

The Relationship Between Rainy Day and Sunshine Duration with Dengue Hemorrhagic Fever Incidence in City of Yogyakarta

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ABSTRACT

Introduction – Dengue fever is a disease that often occurs in tropical countries, including Indonesia. DHF is caused by the dengue virus from the Flaviviridae family and infects through the *Aedes aegypti* or *Aedes albopictus* mosquitoes. DHF transmission is related to the survival capacity, behavior, and habitat of mosquito as vectors, therefore it may be influenced by climatic factors such as the number of rainy days and the sunshine duration.

Purpose – The aim of the study was to determine whether the number of rainy days and the sunshine duration were correlated with the incidence of dengue fever in the city of Yogyakarta.

Methodology/Approach – This study uses a retrospective analytic observational method. This study was conducted by analyzing the relationship between monthly data on the number of rainy days and duration of sunshine with cases of dengue fever in the city of Yogyakarta in 2015-2019. Climatic data were obtained from the recording of the Yogyakarta Mlati Climatology Station and data on dengue cases were obtained from the records of the Yogyakarta City Health Office. The data was then analyzed by the Spearman correlation test to find the correlation between the two variables.

Findings – The city of Yogyakarta is an endemic area of DHF with an accumulation of 3705 cases during 2015-2019. The city has a tropical climate with an average of 8.96 rainy days and 66% of sunshine duration per month. In the Spearman correlation test, it is found that there was no relationship between DHF cases and the number of rainy days, which had a non-significant positive correlation ($p = 0.056$; $r = 0.249$) and there was no relationship between DHF cases and sunshine duration had a negative and insignificant correlation ($p = 0.316$; $r = - 0.132$). There is no significant relationship between the number of rainy days and the sunshine duration with the incidence of DHF in the city of Yogyakarta. There is a difference in the direction of the correlation between the two variables, namely the number of rainy days is positively correlated while the sunshine duration is negatively correlated with the incidence of DHF in Yogyakarta City.

Originality/ Value/ Implication – This study proves that the factor of the number of rainy days shows a positive correlation with the number of cases of DHF, while the factor of the sunshine duration shows a negative correlation in the city of Yogyakarta.

Keywords: Rainy day, Sunshine duration, DHF

INTRODUCTION

Dengue hemorrhagic fever is a disease that is often found in the tropics. This disease is caused by the dengue virus from the Flaviviridae family and infects humans through the *Aedes aegypti* or *Aedes albopictus* mosquitoes. In the last decade, dengue fever is still a significant health burden worldwide. It is estimated that there are 50 million cases of dengue fever annually globally. Generally, this disease is endemic with a significant prevalence rate in tropical countries such as the Philippines, Myanmar, and Indonesia (WHO, 2021).

The Pusdatin of the Ministry of Health (2021) reported that there were 108,303 cases of dengue fever during 2020 throughout Indonesia. In Indonesia, dengue fever is still a significant health burden, this can be seen from the high incidence rate. The incidence rate of dengue reached 40 cases per 100,000 population in 2020. DI Yogyakarta province itself was ranked third in Indonesia based on the highest incidence rate of 93.2 cases per 100,000 population in 2020.

Dengue fever is one of the endemic infectious diseases that affects the population of Yogyakarta City. Based on data from the Yogyakarta City Health Office, in 2020 there were 296 cases of dengue fever in the city of Yogyakarta, with an average of 601 cases per year in 2016-2020. The case fatality rate in 2019 was 0.2%, i.e. 1 patient died out of a total of 478 patients infected with dengue fever (Yogyakarta City Health Office, 2020).

Mentioned in an article published by WHO (2021), the spread of dengue fever in the tropics is influenced by climatic factors in the form of rainfall, temperature, and relative humidity. The WHO statement is reinforced by the results of research conducted by other researchers, such as a study conducted by Couret (2014) regarding the relationship between temperature factors and the growth rate and survival rate of *Aedes aegypti* mosquitoes and research by Tuladhar (2019) regarding the relationship of meteorological factors (rainfall, temperature and humidity) on the prevalence of dengue fever.

