DBD_WEATHER

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Dengue Hemorrhagic Fever and Its Correlation with The Weather Factor In Bandar Lampung City: Study From 2009-2018

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ABSTRACT

Dengue Hemorrhagic Fever (DHF) is the most serious vector-borne disease in Bandar Lampung. Dengue virus and its vector *Aedes Aegypti* are sensitive to weather changes, especially rainfall, temperature and humidity. This research objective was to determine the correlation between weather factors and dengue cases using the period 2009-2018. Data obtained from reports on the number of monthly cases of the in Health Office of Bandar Lampung City, and daily climate reports from the Meteorology, Climatology and Geophysics Agency, which are converted into monthly averages. We found that the highest DHF cases were in January, February and March. Rainfall has a positive correlation with the number of dengue cases in 2011 (p-value = 0.012) and 2015 (p-value = 0.020). Each year, the rainy period precedes the start of the increase in dengue cases. Temperature has a negative correlation in 2014 (p-value = 0.036). Humidity has a positive correlation in 2014 (p-value = 0.024) and 2015 (p-value = 0.018). Rainfall has the greatest influence in relation to DHF cases in Bandar Lampung City (36.9%). These findings provide empirical evidence regarding the correlation between weather factors and DHF transmission, and are expected to provide a scientific basis for the prevention and control of DHF.

Penyakit Demam Berdarah Dengue dan Hubungannya dengan Faktor Cuaca Di Kota Bandar Lampung: Studi Tahun 2009-2018

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ABSTRAK

DBD adalah penyakit tular vektor yang paling serius di Kota Bandar Lampung. Virus dengue dan vektornya Aedes aegypti sensitif terhadap perubahan cuaca, khususnya curah hujan, temperatur dan kelembaban. Penelitian bertujuan mengetahui hubungan faktor cuaca dengan kasus DBD menggunakan periode tahun 2009-2018. Data diperoleh dari laporan jumlah kasus bulanan Dinas Kesehatan Kota Bandar Lampung, dan iklim harian dari Badan Meteorologi Klimatologi dan Geofisika yang dikonversi menjadi rata-rata bulanan. Kami menemukan, kasus DBD tertinggi pada bulan Januari, Februari, dan Maret. Curah hujan berkorelasi positif dengan jumlah kasus DBD pada tahun 2011 (p-value=0,012), dan 2015 (p-value=0,020). Setiap tahunnya, periode hujan mendahului dimulainya waktu peningkatan kasus DBD. Temperatur berkorelasi negatif pada tahun 2014 (p-value=0,036). Kelembaban berkorelasi positif pada tahun 2014 (p-value=0,024), dan 2015 (p-value=0,018). Curah hujan memberikan pengaruh terbesar dalam hubungan dengan kasus DBD di Kota Bandar Lampung (36,9%). Temuan ini memberikan bukti empirik mengenai hubungan faktor cuaca dengan penularan DBD, dan diharapkan dapat memberikan landasan ilmiah untuk pencegahan dan penanggulangan DBD.

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is caused by the dengue virus which is transmitted by the *Aedes Aegypti* mosquito as the main vector (Health Ministry of Republic Indonesia, 2005; Naish et al., 2014). Until now, dengue is still a world health problem because it causes high mortality, especially in children (Gubler, 2012). It is estimated that 3.6 billion people are at risk, 230 million infected, and 21,000 deaths (Beatty, Letson, & Margolis, 2009; Gubler, 2012; Halasa, Shepard, & Zeng, 2012; Naish et al., 2014). Globally, DHF cases are always the highest in Asia every year. From 1968 to 2010, Indonesia became the country with the highest number of dengue cases in Southeast Asia (Ministry of Health, 2010). In Bandar Lampung, the genesis of dengue fever shows a high and varied rate each year. In the 2007-2017 period, the average incidence (per 100,000 population) was 103.97 (35.30-230.90), far above the figures for Lampung Province 42.37 (16.37 - 68.44) and National 54.21 (27.7 - 78.6).

