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Dynamics of dengue hemorrhagic fever incidence and climate as potential factors in Palembang 2013 – 2019

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Abstract. Palembang is one of the dengue hemorrhagic fever endemic areas, the incidence of dengue hemorrhagic fever in 2019 is still high, namely 697 cases, out of 18 Districts in Palembang, 9 Districts are endemic areas of DHF. Environmental factors are factors that play a role in the incidence of DHF, including the physical environment, namely the climate element. This research is an ecological study with the aim of looking at the influence and correlation between the fluctuation of climatic factors and the dynamics of dengue hemorrhagic fever incidence in Palembang in 2013-2019. The results showed that air temperature and the number of rainy days had a significant effect on the dynamics of dengue hemorrhagic fever moderate strength is towards positive, and wind speed has significant effect with moderate strength towards negative. Meanwhile, the amount of rainfall, rainfall index, air humidity and long exposure to the sun had no significant effect with a weak relationship. The results of this study can be used as a policy in decision making and environmental risk management and climate factors can predict and control the incidence of dengue fever in Palembang.

1. Introduction

Dengue hemorrhagic fever is a disease transmitted by vectors, namely *Aedes aegypti*, the mosquito in its reproduction is influenced by environmental factors. According to Law Number 32 of 2009 concerning the protection and management of the environment, it states that environment is a spatial unit with all objects, forces, conditions and living things including humans and their behavior, which affect life and all physical conditions that exist around humans. influential activities. One of the physical environmental factors is climate. Climatic elements include rainfall, humidity, temperature, wind speed, duration of exposure, air pressure (Paramita and Mukono, 2017).

Palembang is an endemic area for dengue hemorrhagic fever. In 2019 the incidence of dengue fever was 697 and there were 9 districts in Palembang City that were classified as dengue endemic, namely Sako District, Jakabaring, Sukarame, Alang-Alang Lebar, Sematang Borang, Bukit Kecil, Plaju, Kemuning and Ilir Barat I and 9 other sub-districts are sporadic areas. Sako sub-district with the highest percentage, namely 29.1%, Jakabaring 22.7% and Sukarame 17.9%. In 2018, Sukarame District was the highest endemic sub-district and in the midst of the Covid 19 pandemic, DHF remains a public health problem, until July 2020 there were 337 dengue cases (Palembang Health Office,



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2020). DHF in Palembang is a problem that has never been resolved, this is because Palembang is a lowland area ranging from 3 - 8 m above sea level with nisbuh humid winds, air temperatures ranging from 23.4° C - 31° C, average rainfall 227.23 mm month⁻¹ (BMKG, 2018). The climatic conditions in Palembang strongly support the breeding of *Aedes aegypti* Vidyah Dini et al (2010), cases of dengue increased with increasing air temperature from 25.5° C - 28.5° C and a rainfall of 3 - 374 mm.

The dengue virus carrier vector can transmit from epidemic areas in Southeast Asia to Jeju Island and can survive the colder winter months. Hence, due to the effects of globalization and climate change (Lee et al., 2013). The impact of temperature, rainfall and relative humidity on *albopictus* populations across Europe was mapped with current climatic conditions, to predict the influence of climate on DHF (Nastassya et al., 2013). Climate is a key factor influencing the seasonal distribution of *Ae. albopictus* in China (Zheng, 2019). Rainfall and temperature play an important role in the incidence of dengue fever in Chiang Rai, Thailand. (Wangkoon et al., 2011). There is a relationship between lighting and the incidence of dengue fever in Sleman Regency (Wijirahayu and Sukesi, 2019). Air temperature and rainfall factors are significant for the incidence of dengue fever in DKI Jakarta (Muhammad Lutfi, et al., 2017). The results of the research by Azhari et. al., (2017) temperature, humidity and rainfall have a relationship with DHF.

Research in Guangzhou, South China, has a significant relationship between temperature, humidity and the incidence of dengue fever during the 10-year period 2005 - 2014 (Xiang et al., 2017). Ramachandra et al., (2016) stated that temperature, humidity and rainfall are related to the incidence of dengue fever. Further research conducted in Semarang City during the period 2011 - 2015 shows that temperature, humidity and rainfall have a significant relationship with the incidence of dengue. Research conducted in Colombia shows that rainfall has an effect on the increase in dengue cases (Mattar et al., 2013). The results of research conducted in Prabumulih showed a significant relationship between the length of exposure and the incidence of dengue (Ritawati and Supranelfy, 2019).

