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Analysis Of Climate Trend Causes Of The Event Of Dengue Hemorrhagic Fever (Dhf) In Batam City 2016-2021

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Abstract

Dengue Hemorrhagic Fever is one of the endemic diseases in Indonesia caused by the virus transmitted by Aedes Aegypti, and the increasing incidence of dengue fever can be influenced by many factors, one of them is climate factors. This study aims to determine the relationship between climate and the case of dengue hemorrhagic fever in Batam City from 2016-2021.The research methodology used is quantitative with the Time Series method of correlation test. This study used secondary data for six years (2016-2021). Data on the number of dengue hemorrhagic fever events per month was obtained from the Batam City Health Office and climate data from the Batam City Meteorological Climatology and Geophysics Agency (BMKG). Data analysis was performed univariate and bivariate using the Pearson Product Moment test if the data is usually distributed and the Spearman Rank test if the data is not normally distributed. The study's results proved a significant relationship of weak meaning with an opposing direction between air temperature and the incidence of dengue hemorrhagic fever; no relationship meant very weak with a positive direction between rainfall and the incidence of dengue. No relationship meant very weak with an opposing direction between humidity and the duration of solar irradiation to the incidence rate of DHF. This study concludes that only air temperature has a meaningful relationship with dengue hemorrhagic fever incidence. Suggestions submitted to Batam City Health Office; it is expected to be able to cooperate with BMKG regarding dengue fever prevention and control programs; The community is expected to participate in the management of dengue fever; Researchers are furthermore expected to continue using different designs and variables.

Keywords: Aedes aegypti, Climate, Dengue Hemorrhagic Fever (DHF)

INTRODUCTION

Vector communicable diseases are interpreted as diseases transmitted through vector intermediary animals, one of them is Dengue Hemorrhagic Fever (DHF) which is still a problem in Indonesia. In Indonesia, Dengue Hemorrhagic Fever (DHF) was first discovered in Surabaya in 1968. At that time, 58 people were infected and 24 of them died (Death Rate (AK): 41.3%) since then Dengue Hemorrhagic Fever (DHF) spread widely throughout Indonesia[1].

WHO estimates that around 50-100 million dengue virus infections occur every year with 22,000 deaths and almost 1.8 trillion people in danger of being infected by dengue. [2]

The cause of the increase in dengue fever is climate change and environmental conditions that are suitable for the growth of mosquitoes. By the explanation [3], the high spread of dengue cases that occurred was most likely caused by climate change, increased population mobility, urban area development, changes in density, and uneven distribution of the population as well as elements of epidemiology.[3]

Aedes aegypti mosquitoes get an increase in the rainy season because rainfall, air temperature, and humidity greatly affect the mosquito life cycle and increase mosquito breeding power, besides that it also affects their biting behavior and the normal number of mosquitoes in the mosquito population[4]. The change of season from dry to rainy is also a weak point for the explosion of Dengue Hemorrhagic Fever cases, moreover, the puddle supports the growing and breeding of mosquitoes. Based on research[5], mosquitoes have a normal ideal temperature for growth and breed between 25º-27ºC. Mosquitoes stop breeding at temperatures below 10ºC and mosquito eggs take 7 to 8 days to become adult mosquitoes at temperatures over 40ºC and can breed longer if environmental conditions are unstable[6]. At air humidity below 60%, the mosquito lifetime period will be more limited[7].

In 2020, 95,893 cases have reported in Indonesia because of the incidence of DHF with IR: 49 per 100,000 populations with 661 deaths and CFR: 0.69% [8]. The incidence of DHF in Riau Islands Province in 2020 was 1,393 cases with IR: 33.6 per 100,000 population and 7 cases of death and CFR: 0.5%[9] [9]. Climatic data in Batam City in 2020 has an average temperature of 26º-34ºC, humidity ranges from 73-96%, and annual rainfall is around 2,600 mm per year [10]. in 2021 the average temperature data ranges from 26º-28ºC where the lowest temperature occurs in January and the highest in May, the average humidity ranges from 75%-85% where the lowest humidity is in February and the highest is in August, and the highest rainfall in January is 640.3 mm, and the highest duration of sun exposure is in March, which is 214 hours. Based on these data, it can be concluded that Batam City is a tropical city that can be a potential for the spread and development of dengue vectors.

Batam City is a city in the Riau Islands Province with a fairly high report of dengue fever. In 2016 there were 966 cases reported with Incidence Rate (IR): 85 per 100,000 population, in 2017 there were 593 cases with Incidence Rate (IR): 46 per 100,000 population, in 2018 there were 639 cases with Incidence Rate (IR): 50 per 100,000 population, in 2019 there were 727 cases with Incidence Rate (IR): 52.8 per 100,000 population, in 2020 there were 763 cases with Incidence Rate (IR): 53.87 per 100,000 population, and in 2021 there were 710 cases with Incidence Rate (IR): 50 per 100,000 population [11]. Based on the explanation above, the researchers are interested in conducting further research on the relationship between climate (air temperature, rainfall, humidity, and duration of sun exposure) on the incidence of Dengue Hemorrhagic Fever (DHF) in Batam City from 2016-2021.