The spread of DHF is influenced by four main components, namely agents, vectors, hosts and the environment (Lloyd, 2003; Word Health Organization, 1997; World Health Organization, 2011, 2014). The agent of dengue fever is the dengue virus (DENV-1, DENV-2, DENV-3 and DENV-4), all of which have been found in various regions in Indonesia (Kemekes RI, 2005; Kemenkes, 2011). Infection with different sterotypes causes severity and death (Chumpu, Khamsemanan, & Nattee, 2019). Person-to-person transmission of the virus by the Aedes mosquito, the subgenus Stegomyia (Chumpu et al., 2019; Kemekes RI, 2005; Ministry of Health, 2011; Lloyd, 2003; Word Health Organization, 1997; World Health Organization, 2011). *Aedes Aegypti* i is the main vector throughout Indonesia (Health Ministry of Republic Indonesia, 2005; Ministry of Health, 2011; Kesetyaningsih, Andarini, Sudarto, & Pramoedyo, 2018a; Tang, Rusli, & Lestari, 2018; Tosepu, Tantrakarnapa, Nakhapakorn, & Worakhunpiset, 2018 ; Tosepu, Tantrakarnapa, Worakhunpiset, & Nakhapakorn, 2018). Geographically, Ae. aegypti spreads in the tropics (Kraemer et al., 2015), while Ae. albopictus is more prevalent in the sub-tropics (Brady et al., 2014, 2013). Ae. aegypti at a temperature of 26-30 ○ C and humidity of 70-80% (Lloyd, 2003; Mourya, Yadav, & Mishra, 2004; Word Health Organization, 1997; World Health Organization, 2011); along with the availability of a breeding ground (Espinosa et al., 2016; Lloyd, 2003) and a food source (Arrivillaga & Barrera, 2004). Host factors include age, sex, and mobility. While environmental factors include house density, breeding places, resting places, and vector density (Wahyono, Haryanto, Mulyono, & Andreo Adiwibowo, 2010).

Another environmental factor associated with dengue fever is weather (Epstein, 2001; Hopp & Foley, 2001; Karyanti et al., 2014; Kraemer et al., 2015; Mondrow, 2016; Tosepu, Tantrakarnapa, Nakhapakorn, et al., 2018; Tosepu, Tantrakarnapa, Worakhunpiset, et al., 2018), namely rainfall, temperature, and humidity (Brisbois & Ali, 2010). Weather changes are a sensitive factor in DHF transmission through three important bio-ecological aspects, namely viruses, vectors and the environment (Li, Lu, Liu, & Wu, 2018; Li et al., 2017). Weather will affect the survival, replication, development or spread of the dengue virus and mosquitoes, the methods and processes of dengue fever transmission (Li et al., 2018), as well as the abundance of vector organisms (Hopp & Foley, 2001; Karyanti et al., 2014; Tosepu, Tantrakarnapa, Worakhunpiset, et al., 2018). Other research states that ciaca factors are related to vector age, Exterinsic Incubation Period (EIP), diet, age at marriage (Brady et al., 2014, 2013; Kesetyaningsih, Andarini, Sudarto, & Pramoedyo, 2018b; Mourya et al., 2004 ; Regis et al., 2008; Tang et al., 2018).

A number of studies on the correlation between weather and the spread of DHF have been carried out in several cities in Indonesia with various results. Research in Kendari City, obtained a negative correlation between rainfall and the incidence of DHF. However, other studies have identified a positive correlation (Azhar, Marina, & Anwar, 2017; Kesetyaningsih et al., 2018a; Tang et al., 2018; Tosepu, Tantrakarnapa, Nakhapakorn, et al., 2018; Tosepu, Tantrakarnapa, Worakhunpiset, et al. al., 2018). A positive correlation was found in the correlation between air temperature and dengue fever (Azhar et al., 2017; Tosepu, Tantrakarnapa, Nakhapakorn, et al., 2018; Tosepu, Tantrakarnapa, Worakhunpiset, et al., 2018). In other studies, getting a negative correlation (Tang et al., 2018), even not related (Kesetyaningsih et al., 2018a). Humidity also shows a positive correlation (Kesetyaningsih et al., 2018a; Tang et al., 2018; Tosepu, Tantrakarnapa, Worakhunpiset, et al., 2018), and negative (Tosepu, Tantrakarnapa, Nakhapakorn, et al., 2018), even not related (Azhar et al., 2017).

