



## Community Vulnerability Map in Endemic Areas of Dengue Hemorrhagic Fever (DHF), Banyumas, Indonesia

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### Abstract

**Background:** Community vulnerability is influenced by the low participation of the community in Pemberantasan Sarang Nyamuk (PSN). PSN is an activity done by society independently in their respective environment to eliminate mosquito-breeding places by 3 M (Menguras, Menutup, Mengubur). We aimed to prove the relationship between knowledge and practice of the community in PSN with the incidence of Dengue Hemorrhagic Fever (DHF), beside to describe the map of vulnerability of the community in endemic areas of DHF.

**Methods:** This study used case control design. The population of this research is the community in the area of Puskesmas Kembaran 1 and 2. The samples were taken from Bojongsari villageas, Banyumas districtis, Indonesia one of the endemic areas of DHF from Jan 2014- Dec 2015. The number of samples was 62 respondents.

**Results:** The community in endemic areas of knowledge about dengue was mostly good (55%) but in practice PSN was mostly less (56%). There was no correlation of knowledge with the incidence of DHF ( $P=0.444$ ) and there was an association of DHF occurrence with PSN practice ( $P=0.010$ ) and the vulnerability map showing many negative DHF residents living close to dengue cases.

**Conclusion:** Community vulnerability in DHF endemic areas is dominated by densely populated settlements, Slum environmental conditions, and PSN practices are lacking. Mobilization of all components of the community is required to participate in prevention of DHF.

**Keywords:** Vulnerability; Dengue; Endemic

### Introduction

The spread of *Aedes aegypti* vector carrying single-stranded RNA virus consisting of four different serotypes of DENV-1, DENV-2, DENV-3 and DENV-4 is increasingly widespread and this will create new maps of vulnerability of the community especially in the area endemic Dengue Hemorrhagic Fever (DHF). Currently an estimated 70-500 million people are infected with dengue virus every year in more than 100 countries around the world. DHF will continue to spread especially in the tropics due to the effects of rain-

fall, temperature and urbanization rates. The cartographic approach estimates there are 390 million/year infections due to DHF and 96 million indicating clinical or sub-clinical severity (1).

Indonesia is one country with Incidence Rate (IR) DHF disease from year to year tend to fluctuate. In 2013 the incidence of dengue fever rate per 100.000 population in Indonesia is 41.25, 2014 was 38.9, and year 2015 was 49.5 (2). Banyumas regency is one of the areas in Central Java Province with the proportion of dengue cas-

es still high enough. In 2013 there were 539, 4 people died, 2014 as many as 209, 4 people died, in 2015 as many as 296 cases, 1 person died, while in February of 2016, Banyumas regency declared DHF outbreak status in Banyumas District due to an increase in cases from January to February of 155 cases and 10 deaths died (3). The increasing number of dengue cases in Banyumas districts caused by the better transportation, new settlement and the low participation of the community in Pemberantasan Sarang Nyamuk (PSN). PSN is an activity carried out by communities independently in their respective environments to eliminate mosquito breeding places through 3 M, the first M (Menguras) is the drain of the bath and water reservoir maximum one week, the second M (Menutup) closing the water reservoirs, and the third M (Mengubur) that is burying used goods in the neighborhood so as not to become a place of mosquito breeding. In addition, there is an increase in endemic areas. The endemic areas in Banyumas Regency in 2014 had 36 villages, by 2015, there were 33 villages and by 2016, increasing to 49 endemic villages and 40% of them were endemic areas for 3 consecutive years (4).

The increase of endemic areas in Banyumas Regency is partly caused by the ineffective vector control and the lack of community participation in the eradication of DHF. The results conclude one of the obstacles in vector control is the low participation of community in PSN(5). PSN movement if run regularly predicted dengue prone areas would be reduced due to the reduction of vector breeding places. In addition, some people consider fumigation or fogging is a major step to eradicate DHF, whereas fogging kills only adult mosquitoes not to larva so it cannot break the link of vector breeding. Fogging can even be harmful because it can cause resistance to *Ae. aegypti* mosquitoes and leave pesticide residues unhealthy for the environment. Eradication of vector using insecticide can cause resistance of *Ae. aegypti* mosquito (6).

