IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 10 Ver. XIII (Oct. 2017), PP 34-38
www.iosrjournals.org

Spatial And Temporal Determinantsfor Dengue Haemorrhagic Fever: A Descriptive Study In Tanjungpinang City, Indonesia

*Nur Fitriana Arifin[1], M. Sakundarno Adi[2],Suhartono[3],Martini[4],Ari Suwondo[5]
[1]*Master Program in Epidemiology, Postgraduate, Universitas Diponegoro, Indonesia*
[2]*Head of Epidemiology Department, Postgraduate, Universitas Diponegoro, Indonesia*
[3]*Department of Environmental Health, Postgraduate,Universitas Diponegoro, Indonesia*
[4,5]*Department of Public Health, Universitas Diponegoro, Indonesia*
*Corresonding Author: Nur Fitriana Arifin**

Abstract: *Dengue Haemorrhagic Fever (DHF) has emerged as an important public health problem with an extensive incline. This is in line with the increased mobility of population density causing various patterns/cycles of cases. The number of cases of Dengue Haemorrhagic Fever occurring in Tanjungpinang City in 2013 was 168 cases (Incidence Rate = 8.52 per 10,000 people and Case Fatality Rate = 0.59%).In 2014, it experienced an increase to 559 cases (Incident Rate = 27.98 per 10,000 people and Case Fatality Rate = 0.17%). In the next year, 2015, the Incident Rate decreased to 17.5 of the total 358 cases but the Case Fatality Rate increased to 0.83%. Meanwhile, in 2016, there were 306 cases of Dengue Haemorrhagic Fever with the Case Fatality Rate of 0.32%. This research aimed to find out the spatial pattern of DHF incidence, which was related to spatial scope such as climatic and demographic factors.This research was a descriptive analytic survey research using cross-sectional design. The research variables were inspected at the same time from the whole population. A spatial-temporal approach was used to analyze the case transmission, observe the climate change retrospectively affecting the forms of Dengue incidence and analysis the patterns. Using Global Positioning System (GPS), data was collected to determine the coordinates of the location of the patients.The results of this research showed that the highest spread or distribution of patients with Dengue Haemorrhagic Fever in Tanjungpinang City in 2016 was in East Tanjungpinang District, which amounted to 117 cases and (Incident Rate = 40.5 per 100,000 people). Meanwhile, the lowest one was in East Tanjungpinang District, which amounted to 19 cases (Incident Rate = 9.2 per 100,000 people) and mostly occurred to children aged at 5-9 years. As for the land use in Tanjungpinang City, the residential area marked by light-yellow color was mostly found in the area of East Tanjungpinang District. Understanding the spatial characteristics of Dengue Haemorrhagic Fever (DHF) incidence is highly crucial for governmental agencies to implement effective disease control strategies. Various spatial patterns in the population accessibility also bring a varied distribution of DHF cases, following the mobility of human activities. The distribution patterns of DHF cases are strongly affected by the patterns of population mobilities that are currently difficult to be predicted with unplanned settlements (number of buildings, population density, settlement land use). DHF cases are strongly influenced by changes in physical environment, demographics, and topography.*

Keywords: *Dengue Haemorrhagic Fever, Spatial distribution, Temporal determinant, Geographical Information System, Tangjungpinang City*

