The Correlation of Climatic Factors with Incidence of Dengue Hemorrhagic Fever in Palembang Bari General Hospital

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Abstract. An estimated 50 million dengue infections occur worldwide every year, nonetheless in Palembang that the death of dengue hemorrhagic fever (DHF) continues to be a public health problem. Several factors such as characteristic determinants and climate factors caused a high rate of DHF. The study aims to determine the correlation of patients’ characteristics and climatic factors with the incidence of DHF in the general hospital of RSUD Palembang Bari from January 2015 to August 2019. The study was an analytic observational study with a cross-sectional design, using 309 patients’ data and climatic factors obtained from the climate office of the BMKG of Palembang. The sampling technique using a simple random sampling method and the analysis using the chi-square test and the Spearman correlation test. The results showed that the characteristics of DHF patients were a median age of 14 years, dominated by male patients (57,3%), and secondary education level (33,8%). The climatic factors that correlate with the incidence of DHF (p = 0.032) were the air temperature, while other factors such as rainfall (p = 0.797) and relative humidity (p = 0.718) were not significant. The highest incidence of dengue during 2015-2019 occurred around March-April each year. It is necessary to routinely carry out breading place eradication practice 2-3 months before the surge.

1. Introduction

Dengue hemorrhagic fever (DHF) is a severe condition of dengue virus infection [1]. It is estimated that 50 million dengue virus infections occur worldwide [2], where 500,000 DHF cases caused 22,000 deaths every year [1]. With the high morbidity and mortality rates, DHF continues to be a public health problem especially in the equatorial countries where the climate factors suitable for transmission. Indonesia has the highest cases in the Southeast Asia region in 2012 with 45,964 cases and 408 people died [3]. The distribution DHF in Indonesia is evenly distributed in almost all provinces, where South Sumatra province was ranked 10th in 2016 with 3,851 cases and 25 of them died, and Palembang city with 932 sufferers and 2 of them died [4].

The high morbidity and mortality rate of dengue hemorrhagic fever is caused by several factors, including host factors and climate factors [5]. Host factor is various predisposing conditions in a human that can affect the occurrence of DHF [6], such as age, sex, education level, knowledge level, and behavior to prevent this disease. Climate factors can affect the occurrence of DHF, that rainfall, humidity, and ambient temperature are closely related to the life cycle of the mosquito virus vector [9].

DHF is a highly dangerous disease, and the risk factors should be identified and verified, to put proper mitigation.
2. Methods

The study used descriptive-analytic research with a cross-sectional design, that the secondary data were taken from the regional general hospital Bari (RSUD Palembang Bari) and the data from Meteorological, Climatological, and Geophysical Agency Center (BMKG) Kenten Palembang. Research’s data included in the study were on patients' characteristics and climate factors such as rainfall, humidity, and air temperature ranging between January 2015 and August 2019 collecting data. The ethical certificate was approved by the Ethics Committee of the Faculty of Medicine, University of Muhammadiyah Palembang.

2.1. Measuring Instruments

The instrument used was questionnaires. Medical records provide the data on patients' age, gender, and level of education. Simple random sampling was applied to a minimal sample size of 309 from a total of 1360 patients data. Randomization was using a simple application from the excel office®. Climate data were averaged monthly from the daily results, using the minimum and maximum points.

2.2. Statistics Analysis

The data obtained were analyzed using the SPSS program and displayed in tabular form. The relationship between the dependent variable and independent variables were determined by the Chi-square test ($\alpha = 0.05$). Further analysis using the chi-square test and the Spearman correlation. Further analysis tabular were prepared in the figure for better visualization.

3. Result and Discussion

The results were the characteristics of patients and average numbers of the climate factors, also the analysis of its relationship to DHF incidence.

| Table 1. The frequency distribution of age (N = 309) |
| Variable | Frequency | Percentage |
|----------|----------|------------|
| Toddler (3-4 years) | 0 | 0 |
| Child (5-11 years) | 123 | 39.86% |
| Adolescent (12-16 years) | 60 | 19.41% |
| Adult (17-59 years) | 124 | 40.12% |
| Old (≥ 60 years) | 2 | 0.64% |

| Table 2. The frequency distribution based on gender (N = 309) |
| Year | Male | Female |
|------|------|--------|
|      | Frequency | Percentage | Frequency | Percentage |
| 2015 | 34 | 55.7% | 27 | 44.3% |
| 2016 | 41 | 53.2% | 36 | 46.8% |
| 2017 | 36 | 69.2% | 16 | 30.8% |
| 2018 | 26 | 48.1% | 28 | 51.9% |
| 2019 | 40 | 61.5% | 25 | 38.5% |

