Indonesian Journal of Global Health Research
Volume 5 Number 2, May 2023
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

SPATIAL AUTOCORRELATION OF DENGUE HAEMORRHAGIC FEVER (DHF) CASES USING THE MORAN'S INDEX METHOD IN MUARO JAMBI DISTRICT, INDONESIA

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ABSTRACT
Dengue incidents in Jambi Province have spread to all districts/cities. Muaro Jambi Regency occupies the second position with the highest cases after Jambi Municipality. This study aims to determine the spatial autocorrelation of DHF cases in Muaro Jambi Regency in 2017–2021. The DHF cases analyzed in this study are case data recorded at the surveillance section of the Muaro Jambi Regency Health Office from 2017-2021. This study analyzed aggregate data from 22 working areas of community health centers in Muaro Jambi Regency. The software GeoDa 1.10 was used for analyzing the Global Moran Index and the Local Indicator for Spatial Autocorrelation (LISA). The results of the global moran's index analysis show that in 2017 (I=-0.400; p=0,001) and 2018 (I=-0,277; P=0,006) the pattern of distribution of DHF cases is spread , while in 2019 to 2021 the results of the analysis show that it is not significant. The results of the analysis using LISA found spatial autocorrelation of DHF cases in the High-High category (hotspots) in 2020 at the Tantan 1 Health Center. Areas with the Low-Low category (cold spots) in 2019 were found at the Kebon IX Health Center, and in 2021 at the Tempino Health Center.

Keywords: dengue haemorrhagic fever; muaro jambi regency; spatial autocorrelation

First Received	Revised	Accepted
08 April 2023	18 April 2023	30 April 2023
Final Proof Received		**Published**
18 May 2023		28 May 2023

How to cite (in APA style)
Syukri, M., & Wardiah, R. (2023). Spatial Autocorrelation of Dengue Haemorrhagic Fever (DHF) Cases Using the Moran's Index Method in Muaro Jambi District, Indonesia. Indonesian Journal of Global Health Research, 5(2), 361-372. https://doi.org/10.37287/ijghr.v5i2.1753.

INTRODUCTION

Dengue is a viral infection caused by the dengue virus (DENV), transmitted to humans through the bite of an infected mosquito. This virus has four main serotypes (DENV-1, DENV-2, DENV-3, and DENV-4) (Murugesan & Manoharan, 2020). Humans are infected with dengue through the bite of female Aedes mosquitoes carrying DENV, including Aedes albopictus and Aedes aegypti. Aedes aegypti is the most important epidemic vector for DHF (Wang et al., 2020). About half of the world's population is now at risk of contracting dengue fever with an estimated 100–400 million infections occurring each year (WHO, 2023). At this time, DHF has occurred in 128 countries and has become endemic in more than 100 countries, including Indonesia (Hernandez-Gaytan et al., 2017).

Indonesia from 2004-2010 was reported as the 2nd highest country with the most DHF cases after Brazil (Maula et al., 2018). Dengue in Indonesia was first reported in Jakarta and Surabaya in 1968, and by 2020 DHF had spread to 34 provinces with 477 districts/cities (Kemenkes RI, 2017). Dengue fever is currently recognized as the most important cause of cases of acute febrile illness requiring hospitalization in Indonesia (Utama et al., 2019). This shows the need for planning better prevention and control strategies for DHF cases in

Indonesia.

Jambi Province is one of 12 provinces in Indonesia with an incidence rate (IR) that is still above the national target (Kemenkes, 2021). Dengue incidents in Jambi Province have spread to all districts/cities. Muaro Jambi Regency occupies the second position with the highest cases after Jambi City (Dinkes Provinsi Jambi, 2021). Muaro Jambi Regency from 2009-2020 experienced 3 DHF outbreaks with the number of cases increasing in the last 4 years (Dinkes Muaro Jambi, 2021). The Case Fatality Rate for Muaro Jambi Regency is also two times higher than the CFR for Jambi Province (Dinkes Provinsi Jambi, 2021). National Medium Term Program Plan (RPJMN) 2014-2019 National CFR target <1% (Kemenkes RI, 2010).