Date of Submission: 29 -07-2017 Date of acceptance: 30-09-2017

I. Introduction

The cause of Dengue Haemorrhagic Fever is Dengue virus that belongs to the Flaviviridae family and Flavivirus Genus. This virus has four serotypes known as DEN-1, DEN-2, DEN-3, and DEN-4, transmitted to humans through the bites of infected mosquitoes, particularly Aedes aegypti and Aedes albopictus mosquitoes almost found throughout Indonesia.[1] Up until now, Dengue Haemorrhagic Fever (DHF) is still a major health problem in the world including in the countries that become the members of WHO. The 70% of countries in Southeast Asia and Western Pacific are endemic areas. In the last 50 years, there has been an increase in the number of DHF cases up to 30 times. The increased number of the cases is the environmental implication and changes due to global warming, high population mobility, and so forth. [2] The number of cases of Dengue Haemorrhagic Fever occurring in Tanjungpinang City in 2013 was 168 cases (Incidence Rate = 8.52 per 10,000 people and Case Fatality Rate = 0.59%).In 2014, it experienced an increase to 559 cases (Incident Rate = 27.98 per 10,000 people and Case Fatality Rate = 0.17%). In the next year, 2015, the Incident Rate decreased to 17.5 of the total 358 cases but the Case Fatality Rate increased to 0.83%. Meanwhile, in 2016, there were 306 cases of Dengue Haemorrhagic Fever with the Case Fatality Rate of 0.32%.

Based on the strategic plan for overcoming the problem of Dengue diseases (The Dengue Strategic Plan for the Asia Pacific Region of 2008-2015) organized by WHO, activities of research were undertaken to reduce the number of mortality due to Dengue Haemorrhagic Fever by developing and testing the tools and new monitoring mechanisms. The outputs expected here are the implementation of Geographic Information System (GIS) in the handling of Dengue cases, development of effective surveillance and tools, and identification of risk factors.[3]Spatial aspect (territory) is important to be studied because there is a different characteristic between one region with another, including the ground level, soil type, population density and behaviors, environmental hygiene level, etc. The result of spatial modeling in the form of area vulnerability map to DHF is expected to be used as a valuable input in the program planning of DHF case eradication and handling as well as effective and efficient decision-making.[4]

II. Methods

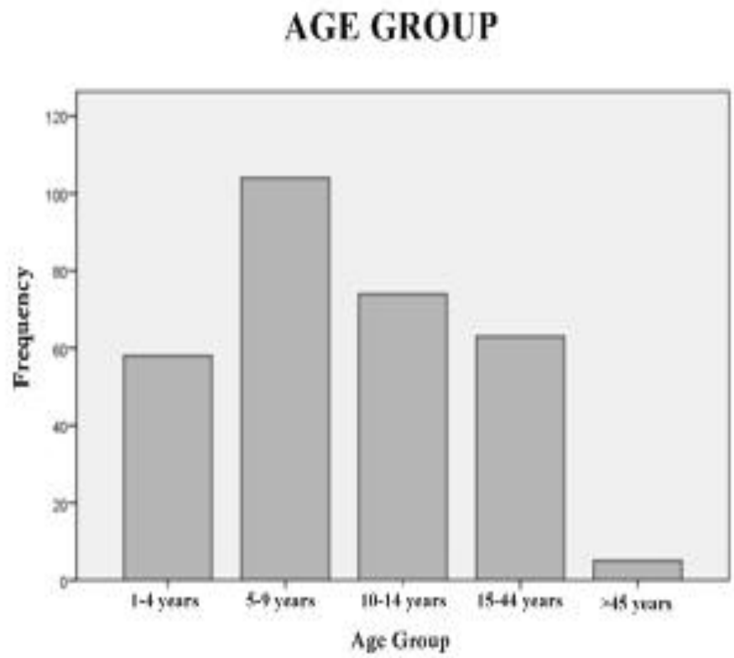
The design of this research was cross-sectional using secondary data. The subjects (sample) studied were all individuals experiencing Dengue Haemorrhagic Fever. The data on climatic and demographic factors are aggregate data that would then be analyzed statistically and spatially to observe the incidence of DHF cases in Tanjungpinang City. The spatial analysis used in this research was pattern analysis. Pattern analysis in epidemiology is the presentation of the disease transmission based on the space. This research also used a Geographic Information System modeling through the spatial analysis to obtain the pattern of DHF transmission and identify the spread (transmission) of DHF. Pattern analysis design was selected because this research used population-based secondary data in Tanjungpinang City. Moreover, the sampling was done by using exhaustive sampling method. Exhaustive sampling is a sampling scheme in which the researcher takes all subjects of the population source as the sample to be studied. The data of DHF cases obtained from the recording results of the Municipal Health Office of Tanjungpinang City started from January – December 2016. The number of cases in each district was the recapitulation result of the report sent by the responsible person of each Puskesmas (Community Health Center) to the Municipal Health Office every month. The climatic data (rainfall) of Tanjungpinang City were obtained from the measurement results of the Meteorological and Geophysical Agency of Tanjungpinang City in 2016.