However, until now there are still few studies that discuss the correlation between weather and the number of DHF cases over a long period of time. This research objective was to determine the correlation between weather factors and the movement of dengue cases in Banadar Lampung 2009-2018. A better understanding of the dengue transmission trends will help determine a more effective and sustainable vector control strategy.

METHOD

Bandar Lampung City is the capital city of Lampung Province with a land area of about 19,722 Ha (197.22 km2), and it is located between 105028 'to 105037' East Longitude and 5020 'to 5030' South Latitude (Figure 1).

Figure 1
Map of the Bandar Lampung City (central bureau statistic, 2020)

This research uses secondary data. DHF cases from the surveillance data of the Bandar Lampung City Health Office are calculated in total every month, from January 1, 2009 to December 31, 2018 (n= 120 months). Weather data including rainfall, temperature and humidity, from the Meteorology, Climatology and Geophysics Agency, is obtained online (website: https://dataonline.bmkg.go.id/). Daily data from Meteorology, Climatology and Geophysics Agency is converted into monthly averages, so that the total data for each variable is equal to 120 data.

Data were analyzed using the SPSS statistical tool (version 24.0), and were carried out in stages. Univariate describes the frequency and distribution of each research variable using the Mean, Median, and Minimum-Maximum. At this stage, data normality testing was also carried out using Kolmogorov-Smirnov, at each observation year (n = 12 months) and periodically (n = 120 months). Data normality is used as the basis for determining the analysis technique at a later stage. Bivariate using Pearson Correlation and Spearman rank Correlation, according to the normality of the data. Tests are also carried out every year of observation and periodic data. The final part of the test uses Multiple Linear Regression. At this stage, data for 2009 and 2012 were not included in the analysis, so that the data analyzed was 96 months. The consideration is that the data for the two years are not normally distributed so that it affects the results of the analysis. The feasibility of the model also takes into account the assumptions of Multivariate normality, Liniarity, Existency, Homoscedascity, Independency, and Colinearity.

RESULTS AND DISCUSSION

During the period 2009-2018, the average number of DHF cases per month in Bandar Lampung was 69.10 (8.00–467.00) people (Table 1). For weather variables, the average rainfall is 7.16 mm (0.00-24.10), air temperature is 28.200C (26.6-29.30), and humidity is 80.09% (73.90-86 , 30%).

Table 1
Description of research variables

Variables	n (Month)	Mean	Median	Minmal	Maximal
DHF (case)	120	69,10	48,50	8,00	467,00
Rainfall (mm)	120	7,16	6,40	0,00	24,10
Temperature (Celcius)	120	28,17	28,20	26,60	29,30
Humidity (%)	120	80,09	80,15	73,90	86,30

Based on the number of monthly cases (Figure 2), the trend of dengue fever in the period 2009-2017 was higher in January, February and March for each year, then gradually decreased in the following months. The months with low cases are August, September, and October. In general, the movement for an increase in cases began in November, and peaked at the beginning of each following year. The data distribution also shows that there are DHF cases every month, concluding that the disease is endemic.

Although the pattern is the same, in 2012 there was a significant increase in DHF cases and was the highest case during the period 2009-2018 (Table 2). In 2018, it looks a little different compared to previous years. Typically, cases start to fall in March, but in 2018 cases continued to move up until they peaked in July. In Figure 2 it can also be seen that in the 2016-2018 period the number of cases tended to be high for each month.

