Correlation between climate factors with dengue hemorrhagic fever cases in Surabaya 2007-2017

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Submission date: 30-Nov-2021 10:46AM (UTC+0800)
Submission ID: 1715888543
File name: rs_with_dengue_hemorrhagic_fever_cases_in_Surabaya_2007-2017.pdf (1.84M)
Word count: 3630
Character count: 19197

Available online at IJTID Website: https://e-journal.unair.ac.id/IJTID/

Indonesian Journal of
Tropical and Infectious Disease

Vol. 9 No. 1 January–April 2021

Original Article

Correlation between Climate Factors with Dengue Hemorrhagic Fever Cases in Surabaya 2007 – 2017

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Received: 22nd January 2019; Revised: 4th February 2019; Accepted: 9th February 2021

ABSTRACT

Dengue Hemorrhagic Fever (DHF) is a disease caused by dengue virus. DHF is mediated by the mosquito vector, the Aedes mosquito The proliferation of dengue vector is influenced by many factors, one of which is climate factors. DHF is one of the main public health problems in Indonesia. Cases of dengue were first discovered in 1968 in the city of Jakarta and Surabaya. Currently Surabaya is one of the dengue endemic areas in Indonesia. . The case of DHF in the city of Surabaya can be said to be still quite high compared with another city in Indonesia, although there is a decrease in the number from year to year. When examined, many factors influence the high number of dengue cases in Surabaya, one of which is climate factor. Climate factors play a role in the proliferation of DHF vectors. Therefore this study aims to examine for 10 years, namely in 2007 - 2017 whether there is a correlation between climate factors with dengue cases in the city of Surabaya., which in this study the climate factors used are rainfall, average temperature, and average air humidity. This research uses an analytical method namely Spearman on the SPSS software version 20. The results obtained that the case of DHF in the city of Surabaya has no relationship with climatic factors such as rainfall and average temperature with a significance value of the relationship p> 0.05. While the climate factor that has a relationship with DHF cases in Surabaya City is air humidity with a significance value of p <0.05 and has a positive relationship with the value of r = + 0.190. It can be concluded that not all climate factors have a relationship with the DHF case in Surabaya in 2007 - 2017, which has a relationship with the DHF case is air humidity.

Keywords: *DHF case; climate factors; humidity; Surabaya; 2007 - 2017*

ABSTRAK

Demam Berdarah Dengue (DBD) merupakan penyakit yang disebabkan oleh virus dengue. DBD diperantarai oleh vektor nyamuk yaitu nyamuk Aedes. Perkembangbiakan vektor demam berdarah ini dipengaruhi oleh banyak faktor salah satunya adalah perubahan iklim DBD merupakan salah satu masalah kesehatan utama masyarakat di Indonesia. Kasus demam berdarah pertama kali ditemukan pada tahun 1968 di Kota Surabaya. Saat ini Surabaya merupakan salah satu daerah endemis DBD di Indonesia. Kasus DBD di Kota Surabaya sendiri dapat dikatakan masih cukup tinggi apabila dibandingkan dengan kota lain di Indonesia walaupun terlihat ada penurunan jumlah dari tahun ke tahun. Apabila ditelaah, banyak faktor yang mempengaruhi masih tingginya kasus DBD di Kota Surabaya, yang salah satunya adalah faktor iklim. Faktor iklim berperan dalam perkembangbiakan vektor DBD. Maka dari itu, penelitian ini bertujuan untuk meneliti selama 10 tahun, yaitu tahun 2007 – 2017 apakah ada hubungan antara faktor iklim dengan kasus DBD di Kota Surabaya, yang pada penelitian ini faktor iklim yang digunakan adalah curah hujan, suhu rata-rata, dan rata-rata kelembaban udara. Penelitian ini menggunkan metode analitik yaitu Spearman pada perangkat SPPS versi 20. Didapatkan hasil bahwa kasus DBD di Kota Surabaya tidak mempunyai hubungan dengan faktor iklim berupa curah hujan dan suhu rata-rata dengan nilai signifikansi hubungan p>0.05. Sedangkan faktor iklim yang memiliki hubungan dengan kasus DBD di Kota Surabaya merupakan kelembaban udara dengan nilai signifikansi p<0.05 serta memiliki hubungan yang positif dengan nilai r = + 0.190. Dapat disimpulkan tidak semua faktor iklim mempunyai hubungan dengan kasus DBD Kota Surabaya tahun 2007 – 2017, yang memiliki hubungan dengan kasus DBD adalah kelembaban udara.