III. Results

Population characteristics

The distribution of DHF cases in Tanjungpinang City in 2016 based on the age group can be seen in Chart 1. Based on Figure 1, it is found that the highest number of DHF cases in 2016 occurred at the age of 5-9 years (school age), which reached 33.8%.

Figure 1. Age Group



Based on Table 1, it is known that the number of DHF cases in 2016 was 304, of which 50.3 % (153) occurred in women and the rest 49.7% (151) occurred in men.

Table 1. Number of DHF Cases

No.	Gender	Frequency (People)	Percentage (%)
1.	Men	151	49.7
2.	Women	153	50.3
	Total	**304**	**100.0**

Univariate Analysis

Temperature: Fluctuations in air temperature on the incidence of DHF cases in Tanjungpinang City in 2016 can be seen in Chart 4.6. The relatively constant air temperature based on the figure above was 26.8 – 28.2^0 C. The highest temperature (28.2^0 C) occurred in April and May. There was a tendency of the case trend above that if the air temperature increased, the number of DHF cases decreased while if the air temperature decreased, i.e. in June, the number of DHF cases tended to increase.

Humidity

Air humidity fluctuations in Tanjungpinang City on the incidence of DHF cases in 2016 can be seen from the chart, in which the movement of air humidity was not followed by the DHF cases. It can be seen that the there were 30 DHF cases occurred in March when the air humidity was 82 but it decreased to 27 cases occurred in April when the air humidity experienced an increase to 84.

Rainfall

Rainfall fluctuations with various intensity occurred in the last 3 months. Tanjungpinang City with rainfall peak and case peak did not have a special pattern of the trend in the chart above. The rainfall peak of 582.6 mm occurred in November with 3 DHF cases while the case peak of 83 cases occurred in January when the rainfall was 252 mm.

Figure 2. Population Density

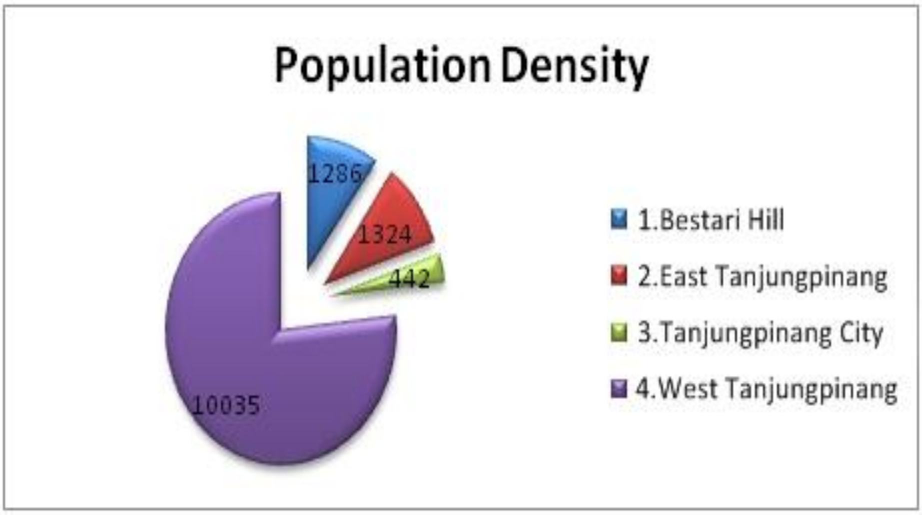


Figure 2 illustrates that the population density in Tanjungpinang City did not spread evenly in each district. West Tanjungpinang District was an area where almost all of its subdistricts had relatively high population density. This district had the smallest land area (4.6 km^2) compared to other districts.