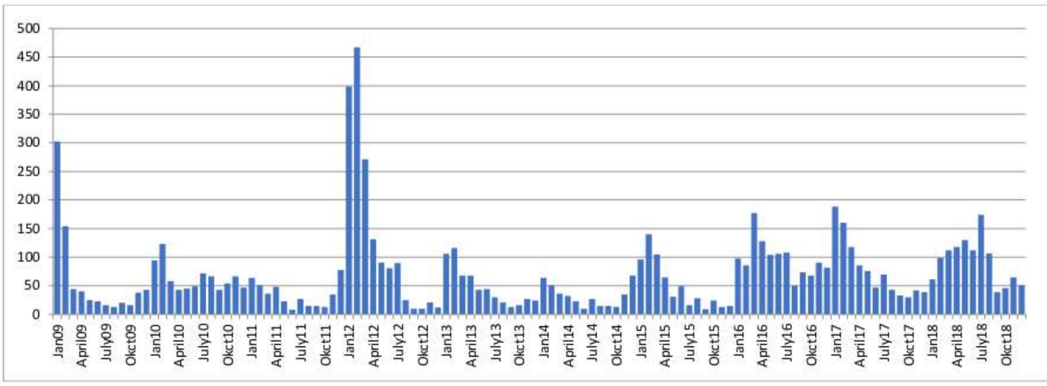

Figure 2
Number of DHF cases based on the months (2009-2018)

Based on Table 2, the highest rainfall was in 2010 (Mean = 15.52 mm), and the lowest was in 2011 (Mean = 4.63 mm). In the 2015-2018 period, rainfall was relatively stable between 7.02-8.19 mm. In Figure 3, it can be seen that there is always rain every month of observation, with varying amounts. Although not persistent, there is more rainfall in December, January and February, and less in June, July and August. Rainfall starts to move up in October, and peaks in December and January. These results suggest that the increase in rainfall precedes the increase in the number of DHF case.

Table 2
Description of research variables based on the year of observation

Year	n (Month)	Case	Mean		
			Rainfall	Temperature	Humidity
2009	12	734	5,32	28,26	77,53
2010	12	763	11,52	28,36	79,36
2011	12	413	4,63	28,04	77,78
2012	12	1608	5,19	28,19	78,34
2013	12	576	7,23	27,93	80,75
2014	12	389	4,89	27,90	81,74
2015	12	591	8,59	28,01	80,49
2016	12	1172	8,11	28,55	81,26
2017	12	932	7,02	28,24	81,86
2018	12	1114	9,18	28,22	81,81
Total	120	8292	7,16	28,17	80,09

The average air temperature (Table 2) is relatively stable in the range of 27.90-28.55 0C, the lowest in 2014 and the highest in 2016. In Figure 3, it can be seen that the temperature in 2013 and 2014 was slightly lower than the previous years. another. Although it did not show a big difference, the air temperature was higher in April-June and September-December. The low temperatures are mostly in January-March and July-August. When compared with the average rainfall, months with low temperatures coincide with high rainfall. When compared with the number of DHF cases, high cases are seen in months with low temperature. These results indicate a correlation between the two variables.

Based on data for each observation year (Table 2), the average humidity ranges from 77.53-81.86%, the lowest in 2009 and the highest in 2017. Although it does not show a permanent pattern, humidity is higher in December-March, and low in July-September. Associated with other weather variables, months with high humidity coincide with high rainfall. When compared with cases, DHF cases were more frequent in months with high humidity (Figure 3).

The Kolmogorov-Smirnov test was conducted to determine the normality of the data, both annual data (n = 12), and total data (n = 120) for each research variable. In each year (Table 2), it can be seen that the distribution of dengue fever case data is not normal for 2009, 2012, and 2015. The distribution of climatic factor data looks normal for each observation year. However, after being combined (n = 120), the data distribution was not normal for the variables of DHF, rainfall, and temperature. In the humidity variable, the data still shows a normal distribution.