DHF mostly occurs in tropical and sub-tropical areas with the main vector of *Ae. aegypti* mosquitoes especially in urban areas and *Ae. albopictus* more in rural areas (7). Vectors and dengue fever

are concentrated in the tropics and sub tropics, the spread of vectors and the increasing movement of mosquito populations cause the virus to become endemic in temperate regions (8). There are differences in the incidence of DHF based on geographic area maps and more incidents, especially in the tropics (9). The widespread expansion of DHF vulnerability maps due to wide spread vector spread due to globalization, trade, urbanization, travel, demographic change, inadequate domestic water supply and increasingly heating temperatures (10). Other factors include high population growth, increased transport facilities, slum environmental conditions and the most dominant factor in increasing DHF transmission is the slum environmental condition (11). This is in line with the Centers for Disease Control and Prevention (CDC) report that rural areas are more prone to increased outbreaks of DHF (12). Therefore, vector control conducted by the community routinely hopes will reduce the vulnerability of people living in dengue endemic areas.

We aimed to prove the relationship between knowledge and practice of the community in PSN with the incidence of Dengue Hemorrhagic Fever (DHF), beside to describe the map of vulnerability of the community in endemic areas of DHF.

## Methods

### *Design and Subject*

The study was approved by The Ethics Commission, Faculty of Health Sciences, Muhammadiyah Purwokerto University. All respondents have signed informed consent. The population of the study were the community in the area of Puskesmas Kembaran 1 and 2. Banyumas, Indonesia. Retrospective research with case control design. The case is dengue fever originating from Bojongsari Village, Banyumas Regency, Central Java Province, Indonesia, which is referred from Puskesmas Kembaran 1 and 2 to one of hospital in Banyumas Regency for further treatment and result of medical record stated positive dengue. Control is not dengue patients taken from the community (Community based) and domiciled near the case.

The project team obtained written informed consent from respondents. The questions concerning the sociodemographic characteristics, level of knowledge and practice of PSN. Map of DHF vulnerability in view of the existence of cases and practices in PSN and knowledge factors as supporters. A questionnaire of knowledge consisting of causes, symptoms, transmission and prevention of DHF consists of 14 questions with a median cut point; if below median knowledge is lacking and  $\geq$  median knowledge is good. While the practice in PSN using observation sheet of mosquito breeding places include clothes hanging habits, bathtub drain, container index, the existence of used goods and cleanliness of the home environment. Checklist consists of 10 statements, with the intersection point using median, if below median practice less and  $\geq$  median good practice. The questions has been validated and the validity value is between 0.449-0.691 and the reliability is 0.881.

#### *Sampling and epidemiological data collection*

This study has used patient data from Puskesmas Kembaran 1 and 2 from Bojongsari village as one of endemic villages in Banyumas Regency. Data source came from medical records from January 2014-December 2015. Sampling using total sampling method. This study was performed in two phases: First: determine cases by registering patients from Bojongsari Village referred to the hospital for further treatment. At this stage, get 31 respondents who meet the inclusion criteria. Inclusion criteria: result of laboratory examination of patient stated positive dengue.