Based on Figure 2 above, it can be seen the distribution of population density in Tanjungpinang for each district. The district with the lowest population density of 442 people per km^2 was Tanjungpinang City District while the district with the highest population density of 10,036 people per km^2 was East Tanjungpinang District. This was in line with the number of DHF cases in which the lowest number of DHF cases was in Tanjungpinang City District and the highest one was in East Tanjungpinang District. Thus, it can be assumed that the population density was related to the number of DHF cases.

Types of land use existing in Tanjungpinang City, covering 4 districts, were divided into several parts, namely: Housings, Commercials, Public and Social Services, Green Areas, Protected Areas, Offices, Industries and Warehousing, and Tourism. The results of this research showed that DHF cases normatively transmitted in the area of land use with a settlement characteristic. There were only some cases found in the area of production forests, other cultivations, tourism, and industries, which partly functioned to be a temporary settlement (camp) for people as workers. This can be said that the area might be the risky area of Dengue Haemorrhagic Fever (DHF).[9]

IV. Discussion

In this research, we examined the spatial and temporal distribution of Dengue incidence. This is because Dengue Haemorrhagic Fever is a disease whose morbidity and the mortality rate is still high. This research used ArcGIS to analyze the spatial and temporal distribution of DHF cases in Tanjungpinang City in January – December 2016. By the ArchGIS, it was obtained the image of the spatial and temporal distribution of Dengue Haemorrhagic Fever cases that could describe the demography and geography of the DHF transmission so as to provide a guidance on where effective community health interventions should be implemented in the prevention measures of Dengue Haemorrhagic Fever.

A spatial analysis aims to describe the incidence of Dengue Haemorraghic Fever (DHF) into a form of a map. In the period of 2014-2016, the Dengue Haemorraghic Fever (DHF) cases in Tanjungpinang City experienced a decrease but still became a concern of the control of Dengue Haemorrhagic Fever. The highest rate of DHF cases in 2014 reached 559 cases, which was in East Tanjungpinang District. Then, it decreased to 358 cases in 2015 that still occurred in East Tanjungpinang District. East Tanjungpinang District consists of 5 sub-districts covering Melayu Kota Piring, Kampung Bulang, Batu 9, Air Raja and Pinang Kencana. The highest number of DHF cases in East Tanjungpinang District was contributed from Pinang Kencana Sub-district, which amounted to 74 cases and the lowest one of 8 cases occurred in Kampung Bulang Sub-district.

Dengue Haemorrhagic Fever is influenced by several factors namely climate and demography. The life cycle of mosquitoes depends on the temperature of the environment. Mosquitoes cannot regulate their own body temperature. The average temperature for mosquito breeding is $25^oC – 27^oC$. Mosquitoes also can survive at a low temperature but the metabolism process can decrease even stop if the temperature decreases up to below the critical temperature. Besides, at a high temperature, mosquitoes will experience changes in the physiological process.[4]Humidity strongly supports the proliferation of infectious vector of Dengue Haemorrhagic Fever that causes the increase of Dengue Haemorraghic Fever patients from year to year.[5] At 85% humidity, female mosquitoes will reach the age of 104 days while male mosquitoes will reach the age of 68 days. Meanwhile, at 60% humidity, the age of mosquitoes will be short and it can not be a vector because there is not enough time to transmit the virus from the stomach to the salivary glands.