Kata kunci: *Kasus DBD; Faktor iklim; Kelembaban udara, Surabaya, 2007 - 2017*

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How to Cite: Ghaisani, NP., Sulistiawati., Lusida, MLI. Correlation between Climate Factors with Dengue Hemorrhagic Fever Cases in Surabaya 2007 – 2017..Indonesian Journal of Tropical and Infectious Disease, 9(1), 39–44

INTRODUCTION

Dengue hemorrhagic fever (DHF) is a disease caused by dengue virus carried by female Aedes mosquitoes, especially Aedes aegepty and a few Aedes albopictus.[1] Dengue is widespread in the tropics and subtropics, including Indonesia. Dengue is one of the main health problems in Indonesia.[2] DHF cases first appeared in Indonesia, namely in Jakarta and Surabaya in 1968.[3] DHF Incidence Rate (IR) in Indonesia from 1968 - 2015 continue to increase.[4,5,6,7,8,9] Dengue cases found in all provinces in Indonesia.[10] One of the things that influences this phenomenon is the climate change. Climate change causes changes in rainfall, temperature, humidity, and air direction, thus affecting the terrestrial and oceanic ecosystems and also health.[11] Climate change has a role in DHF vector.[12]

Aedes mosquitoes live in urban habitat and breed specifically in containers. Water needs for breeding is very important. It reach its peak during the rainy season.[13] This mosquito tend to bite in the morning until noon.

DHF has a strong correlation with the climate because the incidence of DHF usually happens on the beginning and the end of the rainy season.[14] Very high rainfall influences the population of mosquitoes. Increased rainfall intensity refers to the increasing place of mosquitoes to breed, resulting in increasing mosquitoes population. Increasing the mosquito population increases the risk of female mosquitoes carrying the pathogens which will transmit to the next host.[15] Aedes mosquito reproduction cycle will be shorter at temperatures higher than 32°C so that the mosquito population will multiply with increasing temperature [16]. Warm temperatures also accelerate the metabolic process so that the frequency of biting will increase.[17] The maximum temperature for mosquito growth is 25-27°C. [18]

Humidity affects the flight behavior and host search, mosquito life span and mosquito reproduction.[17] High humidity helps the process of mosquito metabolism which will indirectly increase the frequency of biting.

MATERIALS AND METHODS

This research is an analytical study that uses secondary data in the form of institutional administrative data, namely the report of the Meteorology Climatology and Geophysics Agency (BMKG) and the Surabaya City Health Office with a cross-sectional approach. The sampling technique in this study uses a total sampling technique. The data were taken is the BMKG of Surabaya City weather report in 2007-2017 and the Surabaya City Health Office report on the incidence of dengue cases in 2007-2017. The collected data is grouped by month in each year and is written using tables and graphs and analyzed descriptively and tested statistically the correlation using Spearman method on the SPSS software version 20.

RESULT AND DISCUSSION

DHF Cases Profile in Surabaya

In Surabaya, the incidence of DHF in the 2007-2017 period as a whole has decreased in numbers although not stable. In below, figure 1 show the number of DHF cases in Surabaya from 2007 until 2017.

Figure 1. Number of DHF cases in Surabaya in 2007 – 2017

From the data obtained a significant increase occurred in 2010, 2013, and 2016. If it is associated with the time of the El Nino occurrence, in those years the El Nino events that occur in the moderate and strong category. From previous study, there was an increase in the incidence of DHF when the El Nino with the same category occur.

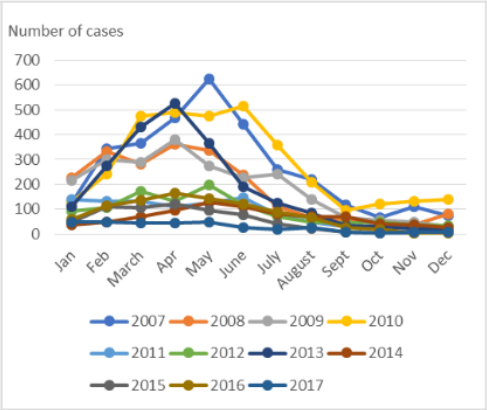

Figure 2. Cases of DHF per month each year

Judging from the graph above in Figure 2, the same pattern was formed in 2007 - 2009. Starting from 2011 to 2017 the number of dengue cases began to decrease so that the pattern formed had changed from before. Whereas in 2010, 2013, and 2016 have different patterns from other years. Overall, from September to December the number of dengue cases has always been lower than in previous months.

