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# Factors Affecting Cases of Dengue Hemorrhagic Fever in Riau Province

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**Abstract**

One infectious disease that has a high morbidity and mortality rate is Dengue Hemorrhagic Fever. Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus transmitted through the bite of the Aedes aegypti mosquito. In general, the habitat of Aedes mosquitoes is in areas with tropical climates, high rainfall, and hot and humid temperatures. The number of patients and the area of distribution are increasing along with increasing mobility and population density. Improper sanitation can also be a cause of DHF. In Riau province, dengue cases in 2022 continue to increase compared to 2021, with the most cases in Pekanbaru City. This study was conducted to see the factors that influence dengue cases in Riau Province. Using multiple linear regression can measure what factors affect the number of dengue cases. From the results, it was found that population density and sanitation had a significant effect on dengue cases in Riau Province. And judging from the coefficient of determination, it can be interpreted that the variables of population density (X1) and sanitation (X2) simultaneously affect the variable of dengue cases (Y) by 77.8%. While the remaining 22.2% were influenced by other variables that were not studied in this study.

*Keywords:* DHF, Population Density, Sanitation, Multiple Linear Regression

## 1. Introduction

One of the infectious diseases that has high morbidity and mortality rates is Dengue Hemorrhagic Fever. Dengue Hemorrhagic Fever is a disease caused by the dengue virus transmitted through the bite of the Aedes aegypti mosquito. This disease is related to environmental conditions and community behavior and has the potential for an Extraordinary Event (KLB) to occur and is a threat to society. In general, the signs and symptoms of someone suffering from dengue hemorrhagic fever are sudden high fever, muscle pain, severe headache, pain behind the eyes, nausea and vomiting and fatigue. (Riau Health Profile, 2021). Viruses require a 4–6-day intrinsic incubation period in the human body before causing disease. Dengue Hemorrhagic Fever causes fever symptoms lasting 2-7 days, pain in the bones and muscles, headaches, a red rash on the skin, and pain behind the eyes. Dengue Hemorrhagic Fever causes bleeding caused by leaking blood vessels and can result in death. (Amalia et al,2010).

Dengue Hemorrhagic Fever (DHF) is a health problem in countries with tropical climates. DHF is a disease that is still a major public health problem in Indonesia. The characteristics of the infectious vector determine the spread and time of infection. In general, the habitat of the Aedes mosquito is in areas with a tropical climate, high rainfall. and hot and humid temperatures. The research results of Qu et al (2018) stated that tropical countries have levels of rainfall, humidity, temperature, and urbanization that have been identified as risk factors for dengue fever outbreaks. The number of sufferers and the area of distribution is increasing along with increasing mobility and population density.

Population density also supports or is a risk factor for the transmission of dengue fever. The denser the population, the easier it is for the Aedes aegypty mosquito to transmit the virus from one person to another. Population density requires special attention from the government regarding the feasibility of human life, especially due to unplanned and uncontrolled urbanization. Population growth that does not have a certain pattern and uncontrolled urbanization is one of the factors that plays a role in the re-emergence of extraordinary cases of dengue fever.

Population density is a non-causative factor in several areas due to the low level of recording and reporting of dengue cases and the status of sufferers at the time they are diagnosed with dengue fever. Population density is a risk factor which along with other risk factors such as population mobility rates, population migration rates, environmental

sanitation, the presence of mosquito breeding containers, vector density, level of knowledge, attitudes and actions regarding dengue fever can cause an increase in the number of dengue sufferers. increases or decreases.

Widayanti Ratna has conducted research with the title "Pearson Correlation Analysis in Determining the Relationship Between the Incident of Dengue Hemorrhagic Fever and Population Density in the City of Surabaya in 2012 - 2014". Where the aim of this research is to determine the level of relationship between population density and the number of dengue fever sufferers in the city of Surabaya during 2012 to 2014. The method in this research is descriptive quantitative statistical analysis by processing secondary data obtained from the Surabaya City Health Service using tests. Pearson Correlation Product Moment statistics. Where it can be concluded that population density influences the incidence of dengue fever each year with a strong relationship value of a moderate relationship. The incidence of dengue fever in the city of Surabaya during 2012 to 2014 had a variance of 14% – 18%.

