years. We selected 3 areas (Purwanegara, Karangpucung and Arcawinangun villages) based on those criteria.
Information about OSS application history were obtained from Section of Infectious disease prevention, Banyumas Regency Officer.

2.2. Study Design and Sampling

This study is cross sectional study which conducted in Banyumas Regency, Central Java, Indonesia. Population of this study is all the household in treated area of Outdoor Spatial Spraying in Banyumas Regency. Samples area in this study were taken using purposive sampling, based on OSS history criteria. 100 houses per villages (Purwanegara, Karangpucung and Arcawinangun villages) were selected using simple random sampling (in total 300 houses). Sample size as amount of 100 each area based on recommendation of the Indonesian Ministry of Health, in “The Technical Manual Eradication of Dengue Mosquito-borne Diseases, Indonesian Ministry of Health” (1992) [12].

2.3. Larvae Inspection

Larvae collection was carried out in 300 houses in selected villaged. Every container, both artificial and natural in the house of participant were inspected. Larvae were collected in bottle and then identified based on the key identification criteria as described by Stojanovich and Scott, 1965 [13].

2.4. Data Analysis

Entomology indices measured by determine the House Index (HI: percentage of houses infested with larvae and/or pupae), Container Index (CI: percentage of water-holding containers infested with larvae or pupae), Breteau Index (BI: number of positive containers per 100 houses inspected), Pupae Index (PI: number of pupae per 100 houses inspected) and Free Larvae Index (FLI: the percentage of houses without larvae) [14]. The transmission risk levels interpretation of each village was made based on the larvae index, as described in the WHO document “A review of entomological sampling methods and indicators for dengue vectors” [14].
2.5. Ethical Statement

Studies conducted here were carried out with ethical approval from Faculty of Medicine Jenderal Soedirman University, Medical and Health Research Ethics Committee  Number 1914/UN23.07.5.1/PP.1/2018

3. RESULTS

Based on the observation of the existence of Aedes sp larvae in the house of respondents, mosquito density index can be determined by calculating House Index, Container Index, Breteau Index, and Free larvae Index (FLI). Based on mosquito density, all three areas have HI in range 8-17%, so it categorized into moderate mosquito density. Detail of mosquito indices could be seen in Table 1.

Table 1. Mosquito Indices in the area of study (HI =House Index, BI = Breteau Index, CI= Container Index, FLI = Free Larvae Index).

| Villages       | DENV status | Mosquitoes Indices (%) |
|----------------|-------------|------------------------|
| Karangpucung   | Endemic     | 10 10 1.75 90          |
| Purwanegara    | Endemic     | 12 17 3.39 83          |
| Arcawinangun   | Endemic     | 14 19 4.4 86           |

We also recorded all water-holding containers in each house of respondents to identify productive container for mosquito breeding places. We observed number, type, condition, and the existence of larvae/pupae. Our study found that bucket is the most common and productive water-holding container which found in the area of study. Bath tube and unused thing around house also found to be common water-holding container (Figure 1).
Figure 1. Number of water holding containers infested with larvae and/or pupae in three villages of the study area. Containers are described by type, as indicated.

4. DISCUSSION

Mosquito indices represented density of mosquito population in certain area. It is measured by counting House Index, Breteau Index and Container Index. Based on the results of this study, all of three areas showed HI >10%, and categorized as medium density. This result reflected that the mosquito population in the area treated with OSS were still at medium risk for dengue transmission. Several studies reported significant correlation between mosquito indices and dengue incidence [15,16]. Thresholds represented the risk of dengue outbreak for House and the Breteau indices were HI=1% and BI=5 [17,18]. While House and Breteau Index in this study all of area were more than 5, indicating at risk of dengue transmission.

This result should be an awareness to local health officer, since mosquito indices the area which treated by OSS were still medium density. Insecticide application in OSS only killed adult mosquito, while all immature stage of mosquito are still alive [9]. The medium
density of mosquito indices in the area of study might reflected the decrease of dengue prevention effort which carried by community. In Indonesia, there is program which applied to eradicate the mosquito’s breeding place by practicing the 3M Plus approach. The basic action of 3M Plus consists of “Menguras” or to drain water reservoirs such as bathtubs, buckets of water, drinking water reservoirs, storage in refrigerators and so on. Secondly, “menutup” or to cover items like drums and water storage cistern, and thirdly, “mengubur” to bury or utilize/recycle used goods that can be potentially used by the dengue mosquitoes in laying their eggs. While Plus includes all forms of dengue prevention, such as larvacide application, using mosquito repellents, keeping fish predators or wearing long shirt to minimize from mosquito bites [19]. Community should aware that they need to conduct this preventive efforts regularly, eventhough OSS was applied in their area.

Several problems due to OSS application also should be considered. The routine insecticide treatment could develop insecticide-resistance in Aedes sp mosquito population [20]. Fogging also could reduce herd immunity in the community, therefore the susceptible population at a risk for larger epidemics in subsequent years. Local health officer should consider the application of OSS only for emergency situations. Previous research also stated that it is crucial to maintain the eradication of mosquito breeding site program in community [21]. Therefore health officer should provide proper information about OSS in treated area community, so they still conduct routine dengue prevention with 3M plus approach.

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