ORIGINAL ARTICLE

Spatial Temporal Analysis of Dengue Hemorrhagic Fever Occurrence Based on Epidemiological Data in Palembang City

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ABSTRACT

Introduction: Health field development in Indonesia still has double load in alleviating the transmision of contagious virus infection in various problems that are not solved yet, one of them is vector disease dengue hemorrhagic fever. Vector disease dengue hemorrhagic fever is carried directly by Aedes Aegypti mosquito. **Methods:** This research discussed the location through temporal by involving the administration as the limitation in the research during the period of 2015 until 2019. The occurrence information was conducted using retrospective approach through Geographic Information System to see the occurrence cluster from the data of surveilance dengue period, while related to the occurrence position information was obtained by using global position system to see the coordinae of the occurrence. **Results:** Obtained in this research explain that the number of occurrence cases confirmed from 2015 until 2019 were 4.699 dengue cases with highest case was in 2018 achieving 1062 cases and the lowest case was in 2015 with 744 cases. The sub district data information with the highest case during 5 years period was obtained at East Ilir Sub District 1 and Sematang Borang Sub District. **Conclusion:** Geographic Information System helps to model spatially from the result and the track record of the case occurrence of dengue hemorrahgic fever temporally, this spatial information can be used as early warning related to the case alleviation and the potential of finding the development of aedes aegypti breeding which can be used by the stakeholders and the related parties related to dengue surveillance.

Keywords: Surveillance, Aedes Aegypti Mosquito, Palembang City

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INTRODUCTION

The World Health Organization (WHO) found that about half of the world's population is at risk of being infected with the dengue virus where the number of people infected each year is around 390 million people (1). Most countries located in tropical and sub-tropical climate areas have a greater risk than countries located in other hemispheres (2, 3). One of the hyperendemic countries in Southeast Asia is Indonesia (4) with an estimated 600,000 cases per year, of which 180,000 require hospitalization (5, 6). Dengue infection is often thought of as a common cold, with even the worst possible risk of death. Symptoms are divided into three phases of the disease, starting from the fever phase, the shock phase, and the recovery phase, which is characterized by headaches, muscle aches, and bone pains (7).

When a country has passive capacity or supervision, then the country will usually find it difficult to detect cases as a whole where this deficiency may then lead to periodic outbreaks of recurrence (8, 9). The existence of an unequal surveillance system needs to be added to an analytical approach, both within and outside the health sciences. One of the analyzes that can be applied in this case is the use of geographic information systems on cases confirmed and reported by health institutions and through determining the location of the incident with vector discovery. The spatial analysis will show the location and position of an object or event that is on the earth's surface and is expressed in a certain coordinate system (10). The information generated from the application of the geographic information system approach and spatial statistical calculations are mostly applied to determine the characteristics of the temporal pattern of infectious diseases. Various epidemiological transmissions of infectious diseases can be estimated through spatial models by increasing the effectiveness of interventions that will lead to better outcomes, such as the implementation of prevention of diarrhea, typhoid, malaria, and dengue fever (11, 12).

Various studies conducted have found evidence of a relationship between climate and weather conditions in certain geographic areas and the number of cases of dengue hemorrhagic fever (13, 14). An example, in this case, is a study conducted in Kaohsiung City, Southern Taiwan which looked at the relationship between meteorological factors and the dengue epidemic found that the element of humidity and bite rate (BR) were strongly associated with cases of dengue fever (15). Research in Bangi Sub-district, Selangor, Malaysia examined the spatial trends of dengue hemorrhagic fever case data from 2016 to 2019 which were clustered and concentrated in urban areas (16). Meanwhile, a study of the spatial-temporal incidence of dengue from 2006 to 2016 in the Northeastern region of Thailand showed a dominance of events occurring at the age of 5-14 years (51.1%) when entering the rainy season. The use of a spatial regression model of temperature values in the study was associated with a higher incidence, while the hotspot analysis resulted in clusters of clusters around the urban areas of Khon Kaen and the rural southwestern part of the Province (17). Information related to the spatial distribution of statistics and spatial trends plays an important role in the modeling evaluation of annual vector control, human behavior, frequency, and severity of dengue.