Dengue fever is a disease for which there is no vaccine or specific medicine (Tuiskunen & Lundkvis, 2013). The best effort that can be done in controlling DHF cases in the community is vector control management (Rather et al., 2017). Steps that can be taken include prioritizing surveillance efforts in anticipating the threat of exploding cases or outbreaks. Surveillance can be done with spatial analysis in detecting the grouping of cases according to space and time, distribution, and trends of DHF cases (Achmadi, 2012).

Many studies have been carried out using spatial and temporal analysis for DHF cases (Abd Naeeim & Abdul Rahman, 2021; Alfiyanti & Siwiendrayant, 2021; Anno et al., 2015; P. W. Dhewantara et al., 2015; Ishak et al., 2018; Pasaribu et al., 2021; Sitepu et al., 2020; Trihastuti & Hendrati, 2021; Zhang et al., 2019). Many studies on distribution patterns and factors related to the number of DHF cases have been carried out in Indonesia, but there are no studies that specifically look at the variation in the distribution of DHF cases in Muaro Jambi District. Spatial distribution studies can be useful in assisting related parties, especially the health office in developing effective programs and focused interventions in efforts to control DHF cases. This study aims to determine the spatial autocorrelation of Dengue Hemorrhagic Fever (DHF) cases in Muaro Jambi Regency in 2017–2021.

METHOD

Study Area

Geographically, Muaro Jambi Regency is located between 1°15'-2°20' Latitude and between 103°10'-104°20' Longitude. Muaro Jambi Regency is one of 11 regencies/cities in Jambi Province with an area of 532,600 Ha (5,326 km2) and is located at an altitude of 0-38 meters above sea level. Muaro Jambi Regency is divided into 11 sub-districts and 155 villages/kelurahan, 22 working areas of public health centers with a population of 412,052 in 2020. The Muaro Jambi Regency area in detail can be seen in the figure 1.

Data Analysis

This study analyzed DHF data at 22 health centers in Muaro Jambi District. All DHF data is processed into the Microsoft Excel application and then analyzed using the open source Geoda 1.20 application using the Moran's Index analysis method. Data analysis begins by making a thematic map of the distribution of DHF cases which aims to show the distribution of the proportion of DHF cases by working area of the public health center (puskesmas). Analysis of Moran's Index and Local Indicator for Spatial Autocorrelation (LISA) aims to find the presence or absence of spatial autocorrelation and find areas that indicate spatial autocorrelation. A general and important concept that can be found in the spatial analysis literature is that where closer observations in space tend to be more related and similar than those far apart (Waters, 2017). Autocorrelation can be defined as the spatial aggregation of disease events or risk factors that is unlikely to occur by chance, especially after the known

risk factors influencing the spatial distribution have been taken into account (Lessler et al., 2017).