In the research that will be conducted by the author, two climatic factors will be examined, namely the number of rainy days and the sunshine duration. These two factors are closely related to other climatic factors, the number of rainy days is positively correlated with rainfall (Ardhitama, 2013). Meanwhile, long-term duration of sunlight is associated with an increase in the temperature of a place (Tjasyono, 2004). Also, Sunshine duration was chosen because this variable has not been widely studied as one of the climate variables that can affect the incidence of dengue hemorrhagic fever. Based on these conditions, the authors are interested in exploring the deeper correlation between climatic factors by conducting research that identifies the

relationship between the rainy day and the duration of sunshine with dengue fever cases in the city of Yogyakarta.

LITERATURE REVIEW

The number of rainy days is defined as the accumulation of the number of days where it rains in one month in units of days (Ariffin et al, 2010). Rain is a precipitation event (the fall of a liquid substance from the atmosphere in liquid or frozen form) on the earth's surface. Rain occurs through the process of condensation of water vapor in the atmosphere into water droplets and falls to the earth's surface (Winarno, 2019). Other forms of rain include, storms, drizzle, fog, and hail. The number of rainy days in an area is influenced by air pressure, sea currents, topography, wind, and seasonal characteristics of an area (Balasubramanian, 2017).

Research by Kosnayani (2018) confirms that the number of rainy days affects the incidence of dengue fever. This is related to the number of rainy days that are more frequent, creating an ideal habitat for mosquitoes to lay their eggs in areas that are flooded and accommodated by rainwater. A retrospective study of dengue fever cases in hospitals in the Dhaka City Corporation area conducted by Rahman (2020) showed that there was a seasonal variation in the incidence of dengue cases which had a significant association with the number of rainy days per month. This is due to the egg-laying pattern of the *Aedes aegypti* mosquito which tends to lay its eggs in water media in urban areas near human habitation. The incidence of dengue that spreads during the rainy season is caused by the presence of many containers that hold rainwater or puddles filled with rainwater. Research by (Pasin, 2018) also found a positive correlation between the number of rainy days and the incidence of dengue fever. The large number of rainy days in the rainy season will increase the risk of transmission of dengue fever due to the formation of an ideal habitat for mosquitoes to lay their eggs in containers that collect rainwater.

The sunshine duration is defined by duration of time the sun shines brightly on the earth's surface starting from sunrise to sunset (Arifin et al, 2010). The sunshine duration is calculated in units of hours, the value of tenths, or in percentages (Arifin, 2010). Measurements using campbell stokes or cards. The incoming sunlight will be focused on hitting the card so that it can absorb the intensity of the incoming sunlight (BMKG, 2006).

The sunshine duration affects the activity of mosquitoes, especially the intensity of light. Light affects the movement of mosquitoes to find food and find a place to rest. Female mosquitoes usually look for prey during the day. The *Aedes aegypti* mosquito is a species that looks for a place to rest in the dark and is protected from the heat of the sun. Sun exposure is one of the key factors that can affect mosquito productivity (Fuadiyah, 2018). Another study by Nia Ratnasari (2014) on climatic factors, larva free rates, and the incidence of dengue fever in Kulon Progo Regency from 2008 to 2013 also showed that the incidence of dengue had a correlation with the length of sunlight.

METHOD

This research is a retrospective analytic observational. The study was conducted by analyzing monthly data on the number of rainy days, duration of sunshine, and cases of

dengue fever in the city of Yogyakarta from 2015-2019 to find out whether there is a correlation between the two climate variables and the incidence of dengue fever.

In this study, "number of rainy days" is defined as the number of days during which a 24-hour period of 0.5 mm or more of rainfall collects. "Sunshine duration" is defined as the duration of the sun shining from sunrise to sunset in one day as a percentage ratio, the number 100% is defined as a condition where the sun shines brightly from sunrise to sunset (generally around 12 hours in the tropics).

The data used in this research is secondary data. Variable data on the number of rainy days and duration of sunshine were obtained from the monthly recording of the Yogyakarta Climatology and Geophysics Station and data on dengue cases were obtained from the monthly recording of the Yogyakarta City Health Office.

