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Analysis of Risk Factors for Dengue Hemorrhagic Fever Using a Geospatial Approach in the Telaga Biru Community Health Center

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ABSTRACT: Dengue Hemorrhagic Fever is an acute viral infectious disease caused by the dengue virus which is characterized by fever lasting 2-7 days accompanied by manifestations of bleeding, decreased platelets (thrombocytopenia), hemoconcentration characterized by plasma leakage (increased hematocrit, ascites, pleural effusion, hypoalbuminemia). This study aims to analyze the risk factors for dengue fever in the Telaga Biru Community Health Center area using a geospatial approach. This type of analytical observational research with a matched case control research design according to place of residence. The research sample consisted of 116 respondents, 58 dengue cases and 58 as controls. The sampling technique is total sampling. Primary data collection was carried out by interviewing cases and controls. Retrieving the coordinates of the residence of dengue fever sufferers in the Telaga Biru Health Center working area was carried out using the GPS Logger application. Data analysis uses bivariate and spatial analysis. The results of the study used the Fisher's Exact Test and showed that the characteristics of respondents aged < 15 years had a risk of 50.9%, which means there was a relationship between age characteristics and the incidence of dengue fever (ρ = 0.000) phi < 0.05, low education had a risk of 54.3% and there is a relationship between educational characteristics and the incidence of dengue fever (ρ=0.000) phi < 0.05, not working is 80.2% more at risk of dengue fever, but there is no relationship between job characteristics (ρ=0.103) > 0.05, spatial analysis (ρ= 0.056) with the incidence of dengue fever in the Telaga Biru Community Health Center area. The conclusion is that the characteristics of age and education are related to the incidence of dengue fever in the Telaga Biru Community Health Center area, while employment and based on spatial analysis there is no relationship between residential density and the incidence of dengue fever with a value of ρ= 0.056 and there is a clustered pattern with an NNI of 0.34.

KEYWORDS: DHF, Risk factors, Spatial, Mapping.

I. INTRODUCTION

Science and technology are not only impacts caused by developments over time, but also environmental health problems that can make a major contribution to developments over time. Environmental health is one of the determinants of population welfare. The environment is one of the factors that influences the spread of various diseases. One of the diseases caused by environmental conditions that do not meet the requirements is Dengue Hemorrhagic Fever (DHF).

Dengue Hemorrhagic Fever is an acute viral infectious disease caused by the dengue virus which is characterized by fever lasting 2-7 days accompanied by manifestations of bleeding, decreased platelets (thrombocytopenia), hemoconcentration characterized by plasma leakage (increased hematocrit, ascites, pleural effusion, hypoalbuminemia). It can be accompanied by atypical symptoms such as headaches, muscle and bone pain, skin rashes or pain behind the eyeballs (Ministry of Health of the Republic of Indonesia, 2017).

The spread of vector-borne diseases, including Dengue Hemorrhagic Fever (DHF), is closely related to population density, mobility, knowledge, attitudes, behavior and community participation as well as climate conditions. Other factors that may have an influence include the problem of poor environmental management, resulting in high breeding habitat for mosquitoes that transmit dengue fever (Ministry of Health of the Republic of Indonesia, 2017). Based on The World Mosquito Program , a global community that aims to protect the world from the threat of mosquito-borne diseases , it is estimated that 40% of the world's population is at risk of dengue virus infection and as many as 390 million people in the world are infected with the dengue virus every year.

In 2020, the number of dengue fever cases in Indonesia was recorded at 108,303 cases with 747 people dying (IR = 49 per 100,000 population). This number experienced a drastic decrease in 2021, which recorded 51,048 cases and 472 people died (IR = 78.85

per 100,000 population. Throughout 2017, the Directorate General of Disease Prevention and Control (DITJEN P2P) of the Indonesian Ministry of Health also reported that Most provinces in Indonesia experienced a reduction in the DHF incidence rate (Incidence Rate) in accordance with the target of the 2015-2019 Strategic Plan (Renstra), namely less than 49 per 100,000 population. This was due to the implementation of the DHF prevention and control program through the "1 House Movement" activity. 1 Jumantik" which has been running quite effectively even though it has not yet been implemented in all provinces and districts/cities (Ministry of Health of the Republic of Indonesia, 2018).