RESEARCH METHODOLOGY

The type of research used is quantitative research with the Time Series method of

correlation test with a cross-sectional approach, which is a study that studies the relationship between risk factors (independent) and effect factors (dependent).

The sample of this study is the incidence of dengue hemorrhagic fever in Batam City per month from January 2016 to December 2021, and 72 samples were obtained from the Health Office.

The data analysis used is univariate and bivariate. Univariate analysis was conducted to determine the description of each variable. Bivariate analysis used the Pearson Product Moment and Rank Spearman correlation tests to assess whether there was a relationship between the two variables. If $p < 0.05$ then there is a significant relationship between two variables and test the correlation, if the value is 1 then the correlation is very strong and the relationship is unidirectional if the correlation coefficient is positive or the relationship is opposite if the correlation coefficient is negative.

RESULTS AND DISCUSSIONS

A. Univariate Analysis

The following is a statistical description of the incidence of DHF, air temperature, rainfall, humidity, and duration of sun exposure in Batam City from 2016-2021.

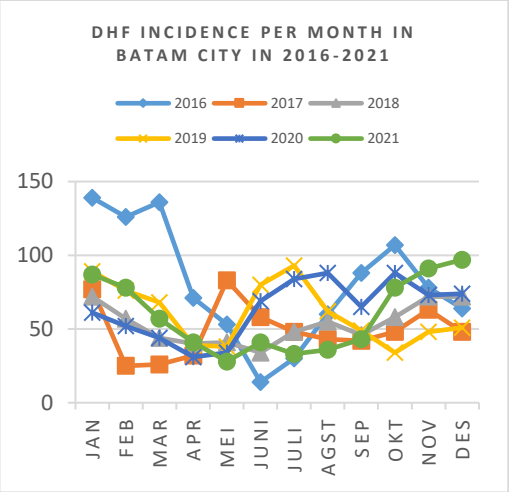

Figure 1. Monthly DHF incidence in Batam City in 2016-2021

The highest incidence of DHF during 2016-2021 was 139 events and the lowest was 14 events.

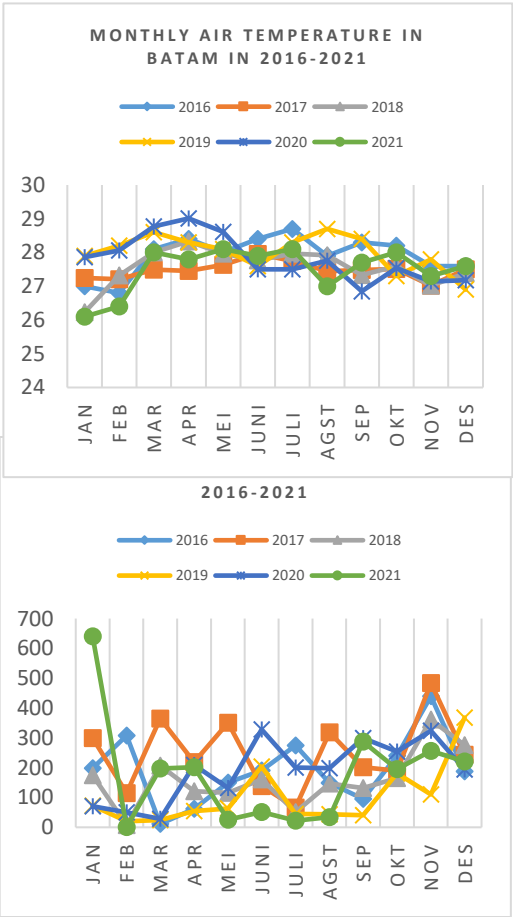

Figure 2. Monthly air temperature in Batam City 2016-2021

The highest temperature during 2016-2021 was 29.0ºC and the lowest was 26.1ºC. The average value of air temperature is 27.7ºC. From the picture above, the tendency of decreasing air temperature is from September to January. Meanwhile, the increasing trend occurred from January to April.

Figure 3. Monthly rainfall in Batam City in 2016-2021

The highest rainfall during 2016-2021 was 640.3 mm and the lowest was 0.8 mm. the average value of air temperature is 178.6 mm. From the picture above, the tendency of decreasing air temperature is from November to December and January to February. Meanwhile, the increasing tendency occurred from September to November.