The data is then analyzed using the SPSS application. The Spearman correlation test was used to analyze the relationship between the number of rainy days and the duration of sunshine with the incidence of dengue hemorrhagic fever in the city of Yogyakarta, this test was chosen because the data were not normally distributed. From this test, it will be obtained how big the relationship between the number of rainy days and the length of sunshine with the incidence of dengue hemorrhagic fever in the city of Yogyakarta.

RESULT AND DISCUSSION

1. General description of the incidence of Dengue Hemorrhagic Fever in Yogyakarta City during 2015-2019

From the results of data collection conducted by the Yogyakarta City Health Office, the number of cases of dengue hemorrhagic fever accumulated was 3705 cases, the number of which fluctuated every month per year. The number of cases of dengue hemorrhagic fever in the city of Yogyakarta each month in the period 2015 to 2019 can be seen in table 1.

Table 1. Number of cases of dengue hemorrhagic fever in Yogyakarta City in 2015-2019

Month	2015	2016	2017	2018	2019	Average/ month
January	93	89	159	7	69	83,4
February	135	102	71	6	56	74
March	118	132	54	8	61	74,6
April	134	121	44	10	76	77
May	130	195	22	9	96	90,4
June	129	203	15	10	47	80,8
July	95	128	8	6	19	51,2
August	33	178	63	3	11	57,6
September	27	159	3	5	12	41,2
October	17	116	15	13	12	34,6
November	20	159	9	8	10	41,2
December	14	123	12	17	9	35

(Source: Yogyakarta City Health Office)

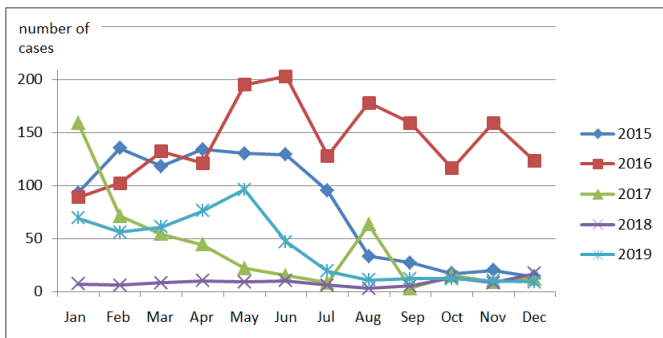


Figure 1. Number of cases of dengue hemorrhagic fever in Yogyakarta City in 2015-2019

The number of cases of dengue hemorrhagic fever in the city of Yogyakarta is still in a significant number, with an average of 731 cases of dengue hemorrhagic fever per year. In the last five years, the highest annual number of dengue cases occurred in 2016 with an accumulation of 1705 cases, while the lowest annual number of dengue cases occurred in 2018 with 113 cases.

The highest number of incidents in the last five years occurred in June 2016 as many as 203 cases and the lowest incidence occurred in August 2018 as many as 3 cases. Generally, the highest number of incidents occurred in the months in the early semester, namely in February 2015 as many as 135 cases, in June 2016 as many as 203 cases, in January 2017 as many as 159 cases, and in May 2019 as many as 96 cases. On the other hand, the lowest number of incidents generally occurred in the final semester months, namely in December 2015 as many as 14 cases, in August 2017 as many as 3 cases, in September 2017 as many as 3 cases, in August 2018 as many as 3 cases, and in December 2019 as many as 17 case.

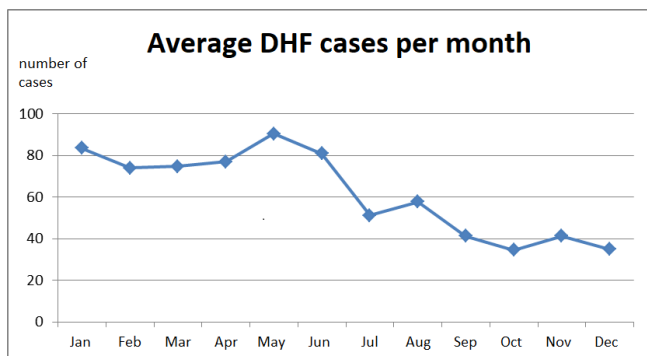


Figure 2. Average Monthly Dengue Hemorrhagic Fever Cases in the City of Yogyakarta in the 2015-2019 period

Based on the average monthly DHF cases, which can be seen in Figure 2. there is a fluctuating increase in DHF cases starting from January and then decreasing again in July. The highest peak in the number of dengue cases occurred in May with an average of 90.4 cases. While the lowest point in the number of dengue cases occurred in December with an average of 35 cases. In a rough picture, we can see a monthly or seasonal pattern of dengue fever cases in the city of Yogyakarta.