Palembang as a dengue endemic area due to climatic factors that support the development of dengue vectors and research on the effects of climate in a long time has never been carried out in Palembang, it is necessary to conduct research on the dynamics of DHF incidence and fluctuations in climate elements in the period 2013 - 2019 in Palembang. The results of this study can be used as a policy in decision making and environmental risk management and climate factors can predict and control the incidence of dengue fever in Palembang.

2. Methodology

This research is quantitative in nature and is a descriptive study using an ecological design. This study can determine the relationship between climatic factors (temperature, rainfall, number of rainy days, rainfall index, percent of sun broadcast, air humidity and wind speed) and the dynamics of dengue hemorrhagic fever in Palembang City from 2013 - 2019. Palembang, which in consideration of Palembang is an endemic city of dengue hemorrhagic fever. Data were collected from June to August 2020. The population and sample in this study were all dengue incidents recorded at the Palembang Health Office.

DHF data collection is carried out by taking secondary data from the Palembang Health Office which currently consists of 18 Districts. Climatic factors in the form of temperature, rainfall, number of rainy days, rainfall index, percent of sun broadcasting, air humidity and wind speed are obtained from the Meteorological Agency. BMKG) Class II Palembang. Univariate and Bivariate data analysis. Univariate analysis to get an overview of the distribution of climate factor fluctuations (temperature, rainfall, number of rainy days, rainfall index, percent of sun broadcasting, air humidity and wind speed) in 2013 - 2019 in Palembang. Bivariate analysis analyzes the correlation test, to see the relationship between the independent variables, namely fluctuations in climate elements (temperature, rainfall, number of rainy days, rainfall index, percent of sun broadcasting, air humidity and wind speed) with the dependent variable dynamic incidence of dengue fever in 2013 - 2019.

To see the closeness of the relationship and the direction of the relationship between two numerical variables, correlation analysis is used. The relationship between the two numerical variables can have a positive or negative pattern. A positive relationship occurs when an increase in one variable is followed by an increase in another. Meanwhile, a negative relationship occurs when an increase in one variable is followed by a decrease in another variable. (Harsono, 2017). According to Calton (Harsono, 2017), namely: $r = 0.00 - 0.25 \rightarrow$ no relationship/weak relationship, $r = 0.26 - 0.50 \rightarrow$ moderate relationship, $r = 0.51 - 0.75 \rightarrow$ strong relationship, $r = 0.76 - 1.00 \rightarrow$ very strong relationship.

The second step is to see the effect of correlation through the probability value obtained with the following hypothesis: $H_0 =$ There is no relationship (correlation) between the two variables; $H_1 =$ There is a relationship (correlation) between the two variables. By using a Confident Interval (CI) of 95%, if the probability obtained is greater than 0.05, then H_0 is accepted. If the probability obtained is smaller than 0.05, then H_0 is rejected. The hypothesis in this study is that there is a relationship (correlation) between climatic factors and the incidence of dengue fever in Palembang from 2013 to 2019.

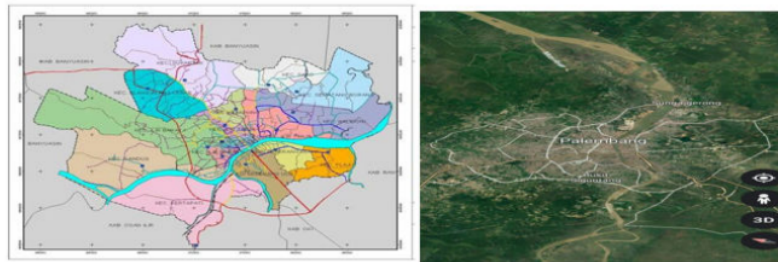


Figure 1. Map of Palembang

3. Result and Discussion

3.1 Distribution of Dengue Hemorrhagic Fever Frequency

Based on the results of observations and data analysis on the dynamics of dengue fever from 2013-2019, the average value of dengue fever incidence is 59.65 cases and the lowest is 13 cases and the highest is 191 cases per month can be seen in table 1 below.

