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Spatial Analysis of Dengue Dengue Fever Manado City and Analysis of Efforts to Control Dengue Dengue Fever Before and During Covid-19 in Malalayang District

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Abstract

Cases of dengue hemorrhagic fever (DHF) are still fluctuating in Manado City. The spread of cases is almost scattered in all regions, the option for prevention is to control and monitor vectors by focusing on localization. The purpose of this study was to analyze the spatial analysis of dengue fever in Manado City and to analyze efforts to control dengue hemorrhagic fever vectors before and during the COVID-19 period in Malalayang District. This type of research is analytic observational with a cross-sectional design. The research sample uses regional samples and purposive sampling. The data of the Manado City DHF case was spatialized and the respondents were 100 houses, a larva density survey was conducted. Data analysis used spatial analysis using Avarage Nearest Neighbor (ANN) and chi square test. The results showed that the map of the distribution of cases in clusters with z-score = -25.774403 < -2.58 years (2019), and -9.902023 < -2.58 years (2020). Implementation of larva survey with HI 22%, CI 14.53%, BI 25% and ABJ 78%. There is a relationship between the presence of larvae and the incidence of DHF with p value = 0.000. Recommendations to related parties are to intensify efforts to control vectors, establish partnerships between the community and the government and seek community participation in tackling DHF through independent and regular activities. Keywords: Dengue Hemorrhagic Fever, vector control program, fogging, PSN 3M plus.

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INTRODUCTION

One of the viral infectious diseases which is a world health problem and is transmitted through the most common mosquito vector spread in most tropical and subtropical regions is dengue hemorrhagic fever. Dengue Hemorrhagic Fever (DHF) is an acute disease caused by dengue virus infection which is transmitted by female Aedes aegypti and Aedes albopictus mosquitoes. The incidence of dengue fever has increased dramatically worldwide over the last decade. The actual number of dengue cases is often underestimated, and many cases are misclassified as dengue. In Southeast Asia, the burden of dengue is comparable to that of meningitis, but the burden of dengue fever is twice as high as hepatitis and one-third greater than the risk of HIV/AIDS [1]. Indonesia is a tropical country with high humidity. which triggers the Aedes aegypti mosquito which is the vector for dengue fever to breed [2].

There were 138,127 cases of dengue fever reported in 2019. This number increased compared to 2018 of 65,602 cases. Deaths due to DHF in 2019 also increased compared to 2018 from 467 to 919 deaths. The Ministry of Health sets one of the indicators in the 2015-2019 Strategic Plan, namely the percentage of districts/cities that have an IR of DHF < 49 per 100,000 population and a high CFR if it exceeds 1% (Kemenkes RI, 2019). Of the 514 districts and cities in Indonesia, there are 320 districts and cities (62.26%) that have reached IR DHF < 49/100,000 population.

North Sulawesi Province is ranked 6th which has a higher IR than 34 other provinces, which is <94.97 per 100,000 population and CFR is above 1%, which is 1.13. (Ministry of Health RI, 2019). Dengue fever has spread widely to all regions in North Sulawesi Province. The incidence of dengue hemorrhagic fever in North Sulawesi Province varies between regions. Dengue Hemorrhagic Fever (DHF) in the last 5 years continues to attack North Sulawesi. According to data from the North Sulawesi Provincial Health Office, a total of 6,130 cases have occurred, with the number of deaths reaching 74 people. The highest number of dengue cases in the last 5 years occurred in 2016, there were 2,217 cases. Had decreased in 2017 to 587 cases, dengue cases increased again in 2018, a total of 1,713 cases occurred. 2018 also recorded the highest number of deaths, namely 24 people.

Based on these data, Manado City is one of the areas in North Sulawesi Province that is endemic for Dengue Hemorrhagic Fever (DHF) which fluctuates from year to year both in terms of the number of sufferers and the death rate. (North Sulawesi Provincial Health Office, 2018). At the beginning of 2019 an extraordinary event occurred in the city of Manado, dengue had attacked 24 people, 3 of whom died (Ministry of Health RI, 2019) [3].