2. General description of the number of rainy days in Yogyakarta City in the period 2015-2019

The number of rainy days is the accumulation of days where it rains in one month in units of days. In table 2, the number of rainy days is recorded in units of days per month. The climate condition of Yogyakarta City is a tropical area with a significant number of rainy days in the rainy month and conversely the number of rainy days is

rare in the dry season.

Table 2. Average number of rainy days per month in Yogyakarta City in 2015-2019 (days)

Month	2015	2016	2017	2018	2019	Average/month (day)
January	17,94	11,87	17,56	23,39	20,71	18,29
February	11,87	14,38	17,56	16,77	14,75	15,06
March	18,72	19,24	13,71	13	17,86	16,5
April	13,23	9,82	11,19	10,67	9,77	10,93
May	4,81	9,44	4,31	4,51	1,96	5
June	1,98	7,45	1,86	0,92	0,27	2,49
July	0	8,31	2,03	0	0,4	2,14
August	0	7,87	0	0	0,62	1,69
September	0	11,11	3,66	2,05	0	3,36
October	0	13,93	8,4	0,27	0	4,52
November	10,59	18,53	17,06	10,36	4,56	12,22
December	17,34	14,35	13,96	13,49	17,45	15,31

(Source: Geophysics Station, Sleman, DI Yogyakarta)

In the city of Yogyakarta, there is a trend in the number of rainy days which increases significantly from the transition from October to November. The general rainy season reaches its peak in the first three months, namely January, February and March. This is marked by the highest number of rainy days in the year. Then the number of rainy days will gradually fall from April to June, before reaching the dry season which generally occurs in July to September.

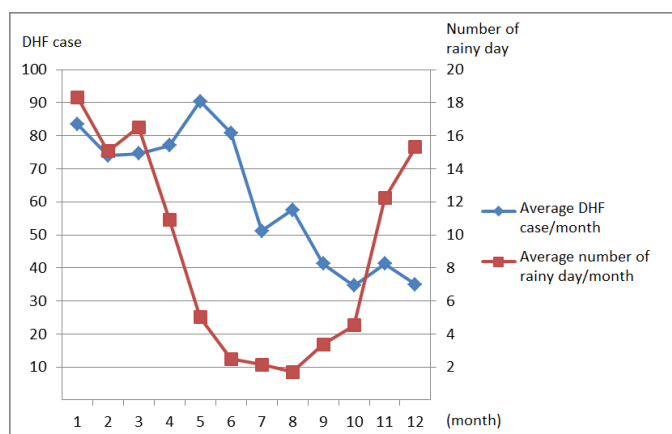


Figure 3. Average cases of dengue hemorrhagic fever and the number of rainy days per month in Yogyakarta City in the 2015-2019 period

Figure 3 shows that there is an impression of a positive correlation between the variable number of rainy days and the number of cases of dengue hemorrhagic fever. For example, the average number of rainy days decreased in May-August and followed by a decrease in the number of dengue fever cases in that month.

3. General description of the sunshine duration in the city of Yogyakarta in the 2015-2019 period

The sunshine duration is the duration of time the sun shines brightly on the earth's surface starting from sunrise to sunset, the duration of sunrise to sunset is around 12 hours per day. In table 3. the duration is recorded in percent, the number 100% shows the sun shines brightly for 12 hours from sunrise to sunset.