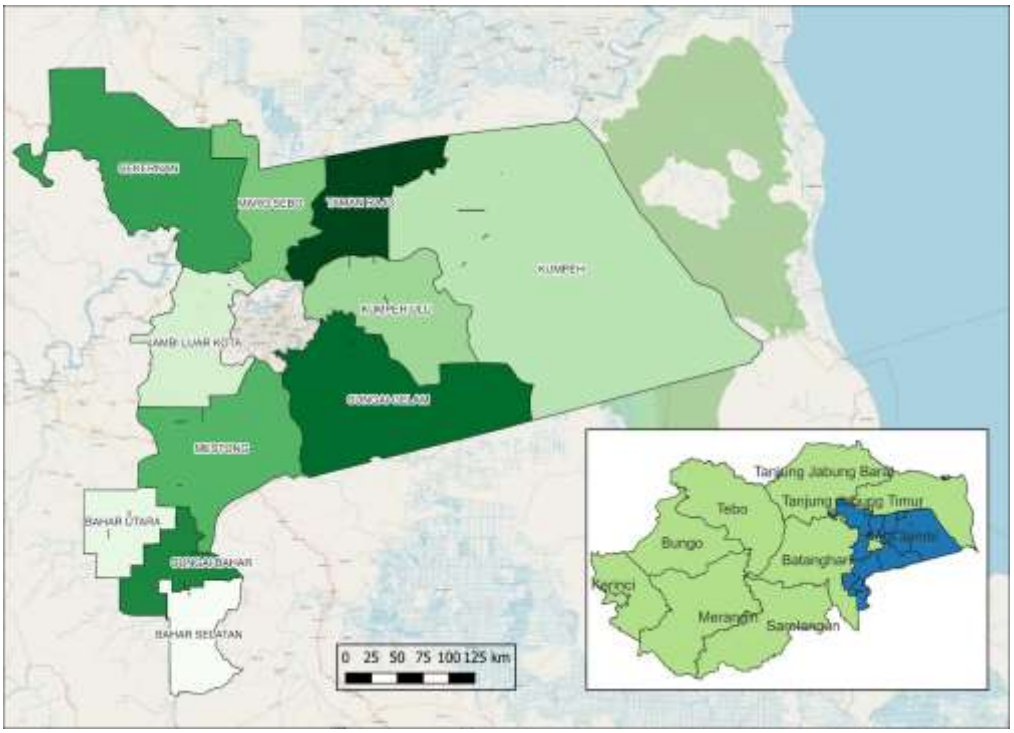


Figure 1. The Muaro Jambi Regency area

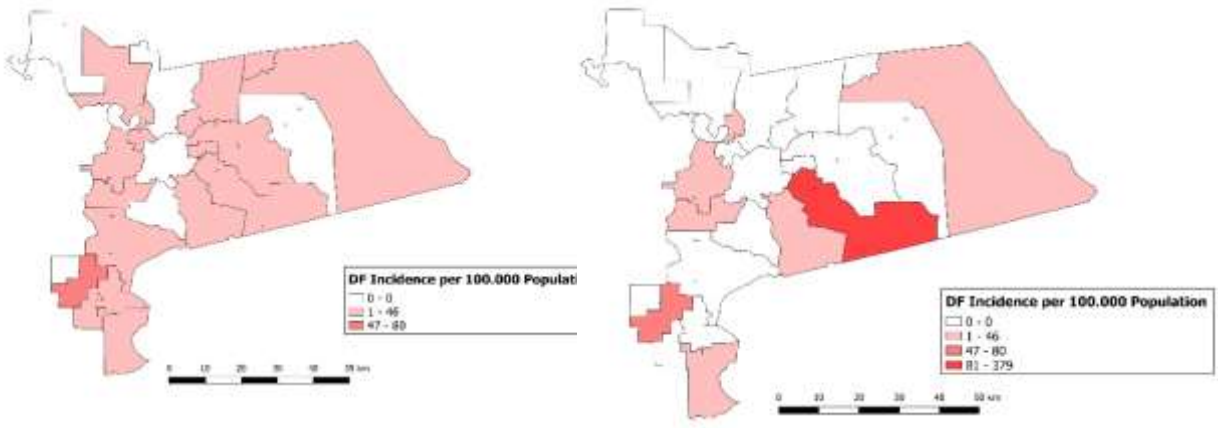
Data Sources

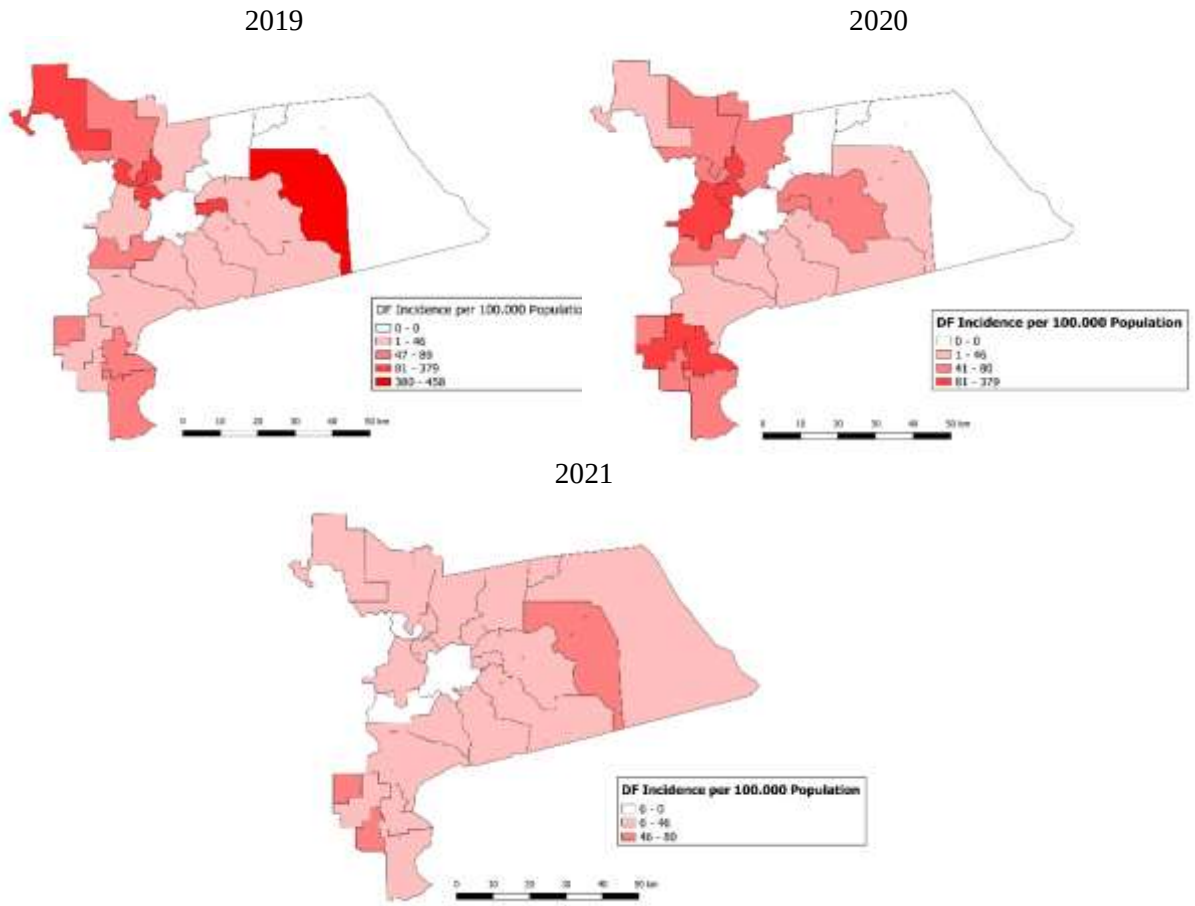
The DHF cases analyzed in this study are case data recorded at the surveillance section of the Muaro Jambi Regency Health Office from 2017-2021.

RESULTS

The area of distribution of DHF cases in Muaro Jambi Regency in 2017-2021 varies by region. During the last 4 years, dengue cases have increased. The highest peak of DHF cases is in 2020. The darker color on the map below shows a higher incidence rate. The following is a picture of the distribution of dengue cases in Muaro Jambi Regency from 2017 to 2021:

2017 2018





In Figure 2 it can be seen that in 2017 the incidence rate (IR) was 47-80 per 100,000 population in the Bahar Utara District area in the Working Area of the Markanding Public Health Center. In 2018, apart from the Working Area of the Markanding Public Health Center, there was an addition with IR 81-379 in the Working Area of the Tangkit Public Health Center, Sungai Gelam District. From 2019 to 2020, the area will continue to expand with high IR categories ranging from 81 to 458 per 100,000 population spread across the Sekernan, Kumpeh, Jambi Luar Kota, Kumpeh Ulu and Bahar VII districts. However, in 2021 the regions with high IR categories experience a decline. There are two public health center that still have an IR above 46 per 100.000 population.

Spatial Distribution Pattern Maps

Global Moran's Index

Spatial autocorrelation analysis with the moran index test (Moran's I test) is used to see and know globally the pattern of distribution of DHF IR annually in Muaro Jambi Regency. In this study the spatial weighting matrix (a matrix that describes the strength of the interaction of DHF cases between public health center), namely the neighborly weighting matrix to calculate the Moran Index value using the Queen Contiguity method, where a public health center is said to be a neighbor if the corners and sides of the boundaries of the public health center based on the map of the administrative area are public health center touch each other.