Table 3
Data normality test using Kolmogorov-Smirnov at CL = 95%

Year	Case	Kolmogorov-Smirnov (p-value)			
		DHF	Rainfall	Temperature	Humidity
2009	734	0,000	0,200	0,200	0,200
2010	763	0,200	0,200	0,200	0,200
2011	413	0,200	0,200	0,064	0,200
2012	1608	0,014	0,200	0,200	0,200
2013	576	0,140	0,200	0,200	0,200
2014	389	0,200	0,200	0,200	0,060
2015	591	0,041	0,114	0,184	0,128
2016	1172	0,158	0,089	0,200	0,090
2017	932	0,106	0,200	0,083	0,200
2018	1114	0,200	0,200	0,200	0,200
2009-2018	8292	0,000	0,019	0,012	0,200

The results of the normality test are used to determine the analytical technique to be used. If the data were normally distributed, the Pearson Correlation (CL = 95%) was used, and the data were not normally distributed, the Spearman's rank correlation (CL = 95%) was used.

In the period data (n = 120), it can be seen that rainfall (R = 44.4%) and humidity (R = 30.3%) show a significant correlation with the number of DHF cases in Bandar Lampung City (Table 4). The correlation is positive with the mean correlation is interpreted as moderate (0.26 <R <0.50). He explained that the high rainfall and humidity were followed by an increase in the number of DHF cases.

Table 4 also shows the correlation between DHF cases and each of the weather variables in each study year. Rainfall shows a significant correlation with dengue cases in 2011 (R = 69.8%) and 2015 (R = 65.8%). In both years, the correlation is positive with a strong closeness (R> 0.51). High rainfall, followed by a high number of DHF cases. Meanwhile, in other years, there is insufficient evidence to state a significant correlation (p-value> 0.05).

Air temperature showed a significant correlation with DHF cases in 2014 (R = -60.7%). Negative correlation with strong closeness (R> 0.51). These results explain, the increase in air temperature is followed by a decrease in DHF cases. In

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the same year, apart from being related to temperature, DHF cases were also related to humidity (R = 64.3%). In 2015, humidity was significantly associated with DHF cases (R = 66.8%), together with rainfall. The correlation between humidity and dengue cases is positive with strong closeness.

Table 4
The result of correlational analysis of the number of DHF cases and weather factor

Year	n (month)	Rainfall		Temperature		Humidity		Correlation Test
		R	P-Value	R	P-Value	R	P-Value	
2009	12	0,490	0,106	-0,436	0,157	0,248	0,437	Spearman's rank
2010	12	-0,190	0,555	-0,118	0,715	-0,073	0,821	Pearson Corrl
2011	12	0,698	0,012	-0,208	0,517	0,565	0,056	Pearson Corrl
2012	12	0,473	0,121	-0,572	0,052	0,172	0,593	Spearman's rank
2013	12	0,246	0,441	0,090	0,780	0,012	0,971	Pearson Corrl
2014	12	0,510	0,090	-0,607	0,036	0,643	0,024	Pearson Corrl
2015	12	0,658	0,020	-0,546	0,066	0,668	0,018	Spearman's rank
2016	12	0,237	0,458	0,467	0,125	0,432	0,161	Pearson Corrl
2017	12	0,159	0,622	-0,434	0,159	0,068	0,833	Pearson Corrl
2018	12	0,383	0,219	-0,397	0,202	0,266	0,403	Pearson Corrl
2009-2018	120	0,444	0,000	-0,140	0,126	0,303	0,001	Spearman's rank

Figure 3 shows the monthly trend of DHF cases and weather variables (n = 120). Statistically it has been proven that the number of DHF cases is related to rainfall (Table 4). Figure 3.a shows the suitability of the DHF case trend pattern with rainfall. The increase in rainfall coincides with the increase in the number of dengue cases, and vice versa. However, based on annual data, confirmation of the significance of the correlation was only in 2011 and 2015 (Table 3).

In general, the DHF case trend pattern does not correspond to the air temperature trend (Figure 3.b). These results confirm the results of previous statistical tests. Based on annual data, only 2014 shows a negative pattern with a dengue trend (Table 4).

The results of statistical tests concluded the significance of the correlation between dengue fever cases and humidity in 2009-2018 (Table 4). This result is illustrated in Figure 3.c which shows the suitability of the case trend pattern and air humidity. The high number of dengue cases coincides with the increase in humidity. However, based on annual data, the suitability of the pattern is identical only in 2014 and 2015.