Apart from that, environmental sanitation is closely related to the growth and breeding process of mosquitoes, poor environmental sanitation can cause various kinds of diseases, one of which is dengue fever which is caused by the Aedes Aegypti mosquito, where these mosquitoes can breed in dirty environments and breed in holes. a hole or container that can collect water when it rains. This is in line with research by Nagao, Y., & Koelle, K. (2008) which states that there is a relationship between environmental sanitation and the incidence of dengue fever. Environmental sanitation in the good category tends to mean that family members do not experience dengue fever, while environmental sanitation in the poor category tends to mean that their families experience dengue fever. (Nagao, Y., & Koelle, K. 2008).

In Riau itself, there are still quite a lot of dengue fever cases. Based on the 2021 Riau Health Profile, the number of dengue fever cases reported in Riau Province in 2021 was 1,033 people with a death rate of 10 people. Reporting from public information, in 2022 cases of Dengue Fever (DHF) in Riau Province will continue to increase. The total number of dengue fever cases in Riau throughout 2022 was recorded at 2,102 cases, 14 of whom died. Of the 12 regencies and cities in Riau, Pekanbaru is the area with the most dengue cases. It is also known that Pekanbaru is one of the areas in Riau Province which has a dense population compared to other areas.

Based on this problem, an accurate forecasting model with the smallest error is needed to predict the number of dengue cases in a certain period in the future so that it can determine appropriate and effective actions in dealing with dengue cases, considering that these cases increase sharply in certain seasons and even cause morbidity. and death. This research was conducted to look at the factors that influence dengue cases in Riau Province. By using multiple regression analysis, you can measure what factors influence the number of dengue cases. If a variable is significant, this indicates that the variable influences the number of dengue cases.

## 2. Materials and Methods

### 2.1. Data and Sources of Data

Materialas icludingThe data used in this research is secondary data sourced from the Riau Health profile and the Riau Province Central Statistics Agency website, namely data on population density, proper sanitation, and dengue fever cases in Riau Province per district/city.

**Table 1**. Research Variable

| Variable | Explanation |
|---|---|
| $Y_1$ | Number of DHF Cases/100,000 Population |
| $X_1$ | Population density |
| $X_2$ | Proper Sanitation |

### 2.2. Data Analysis Method

The analytical method used in this research is multiple linear regression analysis to see whether there is an influence between the independent variables, namely population density and adequate sanitation, with the dependent variable of dengue cases as well as the coefficient of determination to see the extent to which the independent variables influence dengue cases in Riau Province. This analysis uses IBM SPSS Statistics 24 software.

#### 2.2.1. Linear Regression Analysis

Multiple linear regression is a regression model that involves more than one independent variable. Multiple linear regression analysis was carried out to determine the direction and how much influence the independent variable has on the dependent variable (Ghozali, 2018). The aim of the multiple linear regression test is to predict the value of the dependent variable/response (Y) if the values of the independent variables/predictor ($X_1$, $X_2$, ... , $X_n$) are known. This analysis is used to determine the direction of the relationship between the independent variable and the dependent variable, whether each independent variable is positively or negatively related and to predict the value of the dependent

variable if the value of the independent variable increases or decreases. The mathematical multiple linear regression equation is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon \quad (1)$$

Where:

Y : Dependent variable (independent)
a : Constant
$\beta_n$ : Regression coefficients
$X_n$ : Independent variable (free)
$\varepsilon$ : Error

In this research there are 2 independent variables, namely X1 and X2, so the form of the regression equation is:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 \quad (2)$$

Where:

Y : Cases of Dengue Hemorrhagic Fever
$X_1$ : Population density
$X_2$ : Proper Sanitation

### 2.2.2. Hypothesis Test

**a) F-Test**

The use of the F-test aims to determine whether the independent variables (X1, together influence the dependent variable (Tiku, M. L. ,1967). If the F-statistic probability value is smaller than the $\alpha$ value used, then it is concluded that the independent variables jointly influence the dependent variable.

$H_0 : \beta_1 = \beta_2 = 0$ (Variables $X_1$ and $X_2$ have no effect on variable Y).
$H_0$ : There is no influence of population density ($X_1$) and proper sanitation ($X_2$) on dengue hemorrhagic fever cases in Riau province.
$H_1 : \beta_1 \neq \beta_2 \neq 0$ (Variables $X_1$ and $X_2$ have an effect on variable Y).
$H_1$ : There is an influence of population density ($X_1$) and proper sanitation ($X_2$) on dengue hemorrhagic fever cases in Riau province.
Decision : Reject $H_0$ if p-value < alpha.