Table 1.
Pattern of Distribution of DHF IR in Muaro Jambi Regency in 2017-2021

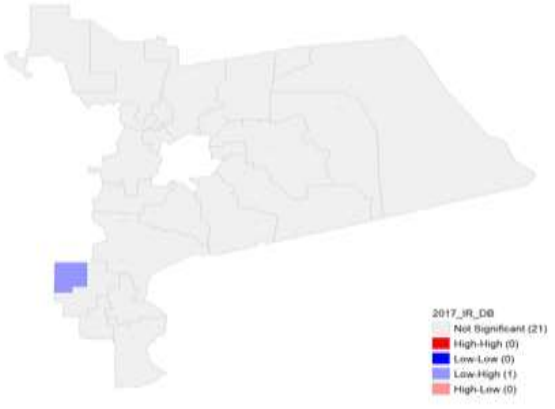
Year	Moran's Index	E[I]	P value	Distribution Pattern
2017	-0.400	-0.0476	0.001	Dispered
2018	-0.277	-0.0476	0.006	Dispered
2019	-0.139	-0.0476	0.243	Not significant
2020	0.228	-0.0476	0.060	Not significant
2021	0.101	-0.0476	0.183	Not Significant

Table 1. above shows the results of the global autocorrelation test for the Moran Index values in 2017 and 2018 respectively of -0.400 and -0.277. It can be concluded that DHF cases in Muaro Jambi Regency in 2017 and 2018 had a spreading pattern. Theoretically, Moran's index values range from -1 to 1. A negative value indicates a negative autocorrelation or a dispersed pattern, a positive value indicates a positive autocorrelation or a clustered distribution pattern. In 2019 to 2021 the results of the analysis show no significant.

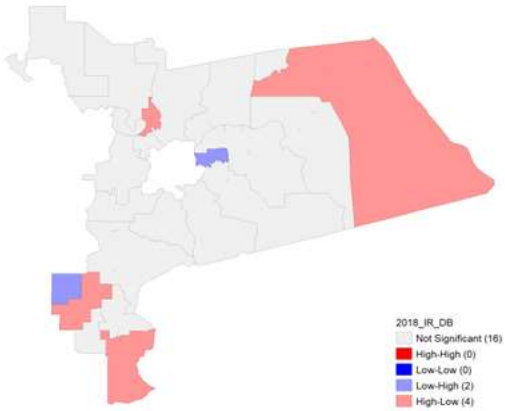
Local Indicator for Spatial Autocorrelation

Local Autocorrelation analysis uses the Local Indicator of Spatial Autocorrelation (LISA) test which aims to produce clustering based on area identification and finding patterns of spatial relationships based on local areas. The LISA index value is a local indicator value from spatial association which is useful for detecting hotspots or coldspots (Fatati et al., 2017). The results of the local spatial autocorrelation analysis are as follows:

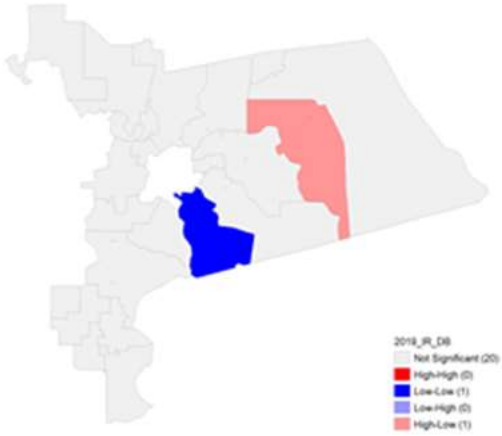
2017



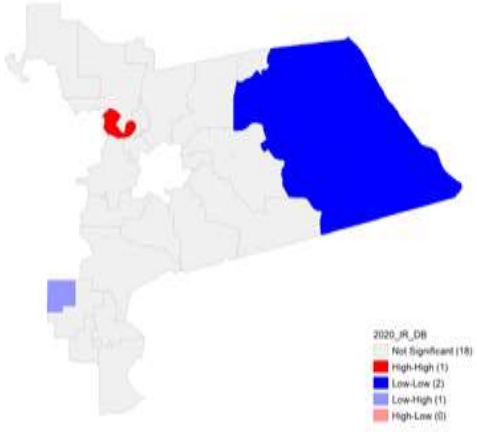
2018



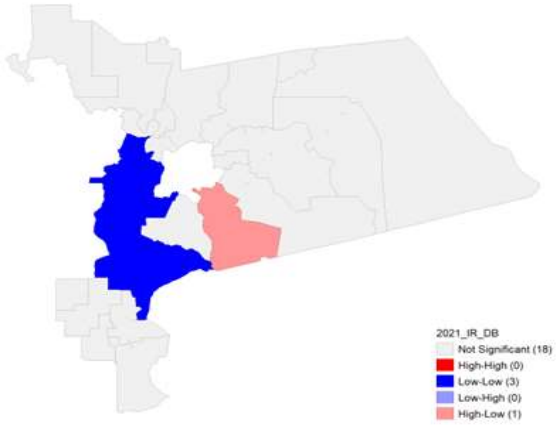
2019



2020



2021



The relationship pattern of DHF cases between the working areas of the public health center in Muaro Jambi Regency was identified into 4 groups, namely as follows:

a. The working areas of public health centers with high DHF IR are surrounded by the working areas of public health centers with high IR cases of DHF. On the map is the working area of the community health center in bright red, identified as the working area of the public health center category HH (High-High) referred to as the Hot Spot area for DHF cases found in 2020, namely the Tantan community health center.

b. The working areas of public health centers with low IR cases of DHF but are surrounded by the working areas of public health centers with high IR cases of DHF. On the map is the work area of the community health center in faded blue, identified as the work area of the community health center category LH (Low-High). This area is at risk or prone to contracting dengue cases from its neighboring area which was discovered in 2017, namely the Talang Bukit Community Health Center. In 2018, namely the Talang Bukit community health center and the Kasang Pudak community health center. In 2020 it was discovered namely the Talang Bukit Community Health Center.

c. The working area of the public health center with Low IR cases of DHF is surrounded by the working area of the public health center with a low number of DHF cases. On the map is the working area of the community health center in bright blue, identified as the working area of the LL (Low-Low) category public health center which is a Cold Spot area discovered in 2019, namely the Kebon IX community health center. In 2020 it was discovered, namely the Tanjung Community Health Center. In 2021 it was found namely the Tempino Community Health Center.

d. The working areas of public health centers with high DHF case IRs are surrounded by the working areas of community health centers with low DHF case IRs. On the map is the work area of the community health center in faded red, identified as the work area of the community health center category HL (High-Low), namely the work area of the community health center that has the potential to transmit dengue fever cases to the work area of the neighboring public health center. Found in 2018, namely the Tanjung community health center, the Sekernan Ilir community health center, the Merkanding community health center and the Sungai Bahar VII community health center. In 2019 it was discovered, namely the Pudding Community Health Center. In 2021 it was found, namely the Kebon IX Community Health Center. of TB in Muaro Jambi Regency.

DISCUSSION

Muaro Jambi Regency is one of the DHF endemic areas in Jambi Province with the highest IR report after Jambi Municipality. Areas that are still endemic for DHF are areas bordering Jambi Municipality. The results of the study show that DHF IR from 2017 to 2020 continues to increase, IR will decrease in 2021 possibly due to a lack of records as a result of reduced public visits to health services during the COVID-19 pandemic. The spike in cases in Muaro Jambi Regency from 2017 to 2020 is almost the same as the spike in cases that have occurred in other regions in Indonesia such as the City of Semarang, Southeast Sulawesi and the City of Tasikmalaya (Alfiyanti & Siwiendrayant, 2021; Fuadzy et al., 2021; Masluhiya et al., 2021). In the regional aspect, Muaro Jambi Regency is located around Jambi City and is a buffer district of Jambi City. There was a mobilization of Jambi City residents who worked a lot to Muaro Jambi in the morning and returned to Jambi City in the evening. The regional and population characteristics of Muaro Jambi are almost the same as Jambi City. Apart from that, in terms of environment, Muaro Jambi Regency also has a supportive environment where it is also a sub-urban area or suburban area which is dominated by many new settlements and also areas that are located on the banks of the Batang Hari river which will result in the development of mosquito vectors and the transmission of transmission. Dengue fever will be high (Khairunisa et al., 2017).