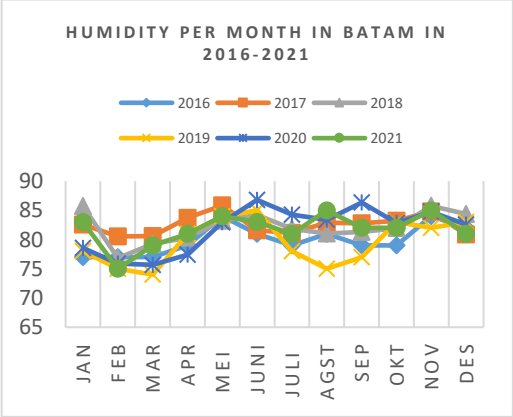

Figure 4. Humidity per month in Batam City in 2016-2021

The highest humidity during 2016-2021 is 86.8% and the lowest is 74%. the average value of air temperature is 81.3%. From the picture above, the trend of decreasing air temperature is from January to February and May to July. While the increasing tendency occurs from February to May.

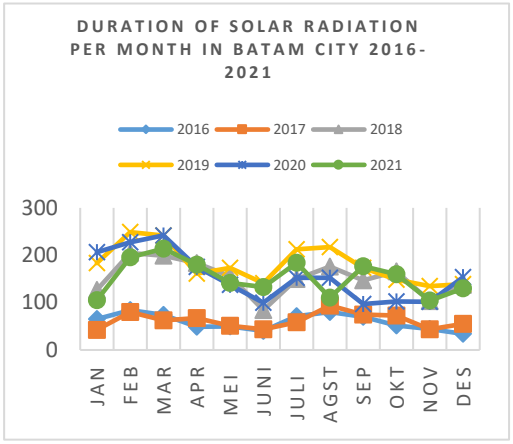

Figure 5. The duration of sun exposure per month in Batam City in 2016-2021

The highest duration of sun exposure during 2016-2021 is 248.8 hours/month and the lowest is 34 hours/month. the average value of air temperature is 81.3%. From the picture above, the trend of decreasing air temperature is from March to June. Meanwhile, the increasing tendency occurred from June to August.

B. Bivariate Analysis

1. Data Normality Test

The normality test in this study uses the Kolmogorov Smirnov test, which is to determine the distribution of research data and whether it is normally distributed or not and as shown in table 1 below.

Table 1. Data normality test results

Variable	Test of Normality Kolmogorov-Smirnov		
	Significance	n	Note
Temperature	0,200	72	Normal
Rainfall	0,087	72	Normal
Humidity	0,018	72	Not normal
Duration of sun exposure	0,070	72	Normal
DHF incidence	0,082	72	Normal

The data above is obtained only on the humidity variable with a value of p = 0.018 (p <0.05), so the interpretation of it uses Spearman Rank.

2. Correlation Test

Based on the table above, the value of r = -0.279 at air temperature means that it has a weak relationship and a negative system, which means that the case of dengue fever will decrease if the air temperature increases. The value of p = 0.018 can be concluded that there is a significant relationship between air temperature and the case of DHF in Batam City.

The rainfall variable has a value of r = 0.166, which means it has a very weak relationship and has a positive system, which means that the case of DHF will increase if the rainfall increases. With the p-value = 0.164, it can be concluded that there is no significant relationship between rainfall and the case of DHF in Batam City.

The humidity test results obtained a value of r = -0.032 which means it has a very weak relationship and has a negative system, it means that the case of DHF will decrease if the humidity increases. With the p value = 0.789, it can be concluded that there is no significant relationship between humidity and the incidence of DHF in Batam City.

The results of the sun exposure test showed that the value of r = -0.119, which means it has a very weak relationship and has a negative pattern, which means that the case of DHF will decrease if the duration of sun exposure increases. With the p-value = 0.321, it can be concluded that there is no significant relationship between the duration of sun exposure to the case of dengue fever in Batam City.

3. The relationship between air temperature and the incidence of dengue fever

Dengue Hemorrhagic Fever				
Variable	**Coef. Correlation (r)**	**Significance (p)**	**Sum (n)**	**Note**
Temperature	-0,279	0,018	72	Negative Correlation weak, significant relationship
Rainfall	0,166	0,164	72	Positive Correlation very weak, no significant relationship
Humidity	-0,032	0,789	72	Negative Correlation very weak, no significant relatoinship
Sun exposure	-0,119	0,321	72	Negative Correlation very weak, no significant relationship