Manado City is one of the areas in North Sulawesi Province which is endemic for Dengue Hemorrhagic Fever (DHF) which fluctuates from year to year both in terms of the number of sufferers and the morbidity rate. According to data from the Manado City Health Office, in 2015 there were 446 cases of dengue fever and 6 of them died, in 2016 there were 567 cases and 6 of them died, in 2017 there were 139 cases and no one died and in 2018 there were recorded 294 cases (Manado City Health Office, 2019).

Dengue hemorrhagic fever cases are the biggest concern in 2020, because normally the peak incidence of dengue fever is in March and April, but cases continue to increase until June. Especially at the end of 2019 until the beginning of 2020, the whole world was shocked by the presence of a dangerous virus, namely the corona virus disease or covid-19. The number of confirmed COVID-19 cases as of July 8, 2020 is 68,079. Meanwhile, data from the Ministry of Health of the Republic of Indonesia in July 2020, there were 71,633 cases of dengue hemorrhagic fever throughout Indonesia. This is what the public and government pay attention to in preventing dengue hemorrhagic fever (DHF). The COVID-19 pandemic has had an impact on efforts to prevent dengue hemorrhagic fever. Research Olive stated that the Covid-19 lockdown in France caused the vector control process to be minimized [4].

Efforts to eradicate dengue are mobilizing the community to participate in PSN (the 3M Plus movement, namely draining, closing, burying and giving abate), ABJ monitoring and house management. Dengue hemorrhagic fever control requires complete and accurate information, such as a thematic map showing the main locations, patterns and distribution of cases. Spatial analysis provides information on the distribution of DHF cases in certain areas, thus helping in determining effective and efficient DHF control measures [5].

Methods

The type of research used is an observational research method with a cross-sectional design research design. Geographic Information System (GIS) through spatial analysis to get an overview of the spatial distribution of DHF cases. The purpose of this study was to analyze the spatial incidence of DHF and analyze the

DHF program before and during the Covid-19 period in Manado City. Research Time October 2021-January 2022. Research location in Manado City, Malalayang District. The population in this study were all cases of DHF in 2019-2020 in Manado City and all households in Malalayang District with a total of 16,913. The sample in the study was 100 houses. Data collection using GPS for taking coordinates, distributing questionnaires, and surveying larvae visually. Data processing uses Quantum GIS software version 3.1, ArcGIs version 2.5 to manage spatial data and SPSS version 25 application for chi square test.

Results and Discussion

Spatial Analysis

Table 1. *Number of DBD Incidents and Incidents of Manado City DBD Rate By Subdistrict*

District	DHF Cases		IR	
	2019	2020	2019	2020
Malalayang	112	29	206	47
Sario	32	17	162	72
Wanea	102	13	138	22
Wenang	55	7	194	21
Tikala	38	4	140	13
Paal Dua	47	11	121	25
Mapanget	105	17	180	27
Singkil	53	7	110	14
Tuminting	37	14	73	26
Bunaken	10	2	47	8
Bunaken Kepulauan	0	0	0	0

Source: Primary Data, 2021

Based on table 1, the incidence of dengue fever in Manado City still fluctuates every year, the highest incidence of dengue fever in 2019 and 2020 is Malalayang District. The lowest case of dengue fever is the Bunaken Islands area which has no cases of DHF or 0 sufferers.

