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Eco-Epidemiological Analysis of Dengue Hemorrhagic Fever (DHF) in Makassar City

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Abstract

Dengue hemorrhagic fever (DHF) is still a public health problem in the world, including Indonesia. This study aims to determine the relationship of ecological, epidemiological factors with the endemicity status of DHF in Makassar City in 2013. This study used a cross-sectional study design. A sample of 14 sub-districts in Makassar City, South Sulawesi Province, was categorized based on the endemicity status of DHF. Sampling using exhaustive sampling. Data collection is done through secondary data analysis, observation, and documentation. Data were analyzed using the Mann Whitney test. The results showed that the ecological factors associated with the endemicity status of DHF in Makassar City were population density ($p < 0.05$), while the rate of larva free, rainfall, and occupancy density was not related to the endemicity status of DHF ($p > 0.05$). Therefore, more attention needs to be paid to districts with high population densities and the need to establish trends in the spread of dengue cases based on ecological factors to determine areas prone to dengue fever and their treatment priorities.

Keywords: Dengue Hemorrhagic Fever (DHF), Endemicity, Ecology

Introduction

Dengue hemorrhagic fever (DHF) still a public health problem in the world, including Indonesia. DHF is an infectious disease caused by the dengue virus and transmitted by the *Aedes aegypti* mosquito.⁽¹⁾ Around 2.5 billion inhabitants live in dengue-endemic countries, and there is a population at risk of DHF affected by 70% who live in Southeast Asian and Western Pacific Countries. Since 2000, the dengue epidemic has spread to new areas, and in 2003 there were eight countries reporting dengue cases, one of which was Indonesia.⁽²⁾

DHF is an endemic disease in several regions of South Sulawesi, including Makassar City. The number of dengue cases in Makassar City has increased from 223 cases in 2010 to 452 cases in 2012.⁽³⁾

In terms of epidemiology, in addition to host factors and agent factors, environmental factors also influence the incidence of DHF, so an ecological approach to DHF epidemiology is needed in different geographical conditions. Several studies have concluded that ecological factors are related to the epidemiology of DHF. These ecological factors include vectors, climate, topography, and human ecology.⁽⁴⁾

Research related to DHF eco-epidemiological analysis in India found that the main factors affecting DHF outbreaks are climate factors, namely rainfall, temperature, and relative humidity.⁽⁵⁾ Temperature variations that affect variations in efficiency *Ae. aegypti* is one of the important factors that influence the variation of DHF events.⁽⁶⁾ The existence of environmental

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differences, such as differences in vegetation and differences in the presence of predator vectors, also affect the differences in entomological parameters associated with dengue events.⁽⁷⁾

Analysis of the endemicity status of dengue fever in a region can be associated with disease determinants, which include environmental, geographic and demographic factors. The difference in ecological and geographic conditions in an area also influences the pattern and type of disease, as well as the epidemiology of DHF. Based on the background description, the researcher is interested in studying the relationship of ecological, epidemiological factors with the endemic status of DHF in Makassar City in 2013. By obtaining information on ecological factors related to the DHF endemicity status, it is hoped that DHF control activities can be planned more efficiently and effectively adjusted with the state of the area.

Method

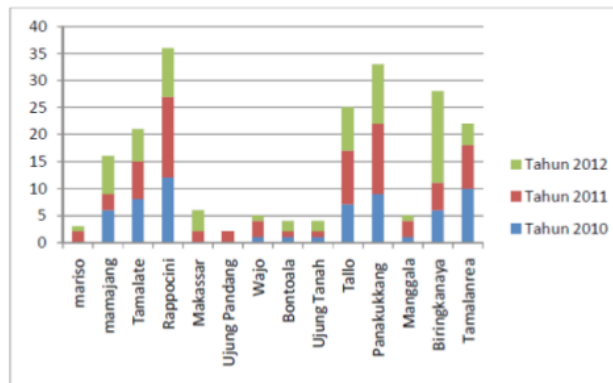
This study is an analytic study with a cross-sectional study design to identify environmental factors that are

epidemiologically suspected to be directly or indirectly related to the endemicity status of DHF. This research was conducted in Makassar City, South Sulawesi Province, Indonesia. The target population in this study is the eco-epidemiological data and the incidence of DHF in each District/Kelurahan in Makassar City. Exhaustive sampling technique is used for the sampling of this study, namely, 14 districts in Makassar with endemicity and non-endemicity status of DHF in 2010-2012.