Based on the normality test, there are three time periods that are not normally distributed, namely 2009, 2012, 2015, so they are not included in the multivariate analysis stage. However, considering the results of the correlation test, the 2015 data is still included, while still paying attention to the normality of the model residuals. The amount of data analyzed was 96 data.

Table 5 shows that the weather variables associated with dengue cases in Bandar Lampung are rainfall and humidity. Each variable gave an influence of 34.3% and 23.8%. Based on the value of the coefficient of determination (R square), the model was able to explain the correlation between weather variables and dengue cases by 21.4%, the rest by other variables not included in the study. The regression assumption assessment has also been fulfilled, namely the assumption of *Liniarity (*ANOVA = 0,000), *Existency* (Mean Residual = 0), *Independency* (Durbin Watson = 0.852), *Colinearity* (VIF rainfall = 1.06; humidity = 1.06), *Multivariate Normality* and *Homoscedascity* are shown in Figure 4.

The results showed that the weather variable had a strong correlation with the number of DHF cases in Bandar Lampung, namely rainfall and humidity. These results confirm research in several cities in Indonesia. Tosepu, et al., Stated that rainfall shows a very close correlation with the incidence of dengue fever in Kendari and Kolaka City (Tosepu, Tantrakarnapa, Nakhapakorn, et al., 2018; Tosepu, Tantrakarnapa, Worakhunpiset, et al., 2018). Positive correlations were also obtained in Sleman, Surabaya, Denpasar, and Pringsewu (Azhar et al., 2017; Kesetyaningsih et al., 2018a, 2018b; Tang et al., 2018; Yushananta & Ahyanti, 2014).

The correlation between rainfall and DHF cases is through vector abundance and distribution, thereby increasing the risk of dengue virus transmission (Gubler, 2013; Lloyd, 2003; Word Health Organization, 1997; World Health Organization, 2011). In the rainy season, water reservoirs will be filled, so they have the potential to become breading places for vectors (breading places). These places are any curved objects that can hold water, such as drums, empty cans, broken bottles, roof gutters, used tires, pieces of bamboo, holes in trees and leaf midribs (Lloyd, 2003; World Health Organization, 2011, 2014; Yushananta & Ahyanti, 2014).

Mosquito eggs that are already in the containers dry out but have not yet had time to hatch, will soon hatch into larvae after being submerged in water for 1 - 2 days (Lloyd, 2003; Word Health Organization, 1997; World Health Organization, 2011). Mosquito eggs can survive in a dry atmosphere for 3 months (Kemekes RI, 2005; Ministry of Health, 2011; Lloyd, 2003). In this condition, transovarium is a concern in the spread of DHF. Although not yet empirical in Bandar Lampung, several studies have reported transovariums in several cities in Indonesia. Transovary or vertical transmission is the entry of the dengue virus into the mosquito's ovary, so that the eggs that hatch already have the same virus as their parents (Tri Baskoro T. Satoto, Umniyati, Suardipa, & Sintorini, 2013; Tri Baskoro Tunggul Satoto et al., 2014; Wanti, Sila, Irfan, & Sinaga, 2016; Windyaraini, Marsifah, Mustangin, & Soenarwan Hery Poerwanto, 2019).

Humidity is affected by rainfall because it increases the volume of water vapor in the air. In months with high humidity, along with high rainfall (Figure 3). Humidity affects diet, age at marriage, spread and longevity of Ae.aegypti, and accelerates virus replication (Brady et al., 2014, 2013; Negev et al., 2015; Regis et al., 2008; Yushananta, Setiawan, & Tugiyono, 2020). Humidity also affects the rate of evaporation of water in breeding places, thus having an impact on vector abundance. In the rainy season with high humidity, the vector population will increase twice so that it produces more eggs (Regis et al., 2008; Yushananta et al., 2020).