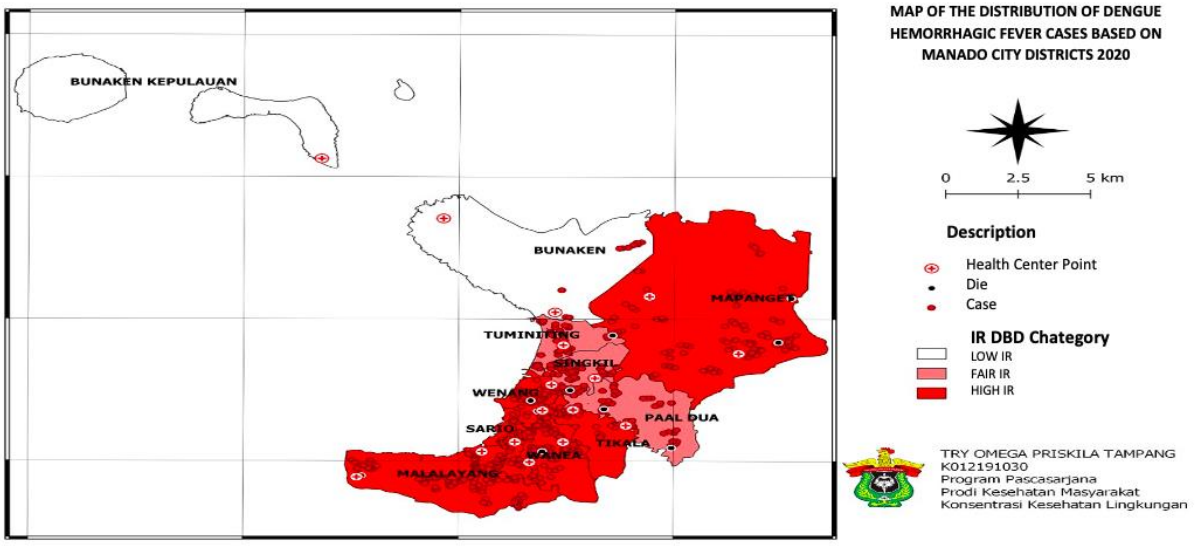

Figure 1. *Map of the spread of Dengue Hemorrhagic Fever disease based on the point of sufferers in Manado City in 2019*

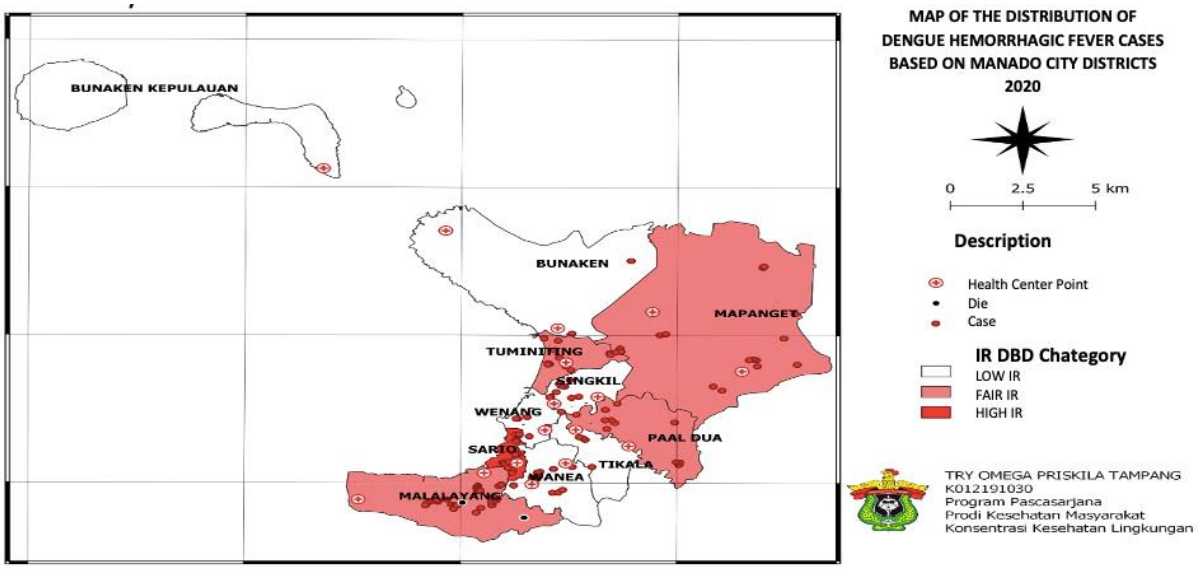

Figure 2. *Map of the distribution of Dengue Hemorrhagic Fever based on the point of sufferers in Manado City in 2020*

The pattern of the spread of dengue fever is known by calculating the Avarage Nearest Neighbor (ANN) index obtained through the ArcGIS software and the results are as follows:

Table 2. *Results of Spatial Analysis of Avarage Nearest Neighbor (ANN) Distribution Patterns*

Parameters	**Year**	
	2019	**2020**
Area Area(km^2)	162,53	162,53
Number of Case points	591	121
Observed Mean Distance	100.98 Meters	272.27 Meters
Nearest Neighbor Ratio *(NNR)*	0.447669	0.529456
z-score	-25.774403	-9.902023
p-value	0.000000	0.000000

Source: Primary Data, 2021

Based on the table, the ANN value of DBD events from 2018-2020 has increased. Nlaii ANN from 2018-2020 is below the number 1 which means that the pattern of spreading DBD events in Manado City is patterned cluster or group.