Rainfall Distribution of Surabaya

Surabaya has monsoonal rain type that is influenced by west and east monsoon winds where the peak of the rainy season occurs in January, and the peak of the dry season occurs in August.[19]

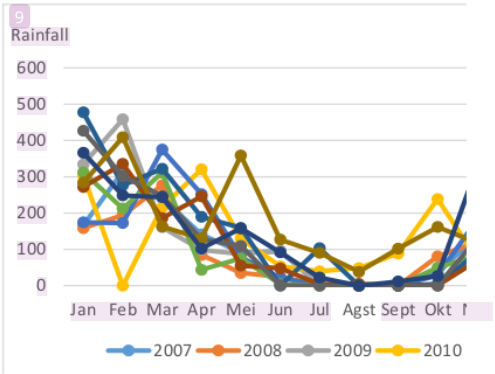

Figure 3. Rainfall per month each year

Based on Surabaya City rainfall data for 2007-2017 in Figure 3, December to March were months with high rate of rainfall, while July to September were months with low rainfall. However, in 2010, 2013 and 2016 there was a change in the pattern in which high rate of rainfall occurred throughout the year even in the month that was supposed to be the peak of the dry season, making the accumulation of rainfall in those years the highest among the other years.

Average Temperature Distribution of Surabaya City

The average temperature of Surabaya City for the last 11 years is within normal range when compared to the 30-year data with an average value of 28,62°C.

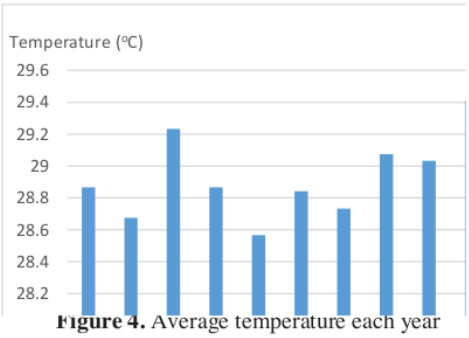

Figure 4. Average temperature each year

From the graph in Figure 4, 2011 became a year with the lowest average temperature with a value of 28,6oC, while 2016 was a year with the highest average temperature of 29,4°C.

Humidity Distribution of Surabaya City

The humidity of the city of Surabaya for the last 11 years is within normal range when compared to the 30-year data with a value of 74,33.

From the graph in Figure 5, 2009 became the year with the lowest humidity with a value of 69,58 and 2017 became the year with the highest average humidity with a value of 76,92.

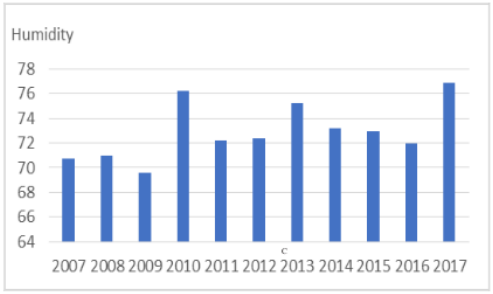

Figure 5. Humidity in Surabaya City per year

Correlation between Rainfall with DHF Cases

The effect of rainfall on the incidence of DHF cases is complex, because it is influenced by several other factors.[20] Rainfall has an influence on the vector growth, which is the density of adult mosquitoes. High rainfall intensity will cause the breeding site of adult mosquitoes to increase, which in turn increase the density of mosquitoes.[15] However, in a short period, heavy rain will destroy mosquito larvae and reduce the survival rate of female mosquitoes.[16]

Table 1. Spearman Correlation Test Result

Variable	Mean ± SD	p
Rainfall	138,265 ± 131,269	0,159
DHF Cases	136,71 ± 135,560	

From the result of published study in Table 1, the correlation test using Spearman obtained relationship significance of p >0.05. It can be interpreted that there was no correlation between rainfall and the incidence of DHF cases in Surabaya in 2007-2017. However, it must be noted that incidence of DHF cases is influenced by other factors besides than rainfall, such as humidity, evaporation of water, wind speed, and cloudiness.[20]