Rainfall will increase the puddles that can be used as a place for mosquito breeding and it also will increase the air humidity. The air temperature and humidity during the rainy season are very conducive to the survival of mosquitoes and the transmission of the disease (DHF). The rainy season causes puddles in the places of Aedes aegepty mosquito breeding that is previously not filled with water in the dry season and the eggs that previously had not hatched will hatch in the rainy season. An Aedes aegepty mosquito can lay around 100-300 eggs so that the population of Aedes aegepty mosquitoes increases. To ripen its eggs, female mosquitoes will search for human blood, causing the tendency to bite man and the transmission of Dengue Haemorrhagic Fever disease increase.Based on the spatial analysis in the general figure, it is shown that the distribution pattern of Dengue Haemorrhagic Fever cases is mostly in the area/region of the district with the highest population density. This is linear with the theory of Achmadi (2008) stating that population density can trigger the emergence of infectious diseases and influences the spread or transmission of Dengue Haemorrhagic Fever cases. The high rate of DHF incidence in densely populated areas does not escape from the role of Aedes aegypti mosquitoes as the vector of DHF. With a high rate of population density in an area, the chances of infective mosquitoes to bite humans and transmit DHF virus to the population of the area will also increase.[6]

Population density in urban areas is a factor to be taken into account in preventing Dengue Haemorrhagic Fever epidemic. Therefore, spatial model analysis can be used to determine areas with dense populations in Tanjungpinang City. Areas with certain characteristics will be easily identified visually and verified by the condition of the population data. In densely populated areas, the transmission potential of Dengue Haemorrhagic Fever virus will be seriously high even though the house index rate at the site is low. This is because Aedes aegepty mosquitoes do not need to fly away so that the DHF epidemic can spread rapidly in the area.[7]

V. Acknowledgment

The researchers are grateful to the patients participating in this research, and to the field workers and health officers in the Municipal Health Office of Tanjungpinang City. In addition, we would like to thank all the lecturers who have helped to comment on the manuscript until the completion of this research.

References

[1]. World Health Organization. Dengue guidelines for diagnosis, treatment, prevention and control. (WHO Library Cataloguing-in-Publication Data).2009

[2]. UF, Achmadi. Manajemen demam berdarah berbasis wilayah buletin jendela epidemiologi.Pusat data dan surveilance Epidemiologi. Kementerian Kesehatan Republik Indonesia.2013;2:15–20.

[3]. World Health Organization. The dengue strategic plan for The Asia Pacific Region 2008 - 2015. WHO. 2008.

[4]. Departemen Kesehatan RI. Panduan peningkatan peran serta masyarakat dalam Pemberantasan Sarang Nyamuk Demam Berdarah

Dengue (PSN DBD). Ditjen P2PL: Jakarta. 2003.
[5]. Departemen Kesehatan RI. Ekologi dan Aspek Perilaku Vektor. Direktorat Jenderal Pengendalian Penyakit dan Penyehatan Lingkungan. Jakarta. 2007.
[6]. Chandra. Studi Epidemiologi Kejadian Demem Berdarah Dengue dengan Pendekatan Spasial Sistem Informasi Geografis di Kecamatan Palu Selatan Kota Palu. 2008.
[7]. Achmadi. Manajemen Penyakit Berbasis Wilayah. Jurnal Kesehatan Masyarakat Nasional. 2009;3(4).
[8]. Farahiyah, Musyarifatun, Nurjazuli, Onnie Setiyani. Analisis Spasial Faktor Lingkungan dan Kejadian DBD di Kabupaten Demak. Buletin Penelitian Kesehatan. 2014; 42(1):25–26.
[9]. Muliansyah, Tri Baskoro. Analisis Pola Sebaran Demam Berdarah Dengue Terhadap Penggunaan Lahan Dengan Pendekatan Spasial Di Kabupaten Banggai Provinsi Sulawesi Tengah Tahun 2011-2013.Journal of Information Systems for Public Health. 2013;1(1).

*Nur Fitriana Arifin. "Spatial And Temporal Determinantsfor Dengue Haemorrhagic Fever: A Descriptive Study In Tanjungpinang City, Indonesia." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 16.10 (2017): 34-38