The development of dengue fever cases in Gorontalo Province also has a trend in the morbidity rate (IR) which has decreased significantly, as evidenced by data in 2020, 954 cases of dengue fever were reported, where the morbidity rate or IR incidence rate was 103.87 - 100,000 pddk and the mortality rate or case fatality rate. Rate (CFR) 0.83, in 2021 there will be 423 cases IR 83.04 per 100,000 people , however the CFR has doubled from the previous year, namely 3.73%, so dengue fever is still a serious problem in Gorontalo Province because historically 6 districts/cities in the Gorontalo region have been infected with dengue infections , some of which are endemic areas for dengue (Gorontalo Provincial Health Service, 2020).

Gorontalo Regency is the region in Gorontalo Province with the highest number of dengue fever cases as of 2019, namely 394 cases, IR 104.08 per 100,000 people with a death rate of 6 people or CFR 1.5%, then in 2020-2021 it decreased, where in 2021 there were 350 cases. or IR 89.03 per 100,000 people with a death rate of 4 people or CFR 1.1%, and in 2021 there will be 27 cases or IR 39.93 per 100,000 people, but the number of deaths will increase by 6 people or CFR 3.7%. This condition indicates that the number of dengue fever cases in Gorontalo Regency is fluctuating and tends to increase when compared with other city districts in Gorontalo Province (Gorontalo District Health Service, 2020).

Gorontalo Regency is an endemic area for breeding vector And transmission disease DHF where there are many risk factors that trigger the high number of DHF morbidity in the area, so that per the year often found dengue fever on every subdistrict. Based on report monthly Field Disease Control and Eradication (P2P) Gorontalo District Health Service In 2021 there are 6 sub-districts with a high number of dengue cases (the number of reported cases exceeds 27 cases) which include: Telaga Biru District.

Subdistrict Telaga Biru is divided into 15 villages with one Puskesmas (Primary Health) unit Care Centers), namely the Telaga Biru Community Health Center. The prevalence of dengue fever in Telaga Biru District is a disease that has the largest contribution every year compared to other sub-districts in Gorontalo Regency. The Telaga Biru Community Health Center area has 8 villages where dengue fever is endemic, where in 2019 the number 24 cases (IR) 85.95 per 100,000 pddk with a CFR figure of 0%, in 2020 the number of cases increased to 28 cases (IR) 96.78 per 100,000 pddk with a CFR figure of 3.57% and in 2021 27 cases (IR) 93.32 per 100,000 pdd with a fairly high CFR of 7.41% (Telaga Biru Health Center Profile 2021).

The working area of the Telaga Biru Community Health Center is in the urban community health center category so that the community is usually said to have a fairly high level of education, however, regarding the prevention and handling of dengue fever cases in this area, the community still thinks that one way to prevent and control dengue fever cases is only by fumigation or fogging focus . , so that community characteristics can influence the incidence of dengue fever in the area.

Transmission disease dengue fever caused by a number of factor risk between other is replacement climate, factor environment, urbanization, mobility population and population density (Ministry of Health of the Republic of Indonesia, 2017). Meanwhile, according to Novrita et al (2017) provide a deeper explanation of the characteristics and patient behavior as risk factors such as age, gender, knowledge, occupation, use of wire mesh, draining water reservoirs (TPA) and health services.

The use of spatial maps will help the Telaga Biru Community Health Center to predict the location of areas vulnerable to dengue fever. Spatial maps can detect dengue-vulnerable areas, especially in densely populated areas such as the Telaga Biru health center working area, where most of the residential areas are very close to one house and another. In fact, spatial maps are not only able to present the distribution of dengue cases, but can also map dengue risk factors such as the presence of larvae and the distance between most Aedes aegypti mosquitoes and environmental conditions such as breeding habits.