| Table 3. The frequency distribution based on education level (N = 309) |
| Year | Not Attending | Pre-School | Primary | Secondary | Tertiary |
|------|---------------|------------|---------|-----------|---------|
| Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| 2015 | 11 | 18 | 14 | 23 | 15 | 24.6 | 21 | 34.4 | 0 | 0 |
| 2016 | 23 | 29.9 | 12 | 15.6 | 14 | 18.2 | 26 | 33.8 | 2 | 2.6 |
| 2017 | 17 | 32.7 | 7 | 13.5 | 9 | 17.3 | 17 | 32.7 | 2 | 3.8 |
| 2018 | 8 | 14.8 | 24 | 44.4 | 8 | 14.8 | 14 | 25.9 | 0 | 0 |
| 2019 | 8 | 12.3 | 21 | 32.3 | 13 | 20 | 21 | 32.3 | 2 | 3.1 |
3.1. Questionnaires

Table 1 showed the frequency distribution of age, who dominated with the adult followed by the child age, with an average age of 14 years old. Table 2 showed the frequency distribution of gender, with more male patients than female. Table 3 showed the frequency distribution of the education level of patients, that the secondary school level with the highest percentage after the primary one, and no one in the tertiary education.

3.2. Tabular form Analysis

Figure 1 showed the relation between climate factors (rainfall, air temperature, and relative humidity) and the incidence of DHF. The air temperature weakly correlates with \( p = 0.007 \), while other non-significant \( p = 0.797 \) and \( p = 0.718 \), which are the rainfall and the relative humidity, respectively.

| Year   | Rainfall (mm) | Air Temperature (°C) | Humidity (%) | DHF Incidence |
|--------|---------------|-----------------------|--------------|---------------|
| 2015   | 180.08        | 27.71                 | 89.4         | 61            |
| 2016   | 273.5         | 27.77                 | 83           | 77            |
| 2017   | 199.16        | 27.53                 | 83.66        | 52            |
| 2018   | 196.75        | 27.45                 | 87.66        | 54            |
| 2019   | 185.9         | 27.88                 | 86.6         | 65            |

Figure 1. The relation between climatic factors and DHF incidence in 2015-2019
Figure 2. Monthly mean of rainfall, temperature, humidity, and DHF incidence in 2015-2019

The incidence of DHF correlates with climate factors [11]. Climate is not directly influenced the incidence of DHF, albeit the optimal condition for the mosquitoes’ vector behavior. The average air temperature in Palembang is was 21.94-23.48°C per year, and there is a relation between relative humidity and the incidence of DHF ($p = 0.032$). A similar result was also from Surabaya city with a weak positive correlation ($r = 0.301$) [16]. The average temperature range is still the optimal temperature for *Aedes* mosquitoes to be able to breed and dengue virus development so that the incidence of DHF in Palembang is affected by the air temperature. As for rainfall and relative humidity with the incidence of DHF ($p = 0.797$ and $p = 0.718$) showed no significant relation. The average rainfall in Palembang is in the medium-high range, which means there was high rainfall and lasts for a long time which can cause flooding that several mosquito breeding will be reduced [17]. There is not much rainfall variance that is far enough, perhaps affecting the analysis regarding the incidence of DHF in Palembang. On contrary, results in Pekalongan Regency mentioned that the humidity in Pekalongan Regency is related to the incidence [18]. Air humidity of 71.9-83.5% is suitable condition for the dengue virus to travel from the stomach to the salivary glands of *Aedes* mosquitoes [20], while less optimal humidity of 60% will shorten the age of mosquitoes therefore interrupting the cycle of virus growth in the mosquito's body (the Ministry of Health of the Republic of Indonesia, 2010).

Limitation of the study were the site of collecting data and the randomization method. The general regional hospital treats only the severe patients due to its referral systems, while more DHF cases might happen in smaller hospitals which implied that the incidence rate might not the representative of the whole city case. Randomization was taken to simplify the analysis with a minimum number, due to the shortcoming of time and resources. Larger data could show a better result and deeper analysis regarding incidence and the climate factor correlation.

4. Conclusion

There is a significant correlation between the incidence of DHF in RSUD Palembang Bari to air temperature. It is recommended to carry out breeding place eradication practice 2-3 months before the surge when the highest incidence occurred around March-April each year.

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