Flick Density

Table 3. *Distribution of Number of Houses found to be Lartic Positive*

Flick Positive House	(n)	(%)
Not	78	78.0
Yes	22	22.0
Total	100	100.0

Source: Primary Data, 2021

Based on table 15, the results showed that 22 (22%) houses found larvae and 78 (78%) houses that were not larvae positive were surveyed.

Table 4. *Distribution of Characteristics by Type of Container*

Container Type	(n)	(%)
Bathtub	17	9.9%
Bucket	81	47.1%
Used Tires	2	1.2%
Drum	29	16.9%
Dispenser Shelter	17	9.9%
The pond has no fish.	2	1.2%
Washbasin	24	14%
Total	172	100%

Source: Primary Data, 2021

Based on table 17, the most containers are 81 buckets (47.1%) and the least ponds with no fish 2 (1.2%).

Table 5. *Distribution of the number of positive containers flick*

Flick Positive Container	(n)	(%)
Exist	25	14.5
Not	147	85.5
Total	172	100.0

Source: Primary Data, 2021

It can be seen that based on the table 16, that of the 172 inspected containers, it was found that 25 (14.5%) were larvae positive and 147 (85.5%).

Table 6. *Distribution by Container Cover*

Close Container	**(n)**	**(%)**
Exist	91	52.9%
None	81	47.1%
Total	172	100%

Source: Primary Data, 2021

It can be seen based on table 18, that of the 172 containers inspected, it was found that 91 containers or 52.9% were wearing lids or using lids and 81 containers or 47.1% were not wearing lids.

Table 7. *Distribution by Container Location*

Container Location	**(n)**	**(%)**
Deep	94	54.7
Outside	78	45.3
Total	172	100.0

Source: Primary Data, 2021

It can be seen based on table 19, that of the 172 containers inspected, 94 (54.7%) were inside thehouse and 78 (45.3) were outside the house.

Table 8. *Density Figures in Malalayang District, Manado City*

Indicator	%	*Density figure* (DF)
House Index (HI)	22%	4
Container Index (CI)	14,53%	4
Breteau Index (BI)	25%	4

Source: Primary Data, 2021

The mosquito population density (density figure) was obtained from the combination of HI, CI, and BI. Category determination DF = 1 (low density), DF = 2-5 = (medium density), DF = 6-9 (high density). Table is the result of the calculation of entomological indicators. The HI value of 22% is on the DF4 scale, the CI value of 14.53% is on the DF 4 scale, and the BI value of 25% is on the DF 4 scale.

The larva free rate (ABJ) was obtained from the percentage of the number of negative dwellings with larvae per the number of dwellings surveyed. ABJ calculations in this study:

ABJ =(Number of larval negative houses)/(Number of houses observed) ×100%

ABJ=78/100 ×100% =78% ABJ is calculated to find out how many houses are free from mosquito larvae. ABJ was reported to be high if no larvae were found in the study area, and also low when many larvae were found. ABJ is an indicator of the success of fogging and early prevention of DHF. The ABJ value in this study was 78%, this value is less than the standard of the Minister of Health Regulation No. 50 concerning environmental health quality standards which stipulates the standard ABJ value of 95%. The lower the ABJ value, the higher the spread of DHF in an area.