Monitoring the spread of dengue fever using spatial data is very important for making decisions in breaking the chain of dengue virus spread and GIS is used as a tool to monitor the extent of the spread of the disease through vector media, environmental conditions, social conditions, health services, and resolving various problems. public health problemChayote juice (*Sechium edule*) is an herbal plant that contains natural antioxidant compounds such as flavonoids, polyphenols, carotenoids, vitamin C, and vitamin E. These natural antioxidants have the benefit of protecting the body against cell damage caused by ROS, being able to lower lipid profiles.[13] Dysplidemia causes oxidative stress as a result of increased cholesterol accumulation triggering the production of reactive oxygen species (ROS) so that antioxidants in the body are reduced.[14] An increase in ROS that exceeds the capacity of antioxidant enzymes in the body will cause an increase in lipid peroxidation which damages proteins, DNA (Deoxy Nucleic Acid), and the cell membranes of the body.[15]

A high-fat diet causes an increase in plasma lipopolysaccharide (LPS) and activates toll-like receptor 4 (TLR4) resulting in increased

levels of pro-inflammatory cytokines such as interleukin-6 (IL-6).[16] Siamese pumpkin can prevent oxidative stress because it can act as an antioxidant, which works directly with the flavonoid content to prevent oxidative stress, thereby reducing tissue damage, reducing oxidative damage, lipid peroxidation, and inflammation.[17,18] Based on the description above, a study was conducted on the effect of giving chayote juice (*Sechium edule*) against the MDA rate and interleukin-6 in mice fed a high-fat diet.

II. MATERIAL AND METHOD

This type of research is observational analytic with a matched case control research design according to place of residence. According to Notoatmodjo (2018), in matched case control research, risk factors are studied using a retrospective approach , namely effects are identified now, then risk factors are identified as having occurred in the past by matching certain variables (matching). The selection of the control group is carried out by selecting from a population that has the same characteristics as the case group but does not have a dependent variable (effect).

III. RESULT

Levels Analysis of the age characteristics of sufferers with the incidence of dengue fever in the Telaga Biru Community Health Center area

Table 1. Distribution of the Relationship between Age Risk Factors and DHF Incidence in Regions Telaga Biru Health Center

Age	Dengue fever incidence				Total		P value phi
	dengue fever		Not dengue fever				
	N	%	N	%	N	%	
> 15 yrs	12	20.3	47	79.7	59	100	0,000
≤ 15 yrs	46	80.7	11	19.3	57	100	
	58	50.0	58	50.0	116	100	

Source: Primary data, 2023

Based on table 1, the age characteristics of respondents can be seen that the age group ≤ 15 years suffering from dengue fever is at greater risk with a number of n 46 (80.7%) compared to those aged > 15 years and suffering from dengue fever with a value of n 12 (20.3%). The results of the Fisher's Exact Test statistical test show that ρ value = 0.000 (ρ < 0.05). Ho is rejected, meaning that there is a relationship between age characteristics and the incidence of dengue fever in the Telaga Biru Health Center area.

Educational characteristics respondents with dengue fever incidents in the Telaga Biru Community Health Center area

Table 2. Distribution of Relationship between Respondents' Education and Risk Factors The incidence of dengue fever in the Telaga Biru Community Health Center area

Education	Dengue fever incidence				Total		ρ valu e Phi
	dengue fever		Not dengue fever				
	n	%	N	%	N	%	
higher education	7	13.2	46	86.8	53	100	0,000
Lower Education	51	81.0	12	19.0	63	100	
	58	50.0	58	50.0	116	100	

Source: Primary data, 2023

Based on table 2, the educational characteristics of respondents can be seen that low education and suffering from dengue fever are more at risk with a number of n 51 (81.0%) compared to high education and suffering with a value of n 7 (13.2%). The results of the Fisher's Exact Test statistical test show that ρ value = 0.000 (ρ < 0.05). Ho is rejected, meaning that there is a relationship between educational characteristics and the incidence of dengue fever in the Telaga Biru Health Center area.