Based on the information that has been found by previous research, researchers are interested in studying and processing data related to the dynamics of the number of infectious disease cases with temporal. Data on the history of annual dengue incidence in Palembang City, South Sumatera Province between early January 2015 to December 2019. This study resulted in 2 main objectives, including the trend of dengue hemorrhagic fever in 5 years and spatially informing clusters of the spread of dengue infectious disease.

MATERIALS AND METHODS

Study Design and Study Location

The Dengue Hemorrhagic Fever Incidence Study was conducted carried out from 2015 to 2019, and the total number of cases reached 4699. This study was conducted in Palembang City, South Sumatera. The Palembang city is one of the oldest cities in Indonesia based on information obtained from the 1337-year-old Srivijaya inscription. The area of Palembang is 400.61 km2 with a population of 1.5 million. The city of Palembang is located in the south of the island of Sumatera and has a tropical climate and has wind speeds of 2.3 km/hour – 4.5 km/hour, and temperatures ranging from 23.4 C – 31.7 C. The soil morphology is relatively low to flat, making this city mostly consist of marshy areas. When the rainy season comes, it is very easy to find flooded areas in this city. The reason for choosing Palembang City as the research area was because the incidence of abnormal dengue fever experienced dynamics from 2015 to 2019.

Study Sample

A total of 4699 cases were selected in their entirety and then a random sample was taken. The sample was selected based on criteria when the house information is not found, the next step is to build a sample frame using aerial and satellite imagery (18). If only an area framework is available, then the number of sample units in the population is unknown and it is difficult to find a start or finish for the selection to be included in the sample (19).

Data Collection Procedure

Data on cases of dengue hemorrhagic fever in Palembang City from 2015 to 2019 was obtained from Palembang City government health institutions through an open data platform. After the data is obtained, the next research stage is to determine the location of the incident using the global position system. Considering that the data obtained is cumulative, the researcher estimates the location of the incident through a random sample point approach that is administratively limited so that the data does not widen towards the surrounding administration.

Data Analysis

The collected data from the location of the incident and measurements were analyzed using the retrospective method carried out by making a graph or description of a symptom objectively with information behind it.The results described can calculate the prevalence rate in a certain period (20). The tests that were used in this study were descriptive analysis using geographic information system software.

RESULTS

The first information is related to the data distribution of cases in the last five years, while the second informs the total incidence of dengue hemorrhagic fever from 2015 to 2019. Figure 1 which is part of the data distribution in the sub-district displays the code name of each sub-district, namely code A for Alang-Alang Lebar Sub-District, code B for Bukit Kecil Sub-District, code C for Gandus Sub-District, code D for Ilir Barat Sub-District 1, code E for Ilir Barat Sub-District 2, code F for Ilir Timur Sub-District 1, code G for Ili Tiur 2 Sub-District, code H for Ilir Timur 3 Sub-District, code I for Jakabaring Sub-District, code J for Kalidoni

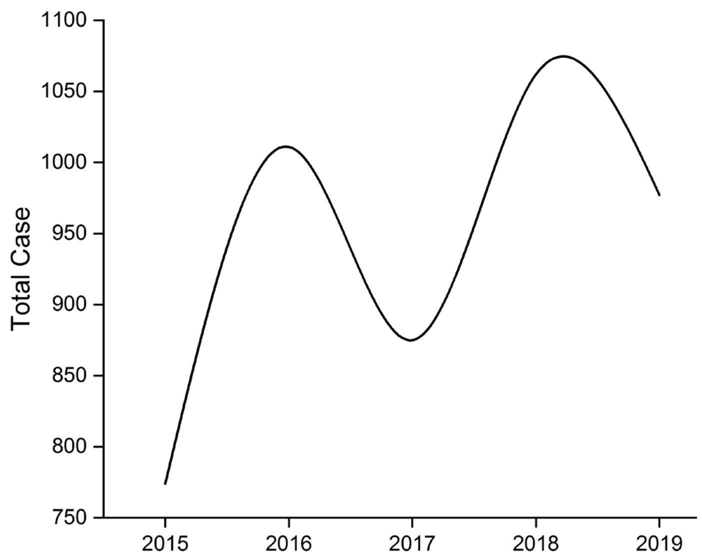

Figure 1 : Data distributon and incidence curve of dengue hemorrhagic fever in Palembang City. The first information is related to the data distribution of cases in the last five years, while the second informs the total incidence of dengue hemorrhagic fever from 2015 to 2019.