Table 3. Average percentage of sunshine duration per month in Yogyakarta City in 2015-2019 (%)

Month	2015	2016	2017	2018	2019	Average/month (%)
January	60	65	38	36	59	51,6
February	69	43	48	62	65	57,4
March	66	54	59	65	40	56,8
April	60	69	59	75	75	67,6
May	82	62	74	81	83	76,4
June	84	62	66	69	77	71,6
July	85	71	54	86	79	75
August	93	70	71	77	83	78,8
September	89	63	68	71	88	75,8
October	92	58	57	82	87	75,2
November	67	46	26	61	68	53,6
December	57	45	50	52	59	52,6

(Source: Geophysics Station, Sleman, DI Yogyakarta)

The climate condition of Yogyakarta City is a tropical area with an average of 66% of sunshine duration time per year. The sunshine duration had a fluctuating up and down cycle every month, with the highest peak in the last 5 years occurring in August with an average of 78.8% and the lowest occurring in January with an average of 51.6%.

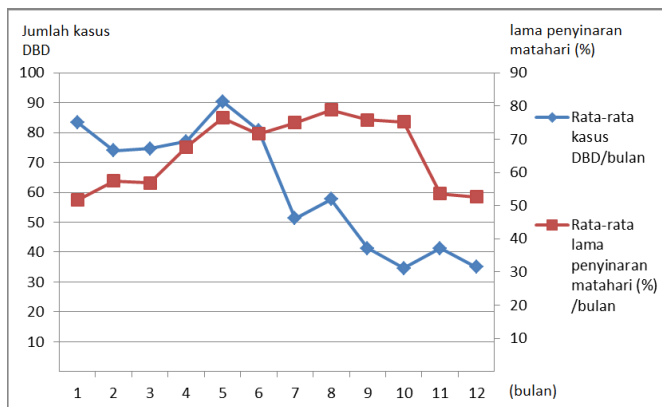


Figure 4. Average Cases of Dengue Hemorrhagic Fever and Sunshine duration per month in Yogyakarta City in the 2015-2019 period

In Figure 4. it can be seen that there is an impression of a negative correlation between the variable duration of sunshine and the number of cases of dengue hemorrhagic fever. For example, the duration of sunshine reaches its highest average in July-October but is inversely proportional to the number of cases of dengue fever decreasing in that month.

4. The results of the correlation analysis of the number of rainy days and the sunshine duration on the incidence of dengue hemorrhagic fever in the city of Yogyakarta

The selection of the correlation method to be used was chosen based on the results of the normality test on the data on the number of rainy days, the sunshine duration, and the data on dengue cases. The three data are numerical data so that there are two options available in the correlative test that can be used, namely the Pearson test if both data are normally distributed or the non-parametric Spearman test if one of the data is not normally distributed. After the normality test was carried out, it was found that the data on the number of rainy days were normally distributed, the data for the sunshine duration was not normally distributed, and the data for DHF cases were not normally distributed. Therefore, in the correlative test of the two variables, Spearman's non-parametric test was used.

In the Spearman correlation test, there was no relationship between DHF cases and the number of rainy days had a non-significant positive correlation ($p = 0.056$; $r = 0.249$) and there was no relationship between DHF cases and the sunshine duration had a negative and insignificant correlation ($p = 0.316$; $r = -0.132$). There is no significant relationship between the number of rainy days and the sunshine duration with the incidence of DHF in the city of Yogyakarta. There is a difference in the direction of the correlation between the two variables, namely the number of rainy days is positively correlated while the sunshine duration is negatively correlated with the incidence of DHF in Yogyakarta City.

The direction of the positive correlation on the variable number of rainy days shows that an increase in the number of rainy days will also be followed by an increase in dengue cases and vice versa if there is a decrease in the number of rainy days it will also be followed by a decrease in dengue cases. While the negative correlation direction on the variable sunshine duration indicates that an increase in the sunshine duration will be followed by a decrease in DHF cases and vice versa if there is a decrease in the sunshine duration, it will be followed by an increase in DHF cases.

5. The relationship between the number of rainy days and the incidence of dengue fever in the city of Yogyakarta

The results of the correlation test show that there is no relationship with the direction of positive correlation. This shows that the number of rainy days does not have a significant effect on the incidence of DHF. The direction of positive correlation indicates that the movement between the 2 variables has the same direction.