Table 1. Frequency distribution of dengue hemorrhagic fever incidence per month in Palembang for the period 2013-2019

Year	Average	Min.	Max.	Deviation Standard
2013	29.66	13	76	4.95
2014	45.00	39	72	2.12
2015	88.58	28	188	2.91
2016	77.66	37	191	4.92
2017	58.16	28	109	3.95
2018	53.58	31	74	6.36
2019	58.08	21	151	7.07
2013 - 2019	59.65	13	191	14.75

3.2 Climate Element Frequency Distribution.

Based on the distribution of climatic elements (rainfall, rainfall index, number of rainy days, humidity, temperature, percent of irradiation for irradiation time and wind speed can be seen in table 3 below:

Table 2. Frequency distribution of dengue fever incidents per month in Palembang for the period 2013-2019

Variable	Average	Min.	Max.	Deviation Standard
Rainfall	219.09	0.20	613.00	33.00
Rainfall index	150.18	0.01	454.60	15.56
Number of rainy days	17.76	1.00	29.00	6.56
Temperature	27.55	26.00	28.70	0.52
Humidity	83.74	71.00	91.00	4.29
Long exposure	48.38	13.00	77.00	12.43
Wind speed	3.59	1.70	5.64	0.77

The average monthly rainfall is 219.06 mm month-1 with a maximum of mm month-1 and a minimum of 0.20 mm/month. The average number of rainy days was 17.76 days with a minimum of 1 day and a maximum of 29 days, while the average rainfall index was 150.18 with a maximum of 454.80 and a minimum of 0.01. Meanwhile, the daily average humidity is 83.87% with a maximum of 91.00% and a minimum of 71.00%. The average percentage of irradiation is 48.38%, maximum 77.00% and minimum 13.00%. The average wind speed of 3.59 knot (km h-1), maximum 5.64 knot (km h-1), and a minimum of 1.70 km/hour.

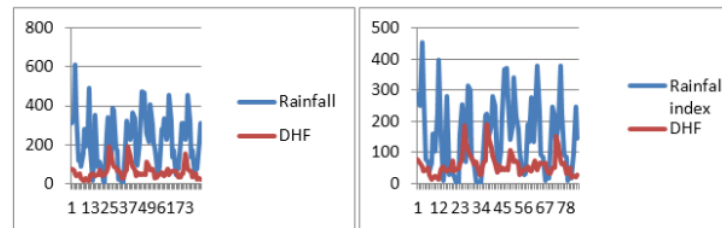


Figure 2. Relationship between Rainfall and Rainfall Index with DHF Incidence

The Relationship between the Dynamics of Dengue Fever and the Fluctuation of Climate Elements in 2013 – 2019.

Table 3. The results of the analysis of the relationship between fluctuations in climate elements and the dynamics of dengue hemorrhagic fever events in 2013-2019

No	Variable	DHF Incidence	
		Correlation Coefficient (r)	Sig. (p 0.05)
1	Rainfall	0.88	0.149
2	Rainfall index	0.065	0.167
3	Number of rainy days	0.004	0.266
4	Temperature	0.004	0.284
5	Humidity	0.133	0.123
6	Long exposure	0.425	0.021
7	Wind speed	0.004	- 0.266

Air temperature with a value (p = 0.00) means that the air temperature has a significant effect on the incidence of dengue. The correlation coefficient is r = - 0.284 with moderate strength and in a positive direction. That the range of air temperature during the period 2013-2019 is 26 oC-28.70oC, which is the optimum temperature for the breeding of Aedes aegypti as the main vector of dengue fever, is in line with research conducted by Wongkoon et al., (2011) in Chiang Rai, Thailand that air

temperature in the range of 24 oC-31oC is the optimum temperature associated with dengue transmission.