Bivariate Analysis

Table 9. *Cross-tabulation between the presence of a flick and the occurrence of DBD*

Flick Positive House	Dbd Positive		Total	**Value *p***
	Positive	Negative		
Yes	22	0	22	0,000
	75.9%	0.0%	22.0%	
Not	7	71	78	
	24.1%	100.0%	78.0%	
Total	29	29	100	
	100.0%	100.0%	100.0%	

Samples with positive DHF were found to be positive for larvae as many as 22, (75%) while samples that were negative for DHF were not found to be larvae, namely 71 (100%). The results of the statistical test between the presence of larvae and DHF showed a p value of 0.0001. The results obtained showed that the incidence of DHF per sub-district in Manado City was still fluctuating, there were still some sub-districts that had IR numbers of DHF that were above the national IR figures. This is due to the environmental conditions of the community who have water reservoirs in the yard of the house which can be a source of mosquito breeding. As Song research, [6] there is a relationship between the number of water reservoirs (TPA) and the presence of larvae, because the more landfills there are, the greater the opportunity for mosquitoes to breed in the landfill.

Cases of Dengue Hemorrhagic Fever in Manado City in 2019 tended to increase compared to 2018, and in 2020 there was a decrease in cases. The results of direct interviews by researchers with surveillance officers at the Manado City Health Office in 2020, especially with the presence of Covid-19 cases, health workers focused on dealing with the Covid-19 problem, coupled with the WFH (Work From Home) Program so that other officers had to work from home. , then there is a possibility that cases of dengue fever were not well reported. In line with research [4] following the COVID-19 crisis and lockdown, vector control interventions were minimized in all French foreign departments, social mobilization campaigns were postponed, and preventive insecticide spraying was restricted, especially in private spaces (indoor and peridomestic spraying).

The results of the analysis of the Average Nearest Neighbor (ANN) in Manado City in this study showed a clustering distribution pattern (table 2). From the number of cases in 2019-2020, Malalayang District has the largest distribution of cases. Malalayang District is an area with a dense population density of 3446.04 Km2. Malalayang District is one of the areas in Manado City Center which shows the distance between houses that are close together, the presence of shops, terminals, and hospitals. Research conducted by Yuli and Yana states that the existence of public places can be a potential for transmission of dengue disease [7].

The pattern of DHF transmission that occurs in various places in the world shows a spatial autocorrelation. Hambali's research in Gorontalo with the incidence of 138 DHF has a spatial pattern, stating that areas with clustered distribution patterns indicate areas that are prone to dengue hemorrhagic fever [8]. The distribution of dengue cases in Seksyen 7 Shah Alam, Malaysia, also shows a spatial autocorrelation with the clustered category [9]. It is different from the research in Lumajang Regency, in Madurai City, India which includes a dispersed distribution pattern.

Determination of areas that are susceptible to dengue can be based on the pattern of transmission of dengue which is influenced by the behavior of the vector mosquito. Therefore, in determining vector control strategies, it is necessary to map dengue cases using a geographic information system. An intelligent solution that can be done to analyze the severity of a location against the incidence of dengue is by using a computer application. As has been done by the Pekanbaru City Health Office in developing a DHF monitoring system, using a web-based system. In addition to assisting in reporting DHF, the web-based monitoring system also makes it easier for the health department to determine areas based on the level of DHF vulnerability, such as endemic, sporadic and free of DHF (Novita R, 2015). Spatial mapping is not only able to present the distribution of DHF cases, but can also map risk factors related to DHF such as the presence of larvae and environmental conditions of breeding habits [7].

DHF cases are often found, especially in the tropics and often cause extraordinary events (KLB). The DHF vector density indicators include the House Index (HI), Breteau Index (BI), Container Index (CI) and Larval Free Rate (ABJ) which are constants where it is determined whether the area has a tendency for dengue hemorrhagic fever to occur every year

or not. In this study, the House Index (HI), Breteau Index (BI), Container Index (CI) were at moderate levels, in line with research in Mamuju, in contrast to the research in the Makassar Daya Market, it is in the high density category.

The characteristics of water reservoirs (TPA) in Malalayang District are different. Based on the existing frequency distribution table, there are several types of landfill used by the community including buckets, drums, bathtubs, basins, and others. The frequency of using TPA in the community of Malalayang District, Manado City is buckets, drums and basins. The bucket is the most widely used container by the community. This research is in line with Murni's research in Mamuju Regency, the most commonly found containers are buckets. Research in Perwitasari Timur Halmahera Regency in 2018, Central Jakarta Astuti in 2016, the dominant community used buckets. Prasetyowati's research in 2018 using bucket-type containers is at risk for dengue fever [10].