Job characteristics analysis respondents with dengue fever incidents in the region Telaga Biru Health Center

Table 3. Distribution of Factor Relationships Respondents' Occupational Risks with Dengue fever incidence in the region Telaga Biru Health Center

Work	Dengue fever incidence				Total		ρ value Phi
	dengue fever		Not dengue fever				
	n	%	N	%	N	%	
Work	8	34.8	15	65.2	23	100	0.103
Doesn't work	50	53.8	43	46.2	93	100	
	58	50.0	58	50.0	116	100	

Source: Primary data, 2023

Based on table 3, it is known that 8 respondents (34.8%) suffered from dengue fever and worked and 50 respondents (53.8%) suffered from dengue fever and did not work. The results of the Fisher's Exact Test statistical test show ρ = 0.103 (ρ > 0.05). Ho is accepted, meaning that there is no relationship between the respondent's work and the incidence of dengue fever in the Telaga Biru Health Center area.

Spatial Analysis

The results of the spatial analysis were obtained from direct visits to the homes of Dengue Hemorrhagic Fever (DHF) sufferers, then researched, recorded the coordinates of the sufferers' homes using GPS, interviewed the sufferers according to the questionnaire that had been prepared. Furthermore, supporting data in this research was obtained based on the specified research characteristics. The aggregate data that will be analyzed is population density and the distance the Aedes aegypti mosquito flies from one case to another. To determine the area score based on the variables used by the ArcMap 10.4 application.

Dengue fever incidence

The sample used in the research and the spatial analysis carried out was from 58 respondents as cases in the dengue fever register, all of which could be mapped . The results can be seen in table 4.

Table 4. Distribution of DHF Cases Per Village in the Telaga Biru Community Health Center Area

Village	Number of DHF Cases	
	N	%
Dumati	9	15.52
Pantungo	4	6,8
Pentadio Barat	8	13.8
Timuato	5	8.62
Tinelo	9	15.52
Tudenggi	18	31.03
Ulapato A	5	8.62
Amount	**58**	**100**

Source: Primary data, 2023

Based on table 4, the proportion of dengue fever cases the highest was in Tuladenggi village 31.03%, followed by Tinelo and Dumati villages 15.52% each , then West Pentadio village 13.8%, then Timuato and Ulapato A villages respectively obtained 8.82%, and lastly was Pantungo village with 6.8%.

Spatial analysis Residential density

Based on the results of the NNA analysis The NNI result was 0.34 < 1, meaning that the dengue case occurred in the work area of the Community Health Center Telaga Biru has a clustered pattern, where everyone Case points are close to each other at the same location . Residential density is one of them factors that influence the high incidence of dengue fever, such as in the working area of the Telaga Biru Health Center , this is because population density results in a high population in an area so that causing high population mobilization, especially in the community health center area Blue Lake.

DISCUSSION

The relationship between the characteristics of the patient's age and dengue fever incident

Fisher's Exact Test statistical test, the Phi ρ value is 0.000, where the value ρ < 0.05 Ho is rejected. This means that there is a relationship between age and the incidence of dengue fever in the Telaga Biru Community Health Center area , this is because dengue fever attacks age groups from toddlers to the elderly. Toddlers and children aged <15 years have a high risk of contracting dengue fever. This is due to the habit of those who are outside the home, both in the school environment in the morning and in the afternoon when playing at home. The results of this research are in line with research conducted by Hikmah (2018) at Tugurejo Hospital, Semarang, which using a case control approach with a total sample size of 62 people, it was found that the respondents who experienced illness and death due to dengue fever were children in the category of respondents. And the results of this research obtained an OR value of 3.87 which explains that the category of child respondents is at risk of suffering from dengue fever. Guspina's research results, 2018, used the Mc Nemar ρ value age statistical test of 0.014 with an OR value of 0.333, which means there is a 0.0333 smaller risk for control casuist couples who are of productive age suffering from dengue fever compared to control couples who are unproductive or < 15 years old in the Puskesmas area Johor. Age characteristics reflect a person's ability to take preventive action.