The research conducted by Kosnayani (2018) shows that the variables of the number of rainy days and rainfall are related to each other. This variable is closely related to the mosquito vector habitat factor, the number of frequent rainy days causes an increase in the occurrence of stagnant water which is ideal for mosquitoes to use as a habitat to lay their eggs. This ideal habitat will increase the number of mosquito populations as vectors that carry the dengue virus, this will certainly increase the probability of the number of dengue cases.

The average number of rainy days per month in Yogyakarta City in 2015-2019 is 8.96 days. On average, the highest number of rainy days occurred in January, which was 18.29 days and the least in August, which was 1.69 days. Based on research conducted by Perwitasari (2015) the number of rainy days that is known to cause an increase in the incidence of DHF is > 20 rainy days with rainfall > 200 mm. In the city of Yogyakarta, the highest average rainy day occurs in January with an average of 18.29 days per month. Therefore, the correlation between the number of rainy days and cases of DHF in the city of Yogyakarta is not significantly correlated due to the fact that the required number of rainy days has not been achieved in order to have a significant effect.

Other evidence that can explain the non-significant correlation between the number of days and cases of DHF can be seen in the results of research by Dini (2011), which requires ideal conditions between the number of rainy days and rainfall. If the rainfall is too high, it will cause flooding and the mosquito habitat to lay eggs will be swept away. Conversely, if the rainfall is too low, it will reduce the probability of stagnant water that can be used by mosquitoes to lay eggs.

6. The relationship between the sunshine on the incidence of dengue fever in the city of Yogyakarta

The results of the correlation test show that there is no relationship with the direction of the negative correlation. This shows that sunshine duration does not have a significant effect on the incidence of DHF. The direction of the negative correlation indicates that the movement between the 2 variables has the opposite direction. This means that every time there is an increase in one variable, there will be a decrease in the other variable.

Several similar studies have also been carried out by other researchers in different areas showing that the variable duration of sunlight does not have a significant relationship with dengue cases, for example, the research conducted by Sungono (2004) in 1999-2003 in Jakarta and Dini (2009) in 2007-2008 in Serang Regency.

In another study, the duration of sun exposure had a significant correlation with the incidence of dengue hemorrhagic fever. For example, research conducted by Fuadiyah (2018) in Cimahi City, Handayani (2012) in DKI Jakarta, and Silaban (2005) in Bogor.

The sunshine duration is related to the daily light intensity variable. In a study conducted by Nurdiana (2015), sunshine affects the duration of mosquito growth maturation to maturity. Sunshine also affects the behavior of mosquitoes in foraging and resting, mosquitoes will tend to look for food in the morning at 08.00-10.00 and in the afternoon at 15.00-17.00, this condition is suitable because the environmental temperature is still cool. Conversely, in a hot environment, mosquitoes will tend to rest in their humid habitat and avoid sunlight (WHO, 2005). The breeding place of the *Aedes aegypti* mosquito is also influenced by the length of sunshine, these mosquitoes will choose and breed rapidly in shady habitats that have standing water and are protected from direct sunlight.

In a study conducted by Handayani (2012), it was concluded that the results of the study on the variable

sunshine duration had a significant negative correlation at an interval of 9 weeks with the incidence of dengue fever. This is interpreted as a decrease in the percentage of previous sun exposure that will affect the incidence of dengue fever in the next 9 weeks. In the city of Yogyakarta, the decrease in the sunshine duration starts from October to November. However, cases of dengue fever that occurred did not increase significantly as observed in Handayani's (2012) study.

There are several things that might affect the difference in significance between the variable duration of sun exposure and the incidence of dengue fever. Other climatic factors, such as rainfall, temperature, and humidity are thought to have an indirect influence. However, there are similarities in the direction of correlation with previous studies, namely the relationship between variables has a negative correlation direction, which indicates that a decrease in the sunshine duration will be followed by an increase in the incidence of dengue fever.

CONCLUSION AND RECOMMENDATION

There is no significant relationship between the number of rainy days and the duration of sunshine with the incidence of dengue fever in the city of Yogyakarta. There is a difference in the direction of the correlation between the two variables, namely the number of rainy days is positively correlated while the sunshine duration is negatively correlated with the incidence of DHF in Yogyakarta City.

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