These results supported previous study in Surabaya which showed no significant fluctuations in certain months of the year regarding the number of dengue cases. These results are also similar with studies in other influencing factors.[20] In addition, changes in rainfall patterns can also affect human behavior which will later affect lifestyle that further affect the dynamics of Aedes mosquito populations, for example, a change in water storing habit.[20] However, studies assessing the correlation of rainfall with the incidence of DHF is not suitable to use the Spearman method. Spearman is suitable for measuring linear and static relationships, while the correlation between weather and DHF events is neither linear nor static.[18] This can happened because from the previous study, the correlation between rainfall and the incidence of DHF has several conditions, such as regular rain that may cause an increase in dengue cases, whereas heavy rainfall does not. [18,21] So, the correlation bertween DHF cases and rainfall are not linear nor static. The results of this study supported previous studies in the city of Surabaya which showed no significant fluctuations in certain months of the year regarding the number of dengue cases.

Correlation between Temperature and DHF Cases

Based on previous study, temperature has a role in the transmission cycle of dengue virus.[21] Research in Thailand and Singapore showed that there was a correlation between temperature and the incidence of DHF cases. [22,16]

Table 2. Spearman Correlation Test Result

Variable	Mean ± SD	p
Temperature	28,909 ± 0,739	0,066
DHF Cases	136,71 ± 135,560	

Correlation test results in Table 2 showed the relationship significance of p >0.05 which means there was no correlation between temperature and the incidence of DHF in the city of Surabaya in 2007-2017. Similar to correlation of rainfall with the incidence of DHF cases, the relationship with temperature is also not a linear relationship or static, thus making this method not suitable for this case.[18] It can be seen that the temperature data used is the average temperature, whereas the temperature is not only measured from the

average value but there is also a minimum and maximum temperature. This minimum or maximum temperature value may also affect the presence or absence of its relationship with the incidence of DHF.

Research that uses an epidemiological approach states that in certain months, high temperatures will cause mosquito populations to increase with low virus transmission, which usually causes an increase in virus transmission under conditions of high rainfall, low temperatures, and high humidity.[23]

Correlation between Humidity with DHF Cases

Humidity affects the flight behavior of mosquitoes by increasing the metabolism of the mosquito's body which then increase the biting behavior.[24]

Table 3. Spearman Correlation Test Result

Variabel	Mean ± SD	p
Humidity	73,48 ± 5,614	0,029
DHF Cases	136,71 ± 135,560	

The correlation test results in Table 3 showed the relationship significance of $p < 0.05$ which means there was a significant correlation between the two variables. The strength of the relationship between the two variables is very weak and the direction of the relationship is positive ($r = +0.190$). It can be interpreted that the higher the humidity, the higher the incidence of DHF.

Similar to current study which showed that air humidity has a relationship with the incidence of DHF cases through the effect on the density of the dengue virus vector, the Aedes aegepty mosquito and the external incubation period of the dengue virus itself, thereby increasing its transmission. [23]

Correlation between ENSO and DHF Cases

Based on the available data, year of 2010, 2013 and 2016 were the year with high rainfall accumulation followed by an increase in the incidence of dengue cases. Previous studies showed that there was a correlation between the increase in the incidence of DHF cases with the phenomenon of El-Nino-Southern Oscillation (ENSO) which is a cycle of sea surface temperature in the Pacific Sea. From the results of studies in Venezuela, 2009 - 2010 were the year with moderate El-Nino category, while 2014-2016 were the year with strong El-Nino or Mega Nino. [24] Within those 3 years, there was a recorded climate phenomenon that does not usually occur in Surabaya. During those years, dengue fever cases in the city of Surabaya also showed an increase in number. This result is linear with the previous study, that there is a significant relationship between ENSO and dengue incidence.[25]

CONCLUSION

The climate factor which has an analytical correlation with the DHF case in Surabaya in 2007 - 2017 is humidity, while the climate factor such as rainfall and temperature does not have an analytical correlation with the DHF incidence rate. There is an influence of the El-Nino phenomenon on the number of DHF cases in Surabaya in a certain year.

CONFLICT OF INTEREST

There is no conflict of interest of this study.

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