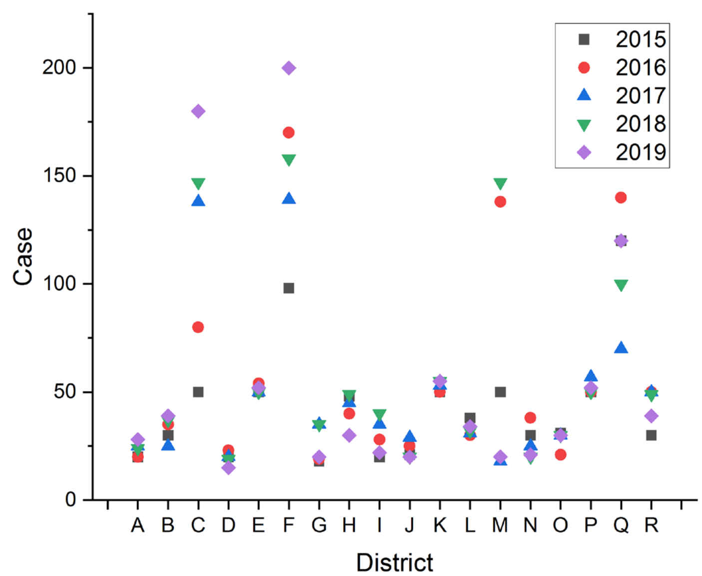

Figure 2 : Distribution of incident location points. Figure 2 describes the spatial-temporal incidence of dengue hemorrhagic fever cases over 5 years. The information displayed provides information that 2015 is marked in purple and looks less close to the spatial distribution of events in the following year.

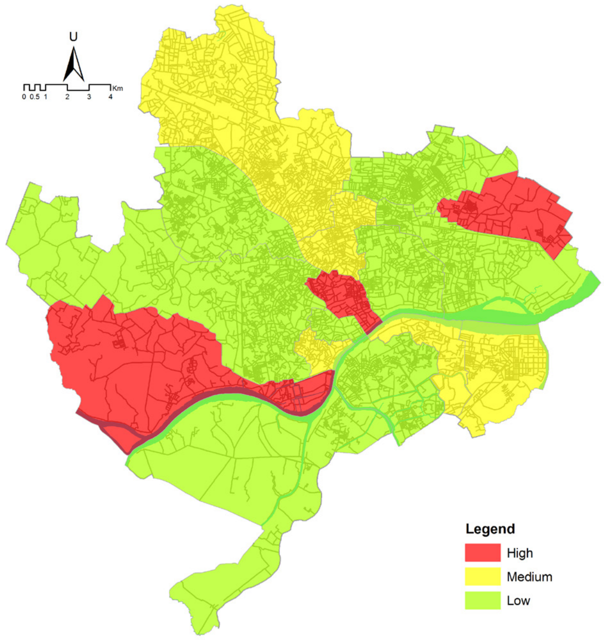

Figure 3 : Clusters of the incidence of dengue hemorrhagic fever. The information obtained from Figure 3 describes the cluster distribution of the incidence of dengue hemorrhagic fever. This value displays a description of the entire Sub-district in the city.

Sub-District, K code for Kemuning Sub-District, L code for Kertapati Sub-District, M code for Plaju Sub-District, code N for Sako Sub-District, code O for Sebarang Ulu 1 Sub-District, P-code for Sebarang Ulu 2 Sub-district, Q code for Sematang Borang Sub-district, and R code for Sukarami Sub-District.

The data distribution code of sub-district F shows the highest incidence cases than other sub-districts for cases in 2019. Meanwhile, the appearance of data distribution in 2018 with sub-district codes C, F, and M became the 3 sub-districts that dominated the most cases, more precisely reaching 158 highest cases in sub-district F. Regarding data distributions in 2017, 2016, and 2015, the worst sub-district cases were still found in sub-district code F with higher data distribution appearances than the surrounding sub-districts.