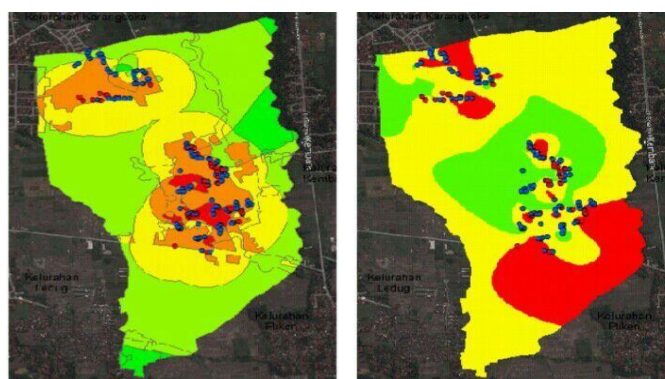
Second: determine control. Controls are healthy people who do not have a history of dengue fever within 6 months prior to taking data. Control is taken from the community (community based) and domiciled near the case with a ratio of 1:1 control obtained by 31 respondents, so the number of samples in this study as many as 62 respondents.

#### *Statistical Methods*

Data were analyzed using SPSS software package version 13.0. (Chicago, IL, USA). The relationship between the level of knowledge and practice of the community in the PSN with the incidence of DHF were analyzed using the Chi square ( $X^2$ ) test with  $P < 0.05$  and community vulnerability map in endemic areas of DHF with software GIS ver.10.2.

#### *Results*

The results showed no relationship between knowledge with the incidence of DHF ( $P: 0.444$ ) and there was a relationship between the practice of PSN with the incidence of DHF ( $P: 0.010$ ) (Table 1). The results of this study indicate good knowledge of the proportion of cases is even greater (Table 2). In Fig. 1, the vulnerability of communities in endemic areas is illustrated by red dots indicating the presence of cases living adjacent to a healthy population (population at risk) illustrated by blue dots.



**Fig.1:** Map of community vulnerability in Dengue Hemorrhagic Fever endemic areas

**Table 1:** Characteristics of age, education, knowledge and practice of respondents

No	Variable	No.	Percentage (%)
1	Age(yr)		
	≤ Adolescent	14	23
	Adult	36	58
2	Elderly	12	19
	Education		
	≤JuniorHigh School	28	45
	High Schools	20	32
3	Colleges	14	23
	Knowledge		
	Less	28	45
4	Good	34	55
	Practice		
	Less	35	56
5	Good	27	44
	Incidence of dengue		
	Yes	31	50
	No	31	50

**Table 2:** Relation between knowledge and practice of Pemberantasan Sarang Nyamuk with Dengue Hemorrhagic Fever incidence

Variable		Incidence of dengue		X <sup>2</sup>	P value
		Yes N(%)	No N(%)		
Knowledge	Less	12(38.7)	16(51.6)	0.586	0.444
	Good	19(61.3)	15(48.4)		
	Total	31(100)	31(100)		
Practice	Less	23(74.2)	12(38.7)	6.561	0.010*
	Good	8(25.8)	19(61.3)		
	Total	31(100)	31(100)		

\*significant

## Discussion

The characteristics of the community in the endemic areas showed that the knowledge of DHF was good, but in the implementation of PSN activities were still lacking. Based on the results of this study, the lack of practice in the PSN activities, among others, abdominal powder behavior, tub draining habits and clothes hanging behavior. The results of this study are in line with another research (13), where only 20% did 3 M (Menguras, Menutup, Mengubur) and 31% covered water storage (13).

Lack of public awareness in eradicating mosquito breeds will increase the risk of *Ae. spp.* mosquito larvae to live and breed. The results showed in endemic areas more container/water reservoir positive *Aedes spp.* than non-endemic areas so that the risk of transmission of dengue disease is higher in endemic areas. In addition, more and more containers were positive larvae *Aedes spp.*, which would increase the endemicity of the area (14). For the success of PSN activities an active participation of all community components is necessary to participate in prevention and eradication of dengue through various information

media and mobilization of local communities and activate local leadership with the active participation of government and non-governmental organizations for the initiation of prevention strategies (15).