Understanding the pattern of distribution of cases both spatially and temporally is very important in efforts to control and prevent dengue cases (Fauzi et al., 2022). The Moran Index analysis in this study was to determine the autocorrelation of DHF cases, while the LISA analysis aimed to determine the hotspots and cold spots of cases. The results of this study found that from 2017 to 2018 the pattern of distribution of DHF cases in Muaro Jambi Regency was spread, while from 2019 to 2021 the results of the analysis showed no significance. The pattern of DHF dispersed from 2017 to 2018 was not in line with previous studies which found a positive autocorrelation (clustered) of DHF cases (do Carmo et al., 2020; Masrani et al., 2022; Murdaningsih Pangestuty et al., 2020; Pasaribu et al., 2021; Zhu et al., 2019). This is possibly due to the input dataset being below 30 which theoretically can cause inaccurate analysis results (ESRI, 2021). The results of the analysis that show DHF data are spreading need to be read carefully. In 2019 to 2021 it is also possible that the results will be the same, not significant because the input dataset is below the standard set theoretically.

Further analysis using the local Moran's Index or LISA found that in 2020 there were hotspots of DHF cases at the Tantan Community Health Center, and in 2019 and 2020 there were cold spots areas respectively at the Kebon IX Community Health Center and the Tanjung Community Health Center. The results of the analysis using LISA are in line with the results of another study in Nakhon Si Thammarat Province, Thailand where statistically significant spatial clusters of dengue fever cases were observed in all provinces in different years. Nabon was identified as a hotspot, whereas Pak Phanang was a coldspot for dengue fever, explained by the fact that the former is a center for rubber plantations, while the latter's agricultural plains are suitable for the practice of fish farming combined with rice farming (Thammarat et al., 2021).

Areas identified as hotspots need special and immediate treatment so that the number of cases of dengue fever can be suppressed and it does not spread to surrounding areas. Efforts that can be made are active case surveillance activities. Public health centers in this area must receive special attention from vector surveillance in an effort to eradicate cases and break the chain of transmission by thoroughly and continuously controlling vectors from eggs to adult mosquitoes. Knowing the public health center as a hotspot for dengue fever cases can assist

public health policy makers in estimating high-risk areas and carrying out direct control so as to prevent the spread of cases to the working areas of the surrounding public health centers. Knowing the area of potential cases is a primary prevention effort in larva survey activities in vector surveillance activities. Community empowerment can be utilized for this activity in addition to the 1 house 1 jumantik program that has been implemented. Innovation in developing and empowering community activities to intensify efforts to eradicate dengue vectors continuously such as forming Dengue Fever care groups at the RT/RW level and in schools with the concept of being free of dengue fever by completely eradicating larvae and mosquitoes. Efforts to control and eradicate dengue fever must be supported by the active participation of the community to minimize the impact of future dengue fever outbreaks. This study has limitations because the aggregate analyzed is the working area of the community health center, which totals 22 puskesmas. Based on the existing literature, a minimum of 30 features as input class features that can be analyzed using the Moran'n Index test, so that the resulting analysis results need to be examined in depth.

CONCLUSION

This study found that in 2017 and 2018 the pattern of distribution of DHF cases is spread , while in 2019 to 2021 the results of the analysis show that it is not significant. The results of the analysis using LISA found spatial autocorrelation of DHF cases in the High-High category (hotspots) in 2020 at the Tantan 1 Public Health Center. Areas with the Low-Low category (cold spots) in 2019 were found at the Kebon IX Public Health Center, and in 2021 at the Tempino Public Health Center.

ACKNOWLEDGMENTS

Special thanks to the Head of the Provincial Health Office and the staff who have helped and provided data so this research can be carried out.

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