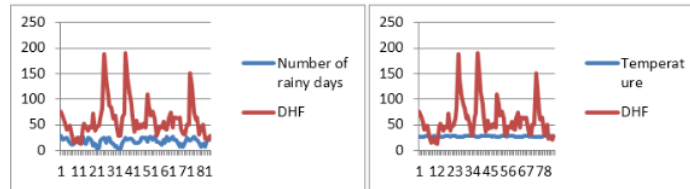


Figure 3. Relationship between Number of rainy days and Temperature with DHF Incidence

The number of rainy days with a value ($p = 0.004$) had a significant effect on the dynamics of dengue fever with a positive correlation coefficient of $r = 0.266$, meaning that the rainier days the incidence of dengue increased. The existence of water is very necessary for the breeding ground for DHF vectors, where *Aedes aegypti* breed from laying eggs to mosquitoes that require water. The existence of rainfall ranging from 3 mm to 275 mm is a good place for vector reproduction, so the most important thing is that the presence of rainfall is not the amount of rainfall, this is evident that the amount of rainfall and the rainfall index have not significant effect on the dynamics of DHF incidence with Rainfall index ($p = 0.065$) with a value of $r = 0.167$ with a weak relationship with a positive collar, the amount of rainfall ($p = 0.88$) with a value of $r = 0.149$ with a very weak relationship towards positive. In line with research conducted by Mattar et. al., (2013), conducted in Colombia that the existence of rainy days was in line with the increase in DHF cases.

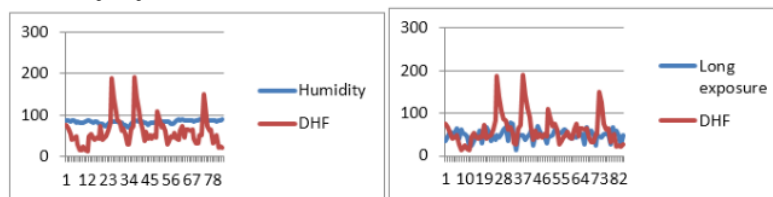


Figure 4. Relationship between Humidity and long exposure with DHF Incidence

The duration of exposure ($p = 0.425$) with $r = 0.021$ is very weak and humidity ($p = 0.88$) with a value of $r = 0.123$, a weak relationship shows an insignificant relationship with the dynamics of dengue fever. This is due to the influence of sunlight indirectly and during 2013 - 2019 there were no fluctuations which caused an influence on the incidence of dengue. So, humidity fluctuations were in optimum conditions for *Aedes aegypti* in Palembang. Wind speed with a value ($p = 0.04$) means that wind speed has an effect on the increase in dengue cases during the period 2013 - 2019 in Palembang with a correlation coefficient of $r = - 0.266$ with moderate strength and in a negative direction means that an increase in wind speed will reduce the incidence of DHF.

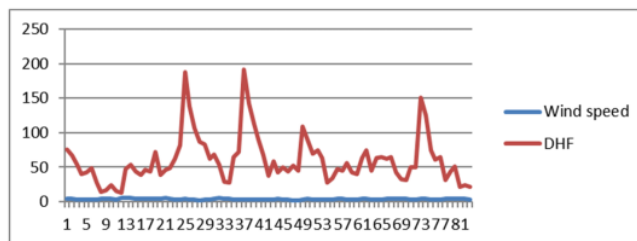


Figure 5. Relationship between Wind Speed with DHF incidence

The wind speed during the study was 1.70 km / h - 5.64 km / h with an average of 3.59 km / h. This shows that the presence of wind is needed for the reproduction of dengue vectors, even wind can increase the altitude and flight distance of *Aedes aegypti* as the main vector of DHF. It is not in line with research conducted in Prabumulih that wind speed affects the increase in dengue cases (Rinawati and Supranelfy, 2017).

Conclusion

Based on the results of research on the dynamics of dengue fever and the fluctuation of climatic elements in Palembang in 2013-2019, it can be concluded as follows:

- a. Air temperature and number of rainy days have a significant effect on the dynamics of dengue hemorrhagic fever with a moderate positive relationship (accept H_0 and reject H_1)
- b. Wind speed has a significant effect on the dynamics of dengue fever with a moderate negative relationship (accept H_0 and reject H_1)
- c. The amount of rainfall, rainfall index, humidity and duration of exposure did not significantly affect the dynamics of dengue hemorrhagic fever (mark H_0 and accept H_1).

Based on the research results, it is suggested that climate element fluctuations can be used as a policy in decision making and environmental risk management and climate factors can be used to predict and control the incidence of DHF in Palembang.

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