The data used in this study are secondary data in the form of dengue case data, climate data, population density data, larvae free data, and base maps of the study area, each obtained from the Health Office, the Meteorology and Geophysics Agency, the Central Statistics Agency, Bakosurtanal, Department of Spatial Planning and Regional Planning Agency of Makassar City area. Data collection is done through secondary data analysis, observation, and documentation. Data were analyzed using the Mann Whitney test to assess the relationship between ecological factors and the endemicity status of DHF.

Results

The incident Dengue Hemorrhagic Fever



Graph 1: Distribution of Dengue Hemorrhagic Fever Cases in 14 Districts in Makassar City in 2010-2012

Graph 1 shows the distribution of dengue cases in Makassar City, which tends to decrease every year. In 2010, the highest incidence of DHF occurred in Rappocini District (12 cases), and the lowest was in three districts namely Mariso, Makassar, and Ujung Pandang District (no cases). In 2011, the highest incidence of DHF occurred in Rappocini District (15 cases), and the lowest occurred in two districts namely Bontoala District

and Ujung Tanah District (1 Case). In 2012, the highest incidence of DHF occurred in Biringkanaya District (17 cases), and the lowest was in Ujung Pandang District (no cases).

DHF Endemicity Status: Table 1 shows that the sub-districts in Makassar are more dominant with DHF endemic (78.6%).

Table 1: Endemicity of Dengue Hemorrhagic Fever in 14 Districts in Makassar City in 2010-2012

| Endemicity Status | Frequency | |
|-------------------|-----------|------|
| | N | % |
| Endemic | 11 | 78.6 |
| Non-Endemic | 3 | 21.4 |
| Total | 14 | 100 |

Relationship of Ecological Factors with DHF Endemicity Status

Table 2: Relationship of Ecological Factors with DHF Endemicity Status in Makassar City in 2013

| Ecological Factors | Endemicity Status | | p-value |
|--------------------|-------------------|-------------|---------|
| | Endemic | Non-Endemic | |
| Larvae free number | 6.82 | 10.0 | 0.239 |
| Rainfall | 5.86 | 7.40 | 0.464 |
| Population density | 5.78 | 10.60 | 0.039 |
| Occupancy Density | 7.95 | 5.83 | 0.406 |

*Mann Whitney Test

Table 9 shows that the mean rank of larval free numbers in non-endemic DHF areas is higher than in endemic DHF regions. Mann Whitney test results obtained p-value = 0.239, so it was concluded that there was no relationship between larval free rates and DHF endemicity status in Makassar City. Based on rainfall, the mean rank value in DHF endemic regions is lower than in non-endemic DHF regions. Mann Whitney test results obtained p = 0.464, meaning there is no relationship between rainfall and the endemic status of dengue in Makassar City.

The mean rank of population density in non-endemic DHF areas is higher than in endemic DHF regions. Mann Whitney test results obtained p-value = 0.039, so it was concluded that there is a significant relationship between population density with the endemic status of DHF in Makassar City. Based on residential density, the mean rank value in non-endemic DHF areas is lower than in endemic DHF regions. Mann Whitney test results obtained p-value = 0.406, meaning there is no relationship between the density of occupancy with the status of endemicity of dengue in Makassar City.