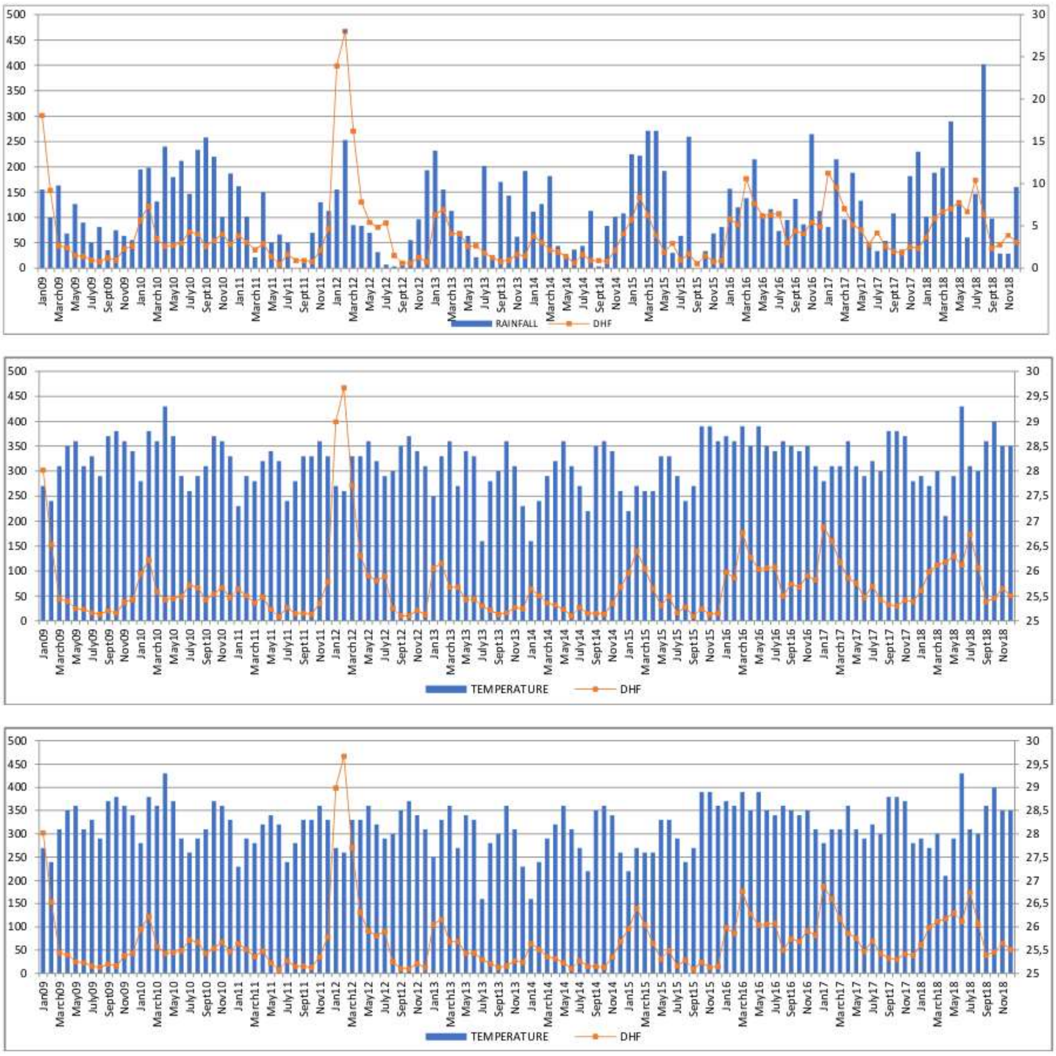

Figure 3
Trends in cases of DHF and rainfall (a), temperature (b), humidity (c) in Bandar Lampung City in 2009-2018

In this research, a significant correlation between air temperature and the number of dengue cases was seen in 2014 (Table 4). Negative value correlations; low air temperature, followed by a high number of cases. Temperature affects the extrinsic incubation period (EIP), which is the period between when mosquitoes absorb virus-laden blood and become infectious. At low temperatures, EIP becomes longer and it is possible for mosquitoes to survive long enough to transmit the virus (Brady et al., 2014, 2013; Kesetyaningsih et al., 2018b; Mourya et al., 2004; Tang et al., 2018). In the A. aegypti system, EIP is a non-linear temperature function so that even small temperature changes can cause changes in transmission dynamics (Focks, Daniels, Haile, & Keesling, 1995; Morin, Comrie, & Ernst, 2013).