Characteristic relationships education of patients with dengue fever

Education is an active learning process for society develop his potential to have spiritual strength, personality, intelligence and skills in forming a character from not knowing to knowing. The results of the Fisher's Exact Test statistical test obtained a Phi ρ value of 0.000 where the value of ρ < 0.05 Ho is rejected, meaning there is a relationship between age with the incidence of dengue fever in the Telaga Biru Community Health Center area. The results of this research are in line with previous research conducted by Sandra et al (2019) in Tembalang sub-district who found there was a relationship between maternal education and the incidence of dengue fever in children aged 6-12 years (ρ= 0.004). Through the results of this research, it can be interpreted that mothers with a low level of education, have a greater chance of their children contracting dengue fever than those with higher education. Relatively low education can make it difficult for the population to understand the concept of the pathogenesis of dengue fever and may often act ignorant. High education always reflects a higher level of better awareness of efforts to prevent the transmission of dengue fever, information in the field Health can be accessed anywhere, so anyone can understand this information if they have a higher education. However, on the other hand, this research is different from the research carried out by Norvita et al (2017) in the working area of the Celikah Community Health Center, Ogan Komering Ilir Regency who found that There is no relationship between low education and the incidence of dengue fever (ρ = 0.134). A person with little education cannot take precautions because it is caused by a lack of understanding in preventing and controlling dengue fever in their own region.

The relationship between the patient's work characteristics and the incidence of dengue fever

Fisher's Exact Test statistical test, it shows that the results of the occupational variable with the incidence of dengue fever obtained a Phi value (ρ = 0.103) above 0.005, meaning that Ho is accepted, meaning there is no relationship between the occupational variable and the incidence of dengue fever in the Telaga Biru Health Center area. This shows that respondents who work and do not work have the same chance of contracting dengue fever. This research is in line with research conducted by Maulida et al (2017) with statistical test results of ρ = 0.189) there is no relationship between the respondent's occupation and the incidence of dengue fever. Work is not a risk factor for dengue fever, because contracting dengue fever does not depend on a person's level of work, because directly or indirectly work provides more knowledge and experience, besides that someone who works will have an awareness of the importance of environmental health. Apart from that, someone who works tends to spend time at least once a week or on holidays to clean their house and eradicate dengue mosquito nests. Apart from that, work status that is not tied to an agency also provides more free time so that in this case the respondent's job does not influence the incidence of dengue fever in the Telaga Biru Health Center area (Trisnawati eit, al. 2017).

The relationship between residential density and dengue fever incidence using a geo-spatial approach

Spatial Weighted Regression (SWR) analysis , it shows that of the 8 villages that were research locations, there were 2 villages that had a relationship between residential density and dengue fever with a standard deviation value for Tuladenggi village 0.02, Dumati village 0.82. However, looking at the residential area zone, there is no relationship between residential density and the incidence of dengue fever in the working area of the Telaga Biru Health Center ρ = 0.056. Based on the results obtained using nearest neighbor analysis, it is known that the distribution pattern of dengue fever cases in the Telaga Biru Community Health Center area is a clustered pattern with an NNI value of 0.34, meaning that the dengue fever case points are located close to each other. And form a cluster pattern.

Tuladenggi Village has an area of 89.58 Ha with the largest population in the Telaga Biru Health Center working area, 4343 people.