Discussion

The results of this study indicate that the distribution of dengue cases in Makassar City from 2010 to 2012

tends to decrease every year. Nevertheless, the sub-districts in Makassar City were more dominant in DHF endemic (78.6%), out of a total of 14 districts. Makassar City is a region with a high level of endemicity based on the endemicity level category stated by Marjuki in his research in Malang, which is an area where in the last three years in a row there were more than ten cases/deaths due to DHF. (8)

Based on the results of the Mann Whitney test, it was concluded that ecological factors significantly related to the endemicity status of DHF in 4 districts in Makassar City were population density. The results of this study are in line with research in Denpasar, which states that there is a relationship between population density and the incidence of DHF. (9) This finding is also in line with the results of research in Venezuela which found that population density is positively correlated with the level of DHF endemicity in a region. (10) A denser population will facilitate the transmission of DHF, especially in urban areas, because mosquito flying distances are estimated at 50 to 100 meters. (11) Female mosquitoes can fly as far as two kilometers, but the normal ability is about 40 meters. In densely populated areas with high mosquito distribution, the potential for virus transmission increases and tends towards the formation of an endemic area.

Larvae free rate is the percentage of houses/buildings not found larvae. Free larvae numbers and house index better illustrates the extent of the spread of mosquitoes in an area. The higher Larvae free rate value in an area shows that the incidence of DHF is lower. Research in Medan and Gorontalo found that the presence of larvae inside or outside the home was significantly related to the incidence of DHF. (12, 13) But the two studies are not following the results of this study, which found that there was no relationship between ABJ and DHF endemicity status. The difference in the results of this study can be caused by the number of study samples that are too small. Also, based on ABJ percentage data obtained from the Makassar City Health Office, it can be seen that almost all districts have ABJ percentage values above 80%; even many districts with endemic status have ABJ percentages above 90%. This means that other factors affect endemicity status in each sub-district because even though most of the houses (> 80%) are declared larvae-free, DHF still occurs. So it can be said that there is no significant relationship between the percentage of ABJ with the incidence of DHF.

Similar to larval free numbers, the results of this study also concluded that there was no relationship between rainfall and DHF endemicity status in Makassar City. This study is not in line with research in Thailand, which found that there was a relationship between rainfall and the incidence of DHF.⁽¹⁴⁾The difference in the results of this study can occur because the influence of rainfall varies according to the amount of rain and the physical condition of an area. Too much rain will cause flooding, and too little rain will cause drought, resulting in the temporary movement of mosquito breeding sites, so that vector breeding will decrease. Towards the rainy season or the transition, the season is marked by the least frequency of rain, so that there is a puddle of clear water long enough to be a habitat for dengue virus carriers, the *Aedes aegypti* mosquito.

Dwelling density can facilitate the transmission of DHF from person to person. However, in this study, no relationship was found between occupancy density and DHF endemicity status. This is in line with research conducted in Surabaya which also found no link between the incidence of DHF with occupancy density.⁽¹⁵⁾There is no relationship between the density of occupancy and endemicity status of dengue fever can be caused by knowledge and attitudes of urban residents who are better towards a disease and the increasing number of health facilities that are spread evenly and easily accessible by the community, so that if there are family members who suffer from dengue disease then members other families will immediately seek treatment before the disease is transmitted to other family members.

Conclusions

This study concludes that the ecological factors associated with the endemicity status of DHF in Makassar City are population density, while the variable rate of larvae free, rainfall, and occupancy density is not related to DHF endemicity status.

Therefore, more attention needs to be paid to districts with high population density and the need to establish trends in the spread of DHF cases based on ecological factors to determine areas prone to DHF as well as to see the achievement of DHF disease prevention programs. Also, it is hoped that there will be an increase in regional-based health problem analysis to make it easier to determine priority priorities and more appropriate preventive measures.

Ethical Clearance: Our study was not directly applied on human, hence ethical clearance was not required.

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Conflict of Interest: The author declare that he has no conflict of interest.

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