The study showed many negative residents of DHF living in areas prone to DHF, so the risk of occurrence of new cases (incidents) will be greater. Vulnerable areas are dominated by densely populated settlements, concentrated in many plantation areas, poor community knowledge, poor environmental hygiene and poor community habits. Unfavorable habits of society, affecting the vulnerability of communities in endemic areas, one of influenced by the community's habit of collecting water for house hold purposes. The habit of storing water in containers for every day purposes indirectly gives *Ae. aegypti* and *Ae albopictus* as a vector of DHF to lay its eggs. Dark colored container preferably *Ae aegypti* mosquito lay egg (16). By reducing the presence of artificial containers such as bathtubs, buckets are assumed to minimize the incidence of DENV (17).

The level of vulnerability of the community is determined by the increase in the presence of vectors, especially *Ae. aegypti* as the main vector. The presence of *Ae. Aegypti* may be influenced by urbanization factors, this may be explained firstly, urbanization factors increase the presence of artificial vector breeding sites such as buckets, bathtubs, aquariums than in rural areas, and this may increase the risk of dengue infection, both urbanization permitting the movement of adult mosquitoes due to the movement between humans (18).

It is not easy to eradicate endemic areas. This is because there are various obstacles in the implementation of vector control. Dengue eradication strategy is not well implemented so that every year Indonesia continues to be overshadowed by the outbreak DHF. Therefore, mapping of community characteristics and environmental conditions is expected to be important to determine the type of control activities that are appropriate and effective. Zoning and geographic distribution of disease map is very useful to study the relationship between climate/weather and disease.

The level of regional vulnerability to the incidence of DHF in Indonesia was determined based on data of DHF incidence in 3 consecutive years. Category of endemic area is applied to a region if in the area within 3 years in succession of DHF attacks. Sporadic areas in case of inconsistent attacks within 3 years (annual data scale) and potential areas of DHF if no attack occurs in the last 3 years (19). The results of the dengue vulnerability study using the WADI indicator (the water associated disease index) indicate a relationship between water with dengue incidence and an indicator of the vulnerability of dengue disease, although this vulnerability is also affected by climate change (20).

Climate change contributes to the distribution and pattern of infection with DENV. At hot temperatures (28 °C-32 °C) with high humidity, *Aedes* spp. mosquitoes will survive for long periods. A research found the mosquito population to rise exponentially from the start of the rainy season in early May and reach its peak in late June and the greatest potential for dengue transmission occurred when the temperature was 28.9 °C. Dengue infection depends on seasonal and climatic variations. Rainfall provides a place for mosquitoes to spawn and evolve into adulthood. Temperature plays an important role in the life cycle and behavior of mosquitoes because very high or very low temperatures reduce the risk of infection (21). Temperature changes due to global warming impact on the distribution and incidence of dengue. Changing rainfall and high temperatures due to long droughts can affect mosquito populations and disease transmission by arboviruses.

As temperatures continue to increase and the changing rainfall patterns provide opportunities for geographic expansion of *Aedes* vector spread and low-income countries higher the incidence of dengue (22). The temperature of 20-30°C with humidity ranging from 60%-90% is the optimum condition for *Ae. aegypti* mosquito breeding. Thus if the environment is at that temperature and humidity it will support the increase of population density of mosquitoes which further impact on the transmission and spread of DHF (23).

The limitations of this study were that we did not examine more sociodemographic factors with age and education levels. An active role of health personnel is required to monitor regularly PSN activities carried out by the community. Health workers should establish working groups to assist with monitoring and evaluation of PSN activities.

## Conclusion

The community in the endemic area of knowledge about DHF is mostly good (55%) but in practice PSN is mostly (56%). There is an association of DHF incidence with PSN practice and no relationship between knowledge with DHF incidence. The vulnerability map shows many negative DHF residents living in areas of dengue fever. Vulnerability DHF-endemic communities are environmentally dominated, and the knowledge and practice of community PSN is lacking. Mobilization of all components of the community is required to participate in the prevention of dengue fever.

## Ethical Considerations

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely considered by the authors.

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## Conflict of interests

The authors declare that there is no conflict of interests.

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