Spatial Analysis And Mapping Of Dengue Hemorrhagic Fever (DHF) Risk In Rural Populations In Panongan Subdistrict, Tangerang

Deborah Siregar¹, I Made Djadja²

¹Lecturer Faculty of Nursing, Universitas Pelita Harapan
²Lecturer Faculty of Public Health, Universitas Indonesia

Corresponding author: Deborah Siregar, Taman Ubud Permai, Lippo Karawaci, Indonesia, deborah.siregar@uph.edu

Abstract

Introduction: Dengue Hemorrhagic Fever (DHF) is a disease that affects the population in urban areas. But several recent research shows that the incidence of dengue has spread to rural areas, where urban areas act as reservoirs of the virus to areas with the scope of the smaller communities.

Objectives: This study aims to analyze the spatial and mapping distribution of DHF with geographic information system (GIS) to inform efforts in reducing prevalence of DHF.

Methods: This study is a descriptive study, using a cross sectional approach with a simple random sampling method, and a sample size of 95. This study was conducted in Panongan Subdistrict, Tangerang and data was analyzed using spatial and statistical analysis.

Results: The results showed that the largest number of respondents came from Mekar Bakti village with 28 cases. Distribution of DHF cases based on age 49 (51.6%) are males, and 46 (48.4%) are females. The proportion in the case group aged <15 years was 23 (24.2%), and ≥15 years were 72 (75.8%).

Conclusion: Efforts to eradicate disease must be done not only by government, but also with community involvement. Eradication of dengue can be done with community empowerment that encourages preventative practices, such as draining, closing, and burying the water reservoir, among others. Other prevention strategies for preventing mosquito bites and breeding such as use of mosquito nets, repellent, cleaning up stagnant water as well as other environmental policies should also be strengthened.

Keywords: DHF, GIS, spatial analysis, rural population

INTRODUCTION

DHF is a disease caused by the dengue virus. It is transmitted by mosquitoes of the genus Aedes, mainly Aedes aegypti or Aedes albopictus. Transmission can occur throughout the year affecting all age groups and is related to the environment and behavior (1). As one of the leading public health concerns in Indonesia, DHF is known to cause frequent outbreaks.

In 2016, outbreaks were reported in 9 districts and two cities from 11 provinces in Indonesia, including Tangerang where 372 cases were reported in 2015 (2). Between January to April 2016, there was a surge of DHF cases in Tangerang resulting in 1041 cases and 20 deaths. The highest prevalence was in Panongan with 158 cases, followed by Cikupa with 122 cases and two deaths, Balaraja with 76 cases and two deaths, and Kresek with 60 cases and two deaths (3).
Preventive efforts such as eradication of dengue mosquitoes has been frequently performed, but DHF cases continue to increase each year. Based on results from a preliminary study in June 2016, various efforts have been made to resolve the concerning DHF issue within the working area of Panongan Health Center. Efforts included the implementation of epidemiological investigations, inspection of mosquito larvae, implementation of fogging, the 3M plus, and educating the public on DHF prevention. Despite these efforts, the incidence of DHF working area of the Panongan Health Center still shows a high number of cases. The incidence of DHF in the Panongan Subdistrict has not been widely reported, mostly because of the living condition of residence, home environment, and local community behavior. This study aims to understand the risk factors contributing to the high incidence of DHF in the Panongan Subdistrict, Tangerang.

As an information management system, GIS can be utilized as a database to inform decisions on controlling and eradicating DHF (4). Spatial analysis can also provide benefits of determining the pattern on the spread of DHF based on area, thus identify high-risk areas. It can also evaluate a disease from various contexts to allow for better approaches in efforts to eradicate and prevent DHF. Understanding of epidemiology, especially spatial distribution patterns, will help identify areas and populations at high risk of DHF and maximize effects of interventions (5). The current information delivery system is ineffective and a geographic distribution of DHF has not been presented, so the relative severity in each area is not known. Therefore, a method in displaying the geographical distribution of affected areas will be needed.

The purpose of this study is to determine the spatial distribution of DHF cases in Panongan Subdistrict, so that spatial information can be used as surveillance data easily understood by DHF programming professionals. This study aims to provide insights for policy makers in an effort to control and reduce DHF cases.

METHOD

This is a descriptive quantitative study conducted between January-June 2016 at the Panongan Health Center, Tangerang. Samples were DHF patients receiving treatment at Panongan Health Center in 2016, which was recorded in the Panongan Health Center using a simple random sampling technique with a minimum sample size of 95. GIS was the approach used to collate spatial data. The data was collected by plotting home addresses and surrounding areas of DHF patients using the Global Positioning System (GPS). The plots were contained in a map of the Panongan Subdistrict, subsequently a map-maker application was used for data processing. The resulting shapefile (.shp) was then opened in the map maker for processing. Edits all shapefiles to produce a sign or symbol that can describe each character. This study was approved by the ethics committee at the Faculty of Public Health, Universitas Indonesia.