People replace the tub with a bucket, the reason is more practical, more efficient and does not require a large area. People also use buckets, basins and drums as a place to store large amounts of water as a reserve, due to limited water. The habit of people who collect water for daily needs can be an opportunity for ae. agypti ventors to breed in these places.

The use of lids on containers/landfills correctly has a significant impact in reducing the presence of Aedes mosquito larvae and pupae compared to containers/landfills without the use of covers. (Ministry of Health RI, 2013). In the study, it was found that 52.9% of containers had lids and 47.1% of containers that did not have lids. In Utomo's research in 2017, most of the respondents closed the water reservoirs tightly. Water reservoirs that are not tightly closed and rarely cleaned can serve as a breeding ground for Ae. aeypti mosquitoes. In addition, research conducted Aniq one of the causes of containers with lids still having Ae. aegypti larvae is caused by the behavior of residents or the community who often forget to close the container again after opening, besides shows that there is a significant relationship with p value of 0.041 between closing the container and the presence of larvae [11].

The importance of the availability of a cover at the TPA is absolutely necessary to suppress the number of mosquitoes that land on the TPA, where the TPA is a breeding ground for Ae mosquitoes. aegypti. When all people realize the importance of covering the landfill, it is hoped that the presence of mosquitoes can be eradicated.

Suitable breeding places for Ae. aegypti larvae are water reservoirs inside or outside the house. The results of the frequency distribution of container locations from this study were 94 (54.7%) inside the house and 78 (45.3%) outside the house. According to the Indonesian Ministry of Health (2005), Ae. aegypti mosquito larvae are commonly found in containers inside houses. This is due to the habit of people who like to collect water for daily needs in houses that are not closed, the atmosphere is dark and humid and hidden in houses or buildings that are protected from the sun and so this place will attract adult mosquitoes to lay their eggs in addition to That is if the community does not have time to drain water reservoirs regularly once a week so that these water reservoirs have the potential to become mosquito breeding places.

Research in Baranangsiang showed that the location of the container in the house was more than 89% and there was a relationship between the location of the container and the presence of larvae [12]. In contrast to Wahab's research , the potential location for breeding mosquitoes is outside the home. The container is inside the house or outside the house, if it is not cleaned often it will cause larvae in the container, therefore once a week the container is cleaned to reduce the breeding of larvae in the container. The results showed that there was a relationship between the presence of larvae and Dengue Fever. A study conducted in Sawit sub-district in 2018 showed that there was a significant relationship with the incidence of dengue fever [13].

The larva-free rate (ABJ) is calculated to determine the number of houses that are free

from mosquito larvae. The value of HI is 22%, CI 14.53%, BI 25% and ABJ 78%. The ABJ value in this study was 78%, this value is less than the standard of the Minister of Health Regulation No. 50 concerning environmental health quality standards which stipulates the standard ABJ value of 95%. The lower the ABJ value, the higher the spread of DHF in an area.

Limitations of the Research

1. This study is cross-sectional and only investigated for a limited time and was only carried out to show conditions that occurred at the time of the study, maybe changes will occur or have already occurred, considering that the researchers tested the behavior of eradicating mosquitoes in the community and the presence of larvae.

2. In this study, the researchers did not map the larval density in the Malalayang area, nor did they map the implementation of the 3M Plus PSN.

3. In this study, researchers did not identify the types of larvae found in containers, so further research is needed to determine the types of larvae.

Conclusion

Based on the results of the research that has been carried out, it can be concluded that the highest distribution of dengue cases in 2018-2020 is in Malalayang District. The results of the analysis of the Average Nearest Neighbor (ANN) in Manado City in this study indicate that there is a clustering distribution pattern. 5. There is a relationship between larval density and the incidence of dengue hemorrhagic fever with p value = 0.000. The value of HI is 22%, CI 14.53%, BI 25% and ABJ 78%. This figure is still far from the 95% standard. This shows that the Malalayang District, Manado City is classified as having a risk of spreading DHF.

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