The total incidence of dengue hemorrhagic fever in the city of Palembang in the period 2015 to 2019 reached 4699 cases with each maximum number of cases increasing every year starting from 2015. The highest number of cases in this incident was 120 cases which continued to increase to 200 cases and is the highest cases that occurred in 2019. The highest cases were not always in Ilir Timur Sub-district. The highest number of cases for 2015 was in Sematang Borang Sub-district.

Table I : Study Literature

No	Literature Sources	Discussion
1	(24)	Based on temporal information on dengue fever in Gunungkidul Regency in 2014-2016 through retrospective history taking, in-depth interviews, and environmental analysis, the results showed that the sample used showed that children (50.8%), and students (57.4%) could the age of transmission was detected
2	(25)	Prediction of dengue hemorrhagic fever outbreak in 2013-2017 with the use of climate variables applied to the entire model provides the right information to take preventive action. The results obtained based on the results of the support vector machine are 70% accuracy, 14% sensitivity, 95% specificity, 56% precision. The use of test samples for sensitivity resulted in a value of 63.54%.
3	(26)	There are variations in local infection patterns. In addition, many findings of vector breeding sites where infection tends to depend on the quality of housing and knowledge of dengue fever. Housing located around the natural cover has a lower risk of infection because it is not a breeding ground for the Aedes Aegypti mosquito.
4	(27)	The spatial distribution of dengue hemorrhagic fever in Seremban Sub-district in 2008 – 2009 resulted in a group distribution pattern, while related to distance, dengue cases showed a standard distance of 22,985 meters in 2008 and 20,318 meters in 2009
5	(28)	The use of the fuzzy association rule mining method for estimating the incidence of dengue fever in the Philippines with historical, environmental, and socio-economic variables shows the accuracy of the model Positive Predictive Value 0.780, Negative Predictive Value (NPV) 0.93, sensitivity 0.54, specificity 0.97 by selecting the model size F0.5.
6	(29)	The development of a small-scale prediction method with local parameters and environmental variables was processed using the ARIMA model and resulted in a significant correlation with the incidence of dengue fever for the period 2008 - 2015.
7	(15)	The number of dengue fever cases observed in Kaohsiung City, Taiwan from 2014 to 2015 was predicted using the M1 model. The correlation coefficient for the DHF prediction model by the next 5 days mod is 0.93 and the correlation coefficient for the 15-day model is 0.71
8	(6)	The rate of increase in dengue fever patients in the city of Bandung from 2014 to 2016 increased by 11.83% where most of the patients were under 10 years old. The pattern was relatively constant (ANOVA, p = 0.283) and no statistically significant difference was found (t-test, p = 0.31). On the other hand, there is an increasing trend of positive cases for young people.

The information displayed provides information that 2015 is marked in purple and looks less close to the spatial distribution of events in the following year. The information for the following year is dominated by 2016 and 2018, where the appearance of the green dot in 2016 and the orange color in 2018 are seen almost covering the entire sub-district in Palembang City. The distribution of incident location points indicates the level of density of events that occur in a sub-district.

This value displays a description of the entire Sub-district in the city. Overall, the city of Palembang has eighteen sub-districts which are divided into 3 categories of incidence rates, ranging from 0 to 200 which belongs to the low cluster category, 200 to 500 including the medium cluster category, and 500 to 800 including the high cluster category. The results obtained from the division of the three clusters resulted in 3 sub-districts belonging to the high cluster consisting of Ilir Timur 1 Sub-district, Gandus Sub-district, and Sematang Borang Sub-district. For the medium cluster, there are 6 sub-districts consisting of Ilir Barat 2, Ilir Timur 3, Kemuning, Plaju, Seberang Ulu 2, and Sukarami. Meanwhile, sub-districts that