In its dynamics, the weather variables are related and influence each other. High rainfall will increase humidity and lower air temperature. In the spread of dengue, this condition will increase the number of breading places, the speed of virus replication, the length of life and the spread of vectors, and shorten the EIP. Thus, vector eradication through environmental management becomes an effective DHF control effort. As long as drugs and vaccines have not been found, the only way to deal with DHF is through environmental management (Lloyd, 2003; World Health Organization, 2011).

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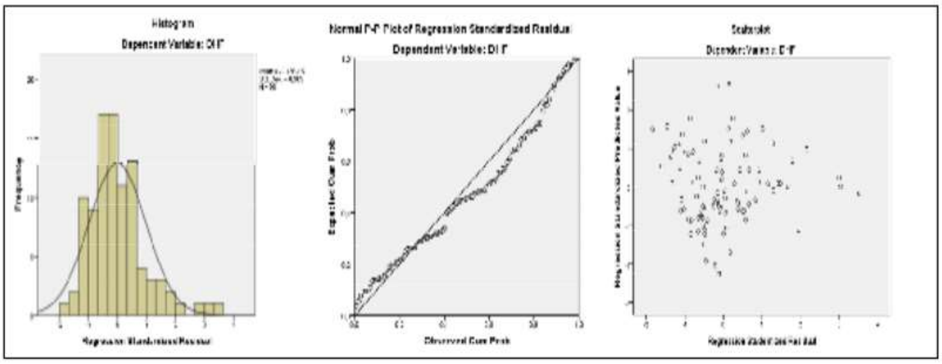
Table 5
Multivariate analysis results

	B	SE	t	Sig.	Beta	R^2
Constanta	-271,614	122,611	-2,215	0,029		
Rainfall	2,969	0,819	3,343	0,000	0,343	0,214
Humidity	3,856	1,537	2,38	0,014	0,238	

Figure 4
Histogram of residual (a), Normal P-P Plot regression standardize residual (b), Scater plot residual



Environmental management is carried out through environmental modification efforts such as draining stagnant water, disposing of solid waste, treating perforated plants; and efforts to manipulate the environment, such as cleaning and closing meetings of water reservoirs (World Health Organization, 2011). Environmental management must be community-based as a household responsibility in controlling DHF (Yushananta et al., 2020). The development of a weather-based surveillance system is an important thing that must be done in planning and controlling. This study has provided empirical evidence on the correlation between weather factors and the number of DHF cases.

RESEARCH LIMITATIONS

The research used secondary data from the Health office in Bandar Lampung City, which records were recorded every month. So that the analysis is carried out at the level of the month. The data collected daily becomes the expected ideal. So that the analysis of the spread of cases can be done in days, and a more comprehensive model is obtained. This research only focuses on weather factors, so it does not discuss other important factors related to the spread of DHF, such as pesticide resistance, vector resistance, control programs, transovariums, and community socio-culture. In the future, a more comprehensive research is needed.

CONCLUSIONS AND SUGGESTIONS

We found that the largest number of dengue cases in Bandar Lampung occurred in January, February and March. Rainfall is positively correlated with the number of cases, and the increase in rainfall precedes the increase in the number of DHF cases. Air temperature appears to be negatively correlated with cases, especially in 2014. Low temperatures coincide with high rainfall. Low humidity coincides with low rainfall, and has a positive correlation with the number of cases. The weather factor is an important factor in determining the incidence of dengue fever in Bandar Lampung, the region with the highest DHF infection in Lampung Province. Apart from more comprehensive research, community-based environmental management and the development of a weather-based surveillance system are urgent efforts that must be carried out in controlling DHF. These findings are expected to assist health authorities in improving efforts to prevent and eradicate dengue in the future.

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Conflict of Interest

The author states there is no conflict of interest.

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