RESULTS

Geographical Location

Tangerang is located in eastern Banten Province with an area of 959.60 km². The Java Sea borders Tangerang in the north, Jakarta Province and Tangerang in the east, Bogor and Depok in the south, Serang and Lebak in the west (6). Panongan is one of the districts in the south of Tangerang. The total area of Panongan Subdistrict 35.94 km² is administratively divided into one urban village, seven villages, 73 hamlets, and 328 neighborhoods. The topographic condition of the Panongan subdistrict is lowland with an altitude between 0-41 m asl, which is evenly distributed across Rancalyuh Village, Mekar Jaya Village, Rancakelapa Village, Panongan Village, SerdangKulon Village, Ciakar Village, MekarBakti Village, and Peusar Village.
Population in Panongan Subdistrict, Tangerang

The population of Panongan Subdistrict in 2014 was 123,067, an 5.78% increase from 2013 when the population was 116,084 with male population of 62,668, and female population of 60,399 (6). This increase was influenced by migration along with increased new housing development in the Panongan District, especially the Citra Raya area. Population density affects disease transmission. Without adequate preventive measures, the higher the population density, the more favorable it becomes for viral replication, which can lead to an increase in cases. Population density requires special attention from the government especially because of unplanned and controlled urbanization. Therefore, information on the geographic distribution of the population allows the government to mitigate risks associated with overcrowding. Information on population density greatly influences efforts on health promotion. The cases of DHF is widespread especially in urban areas and areas with strategic new residential developments. With the higher population density, the flight distance of the DHF vector shortens, causing favorable conditions for transmission.

Table 1. Distribution of DHF cases in Panongan Subdistrict

<table>
<thead>
<tr>
<th>Village</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranca Iyuh</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mekar jaya</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Ranca Kelapa</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Panongan</td>
<td>10</td>
<td>12</td>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Serdang Kulon</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Ciakar</td>
<td>7</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mekar Bakti</td>
<td>4</td>
<td>4</td>
<td>13</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Peusar</td>
<td>10</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The results showed that the largest number of cases lived in Mekar Bakti Village (28 cases). Based on time characteristics, the number of cases in Panongan each month changes. Many cases of DHF in Panongan occurred in the first two months of 2016. In the following months, the incidence of this disease decreased and fluctuated until...
September 2016. The increase in DHF cases began to occur in the last three months of the year, including October-December.

To present information on the distribution of DHF in each area, a map was color coded to represent the distribution in each area.

**Figure 2.** Distribution of reported dengue cases by residence in Panongan Subdistrict, Tangerang.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>49</td>
<td>51.6</td>
</tr>
<tr>
<td>Female</td>
<td>46</td>
<td>48.4</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 15 years old</td>
<td>23</td>
<td>24.2</td>
</tr>
<tr>
<td>≥ 15 years old</td>
<td>72</td>
<td>75.8</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>100</td>
</tr>
</tbody>
</table>

The results also show that 49 (51.6%) are males, and 46 (48.4%) are females. The proportion in the case group aged <15 years was 23 (24.2%), and ≥15 years were 72 (75.8%). The proportion of respondents aged <15 years were 23 people (24.2%) and ≥15 years were 75 people (75.8%).

**DISCUSSION**

This study examined the spatial distribution pattern of DHF in Panongan Subdistrict using GIS and spatial statistics methods. The results showed that the largest number of cases from Mekar Bakti Village (28 cases) as one of the high-risk areas for DHF transmission, which has not been previously reported. Individual characteristics indirectly make a difference to disease reactions. These differences can be seen based on age group and gender.
Sex differences
The prevalence among males and females are comparable, which indicates that sex does not present as a risk factor for DHF, consistent with the inconclusive findings from other studies. A study in Vietnam found that there were more DHF cases among males (60.3%) than females (39.7%) (7) and a study in Southeast Asia (India, Bangladesh, Singapore, and Malaysia) shows that men are more at risk of getting dengue (8). However it has also been reported that women are more susceptible to DHF as they tend to work in and around the house, placing them at higher risk of Aedes mosquito bites (9). Further research into determining the sex differences both in infection and severity of the disease is needed. There is no known reason for the age shift in DHF sufferers, possibly related to the transmission of the virus in locations where someone spends time outside the home.

The shift in affected age group
DHF affects children and adults of all age groups, suggesting the possibility that dengue transmission may occur not only at home but also at schools and workplaces. Adults spend most of their time away from home, such as at work. It indicates the location of the dengue transmission has changed, no longer around the home environment (10)(11), contrary to previous research that suggested DHF to occur mostly among children, and prevalence decreases with age, as Aedes mosquitoes breed in water containers in and around the house, where children spend time playing (9). Different findings were reported in another study in Singapore, Indonesia, Bangladesh, and Thailand. In Nepal, all DHF cases occur between the age of 16-45 years while in Bangladesh, the most affected age group is 18-33 years. Sri Lanka shows that the age group affected by DHF has shifted from <15 years to 15-34 years and there is an increase in dengue fever in the older age group (8)(12). A study in Taiwan also found that the prevalence of DHF increases with age and chronic disease, affecting mostly the elderly, meanwhile children are less likely to be bitten by mosquitoes because they spend more time at home (13). A shift of cases in the age group affected by DHF is unknown, possibly related to the presence of viral transmission that occurs in locations where a person spends time outside (14).

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REFERENCES