The population density in Tuladenggi village is quite large, this is because the village has residential areas in remote areas of the hamlet, so dengue fever cases in this village are very high, supported by population mobilization which is part of community activities every day for daily needs. This is different from Dumati village, which only has a smaller area than Tuladenggi village, 32.28 hectares with a population of 1866 people. Population density in Dumati village is related to the incidence of dengue fever. The condition of Dumati village is the same as that of Tuladenggi village, where there are residential areas where the buildings reach remote areas of the hamlet, supported by environmental conditions that are less clean and less supportive of clean and healthy living habits, so that dengue fever cases in Dumati village spread quickly. This is in line with research by Handayani (2017) in Padang City which found that there was no significant relationship between residential density and the incidence of dengue fever ρ = 0.307. Similarly, research conducted by Guspina (2018) showed no relationship between population density and the incidence of dengue fever in the Johor Community Health Center area. The very high residential density is caused by several factors such as economic factors and educational factors. Residential density is not only spreading in the city center but also in remote villages, such as housing developments that have entered rural areas. As the results of research by Suparni (2017) found that there was no relationship between residential density and the incidence of dengue fever in Jambi City with a value of ρ = 0.678. This research is also in line with research conducted by Aulya et al (2019) which found that there was no relationship between residential density and the incidence of dengue fever in Kendari City in 2014-2018 with a value of ρ = 0.440 > 0.05. In this research, dengue fever does not only focus on densely populated areas but is spread across almost all sub-districts in Gorontalo Regency. Calculation of population density. However, the results of this study are not in accordance with research conducted by Sugeng (2017) in Sleman Regency which found that there was a relationship between residential density and the incidence of dengue fever ρ = 0.0001 < 0.05.

The mapping results show that the level of residential density in the working area of the Telaga Biru Community Health Center with the level of dengue fever is in Tuladenggi village with a residential area of 89.58 ha with a population of 4243 people. However, the risk level is still moderate if seen from the area of the zone where there are dengue cases, namely 43.58 ha or 48.56%. Furthermore, West Pentadio village has a residential area of 58.51 ha with a population of 3839 people, but the risk level for dengue fever is still moderate when seen from the area of the dengue fever distribution zone of 44.86% in the village area. Tinelo Village has a residential area of 44.69 with a population of 2645 people, based on the results of mapping the area of the dengue fever case zone, it was found to be 25.81 ha or 57.76% of settlements prone to dengue cases. Pantungo Village has a residential area of 38.95 ha, with a population of 2090 people. Based on the results of mapping analysis of the distribution area of dengue fever, there are 10.70 ha or 27.48% of settlements that are prone to dengue fever cases. Ulapato A Village has a residential area of 38.27 ha with a population of 2427 people, there are 15.32 ha or 40.02% of settlements that are prone to dengue cases. Dumati Village has a residential area of 32.29 ha with a population of 1866 people. Based on the results of spatial analysis of mapping the distribution zone of dengue cases, there are 25.52 ha or 77.03% that are prone to dengue cases. Timuato Village has a population of 1635 people with a residential area of 24.68 ha, and is a transmission zone for 12.54 ha of dengue cases or 51.44% of the settlements where dengue cases occur in the area.

Based on the explanation from the research above, there are 8 villages that have a high risk of residential density and transmission of dengue cases as evidenced by the zone map of the distribution of dengue cases, namely Dumati village which has a residential area of 32.29 ha with a total of 9 dengue cases in a residential area of 25 , 52 ha or 79.03% of residential areas are at risk of transmitting dengue cases. The same thing is in Tinelo village which has a residential area of 44.69 ha with a total of 9 sufferers living in a residential area of 25.81 ha or 57.76% of settlements that have a high risk of transmitting dengue cases. The residential density in the Telaga Biru Health Center area is 366.24 ha with a distribution zone area of 166.92 ha or 45.58% of settlements that are prone to the spread of dengue fever cases. This research was the same as that conducted by Fadhilah et al, which showed that 20.15% or 1806.55 ha of dengue fever was quite high in the Prambanan sub-district, Klaten Regency in 2028.

Telaga Biru sub-district is on a major road axis with a fairly high level of population mobilization, making it possible for the transmission rate of dengue fever to be quite high. In terms of population density, the areas that have high population density are Tuladenggi village and West Pentadio village, this is because these two villages have quite large residential areas. In the areas of Tuladenggi village, Tinelo village, West Pentadio village and Timuato village, many housing complexes are found that are empty or only used as shelters, so that sometimes the condition of these houses is no longer maintained, there are many water reservoirs that allow the breeding of Aedes aegypti larvae.

IV. CONCLUSION

The conclusion is that the characteristics of age and education are related to the incidence of dengue fever in the Telaga Biru Health Center area, while employment has no relationship to the incidence DHF in the Telaga Biru Community Health Center area.

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