Table II : Cases of dengue hemorrhagic fever 2015 to 2019

District	2015	2016	2017	2018	2019	Total	PERCENTAGE (%)
Alang Alang Lebar	20	20	25	24	28	117	2,48
Bukit Kecil	30	35	25	37	39	166	3,53
Gandus	50	80	138	147	180	595	12,6
Ilir Barat 1	20	23	20	19	15	97	2,06
Ilir Barat 2	50	54	50	50	52	256	5,44
Ilir Timur 1	98	170	139	158	200	765	16,28
Ilir Timur 2	18	19	35	35	20	127	2,70
Ilir Timur 3	48	40	45	49	30	212	4,51
Jakabaring	20	28	35	40	22	145	3,08
Kalidoni	21	25	29	20	20	115	2,44
Kemuning	50	50	53	55	55	263	5,59
Kertapati	38	30	31	32	34	165	3,51
Plaju	50	138	18	147	20	373	7,93
Sako	30	38	25	20	21	134	2,85
Seberang Ulu 1	31	21	30	30	30	142	3,02
Seberang Ulu 2	50	50	57	50	52	259	5,51
Sematang Borang	120	140	70	100	120	550	11,70
Sukarami	30	50	50	49	39	218	4,63
Amount	774	1011	875	1062	977		
Max	120	170	139	158	200		
Min	18	19	18	19	15		
Total Case						4699	100

Source: Analysis, 2021

are included in the low cluster are sub-districts that have not been included in the high cluster and medium clusters, such as Alang-Alang Lebar Sub-sub-district, Bukit Kecil Sub-district, Ilir Barat 1 Sub-district, Ilir Timur Sub-district 2, Jakabaring Sub-district, Kalidoni Sub-district, Kertapati Sub-district, Sako Sub-district, and Seberang Ulu Sub-district 1.

DISCUSSION

This study aimed to identify the movement information temporally from year of 2015 until 2019 based on the surveillance epidemiology data in Palembang City. All objectives of this study were implications as reference data for controlling dengue hemorrhagic fever outbreaks in priority districts with the highest incidence rates in reducing dengue outbreak findings in that area.

DHF cases in Palembang City from year to year have a fluctuating total value. From 2015 to 2016, dengue cases increased by 30%. For the following year, a 13% decrease in cases occurred. In 2018, the number of cases again increased by a percentage of 21%. In 2019, the number of dengue cases again decreased with a percentage of detection of 8%, while the percentage of sub-districts as a whole was below 10%, whereas the sub-district with the smallest percentage was Ilir Barat Sub-district 2. The highest percentage, in this case, was in Ilir Timur 1 Sub-district with a percentage of 16.28%, Gandus Sub-district 12.6%, and Sematang Bontang Sub-district 11.70%.

The incidence of dengue hemorrhagic fever cases in 2015 became the smallest number of cases with a value of 774 cases, while the highest number of cases occurred in 2018 which reached up to 1062 cases. This finding from 2015 to 2016 has experienced a spike in cases reaching 237 cases. However, a significant decline in cases occurred after entering 2017, including the number of deaths around 136 cases. The spike occurred again in 2018 with more than 1000 cases and became the worst year during the 2015 to 2019 period. For information on the 2018 to 2019 incidence, there has been a re-emphasis of around 85 cases from the previous year.

Meanwhile, the small part shows the location of the distribution of dengue fever cases more clearly. More cases are found in Ilir Timur Satu Subdistrict, while on the map administratively, it covers the two surrounding subdistricts in Ilir Barat 2 and Bukit Kecil. The description of the small part in the middle displays detailed distribution information in the Sematang Borang Sub District. This appearance helps to see features that are not visible, even for the distribution of cases that are tightly visible on the map of Palembang City. At the bottom of the thumbnail, it presents the appearance of the Gandus Sub-district with more detailed appearance information.

CONCLUSION

The implementation of the research flow until the explanation of the results is carried out retrospectively. This model describes the situation from the value of the incidence of cases in a temporal manner and displays the dynamics seen from the total number of cases of dengue hemorrhagic fever and the distribution of locations of dengue fever incidence through administrative boundaries. This is done by estimating the distribution of locations using a random sample method that does not exceed this limit. The use of retrospective models, including the simple model approach, will still have many shortcomings so that additional variables and comparisons of several models in application in other case areas are needed.

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