The results of this study indicate that air temperature on the incidence of DHF has a negative direction, meaning that the higher the temperature, the lower the incidence of DHF. This is suitable with the previous research that the relationship between air temperature and the incidence of DHF has a negative direction. The level of closeness of the relationship between air temperature and the incidence of DHF in this study and previous studies is relatively weak. Temperature affects survival, growth, and breeding. An increase in air temperature will change vegetation systems, as well as the spread of insects such as mosquitoes that will be able to survive in areas that were previously too cold for their breeding. The adaptation of a species to high and low air temperature conditions will affect the geographical distribution of the species as well as the Aedes Aegypti mosquito[12]. The decrease in temperature will affect the survival of adult mosquitoes so that it will affect the transmission of the dengue virus and also affect the biting and reproduction patterns of mosquitoes and increase mosquito population density[13]. A study[14] found that temperatures of 16ºC and 36ºC can cause a lack of female mosquito fertility so that the mosquito population decreases. The temperature range of 25-30ºC is the average optimum temperature for mosquito growth. A temperature of more than 35ºC will make physiological processes slow down [15]

4. The relationship of rainfall to the incidence of DHF

The results showed that there was no relationship between rainfall and the incidence of DHF in Batam City from

2016-2021. The relationship is shown to be positive, meaning that the higher the rainfall, the higher the incidence of DHF. The shifting system of rainy and hot weather give a positive influence on the mosquito population because the inundated rainwater provides the best place for breeding and growth of mosquitoes [16]. Th high volume of rainfall will enhance the place for breeding and growth of mosquitoes naturally and it affects the growth of Aedes aegypti and cause an increased case of DHF [17]. The ideal amount of rainfall means that there is no inundated water in containers that are no longer used[18]. According to [19] that the Rainfall Index (ICH) does not directly affect the breeding of mosquitoes, but ideal rainfall instead. However, the level of closeness of the relationship between rainfall and the incidence of DHF is at a very low level. The results of this study are in line with previous studies that there is no significant relationship between rainfall and the incidence of DHF and is positive, which means that the number of DHF events will increase if the rainfall also increases.

5. The relationship of humidity to the incidence of DHF

The results of this study indicate a negative correlation value with the level of closeness of the relationship is classified as very weak in which if there is an increase in humidity then the incidence of DHF decreases. Air humidity is an important factor in the growth of mosquitoes. The optimal humidity required for mosquito growth ranges from 60-80%. The average lifetime period of a female mosquito is 10 days. However, with optimal humidity conditions, the lifetime period of mosquitoes can reach more than 1 month. Indirectly, humidity can affect the age of mosquitoes in their opportunity to become vectors. High humidity causes mosquitoes to weaken quickly and can cause death. At humidity of less than 60%, the lifespan of mosquitoes will be short so it is not sufficient for the viral growth cycle in the mosquito's body[17]. According to [20] that humidity does not directly affect the total cases of DHF but rather affects the age of the Aedes aegypti mosquito, which is the vector of DHF transmission. The results of this study are relevant to previous studies that there is no negative correlation between humidity and the incidence of DHF.

6. The relationship between sun exposure on the incidence of dengue fever

The results showed that the negative correlation value with the level of closeness of the relationship was classified as very weak, which means that the longer the sun exposure, the lower the incidence of DHF. Sunlight affects the habits of mosquitoes to find food and rest. The Aedes Aegypti mosquito has the habit of resting in a dark place and is protected from the sun, as well as in the habit of laying eggs [17]. This study is in line with previous research with a negative correlation coefficient which states that there is no relationship between the length of sunlight on the incidence of DHF. [21]

Conclusion

From the results of the climate correlation test on the incidence of dengue hemorrhagic fever in Batam City in 2016-2021, the following conclusions can be drawn: :

1. Based on the distribution table of the frequency of DHF occurrences in Batam City in 2016-2021 the lowest case is 14 and the highest is 139 cases.

2. Based on the frequency distribution table of Air Temperature in Batam City in 2016-2021 it was found that the lowest air temperature was 26.1ºC and the highest was 29.0ºC.
3. Based on the rainfall frequency distribution table in Batam City in 2016-2021 it was found that the lowest rainfall was 0.8 mm and the highest was 640.3 mm.
4. Based on the Humidity frequency distribution table in Batam City in 2016-2021 it was found that the lowest humidity was 74% and the highest was 86.8%.
5. Based on the frequency distribution table for the sun exposure in Batam City in 2016-2021, it was found that the lowest sun exposure was 34 hours/month and the highest was 248.8 hours/month.
6. There is a relationship between air temperature and the case of Dengue Hemorrhagic Fever (DHF) in Batam City in 2016-2021.
7. There is no relationship between rainfall and the case of Dengue Hemorrhagic Fever (DHF) in Batam City in 2016-2021.
8. There is no relationship between humidity and the case of Dengue Hemorrhagic Fever (DHF) in Batam City in 2016-2021.
9. There is no relationship between the sun exposure on the case of Dengue Hemorrhagic Fever (DHF) in Batam City in 2016-2021.

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