**b) Partial Regression Coefficient Test (t-test)**

The t test is useful for finding out whether each independent variable has a significant effect on the dependent variable (Kim ,2015). Whether or not the independent variable has an influence on the dependent variable can be seen from the probability value of each independent variable coefficient (Tiku,1967). If the probability value of the independent variable coefficient is smaller than the $\alpha$ value used, then the independent variable has a significant influence on the dependent variable partially, and vice versa.

a) $H_0 : \beta_1 = 0$
$H_0$ : There is no influence of population density on dengue hemorrhagic fever cases.
$H_1 : \beta_1 \neq 0$
$H_1$ : There is an influence of population density on dengue hemorrhagic fever cases.
b) $H_0 : \beta_2 = 0$
$H_0$ : There is no effect of proper sanitation on dengue hemorrhagic fever cases.
$H_1 : \beta_2 \neq 0$
$H_1$ : There is an influence of proper sanitation on cases of dengue hemorrhagic fever.
Reject $H_0$ if p-value < alpha.

### 2.2.3. Coefficient of Determination

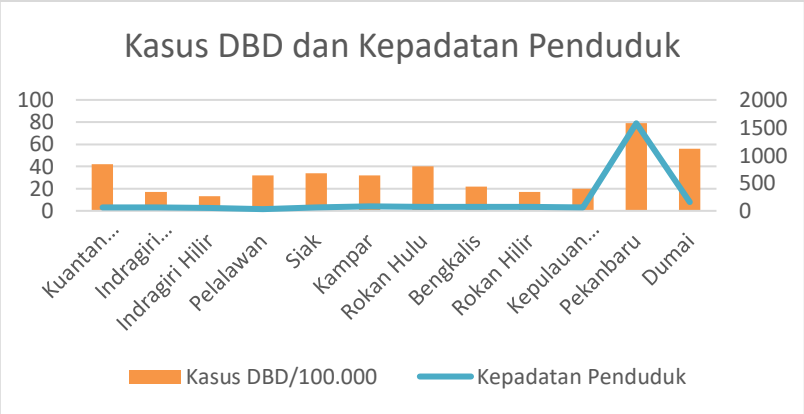
The coefficient of determination shows how much the performance of the independent variable is able to explain the dependent variable with a value between zero and one ($0<R2<1$) (Ghozali, 2018). In this analysis, the overall influence of the independent variable on the dependent variable is transformed into a percentage. If R2 has a value equal to 0, then the transformation that occurs in the dependent variable cannot be interpreted at all by the independent variable. On the other hand, if R2 has a value equal to 1, then the transformation that occurs in the dependent variable as a whole can be interpreted by the independent variable (Ghozali, 2018).

### 2.3. Methods

a) Prepare the data to be used.
b) Conduct data exploration
c) Carry out assumption tests, namely normality tests and multicollinearity tests.
d) Building a multiple linear regression model.
e) The model feasibility test includes the simultaneous F test, partial regression coefficient test (t test), and looking at the coefficient of determination.
f) Make interpretations.
g) Conclusion.

## 3. Results and Discussion

In 2022, dengue fever sufferers in Riau Province were found to have dengue cases with an incidence rate (IR) exceeding the target (> 49/100,000 population in districts/cities), namely in Pekanbaru city 79 per 100,000 population and Dumai city found 56 per 100,000 population. The following is the distribution of dengue fever cases and population density, data obtained from BPS Riau province.




*Sources : BPS Provinsi Riau Data*
**Figure 1**: Visualization of DHF Cases and Population Density of Riau Province in 2022

From Figure 1, it can be seen that the area with the highest population density is in the city of Pekanbaru, followed by the city of Dumai. Apart from that, the area with the most cases of dengue hemorrhagic fever in Riau province in 2022 is also Pekanbaru City, followed by Dumai City. And the area with the lowest cases is Indragiri Hilir district.

### Normality Test

**Table 2.** Normality Test

| | | Unstandardized Residual |
|---|---|---|
| N | | 12 |
| Normal Parameters[a,b] | Mean | .0000000 |
| | Std. Deviation | 8.95917666 |
| Most Extreme Differences | Absolute | .158 |
| | Positive | .158 |
| | Negative | -.116 |
| Test Statistic | | .158 |
| Asymp. Sig. (2-tailed) | | .200[c,d] |

a. Test distribution is Normal.

Based on Table 2, it can be seen that the significance value (Asym. Sig. 2-tailed) of the residual data is 0.200 > 0.05, so it is fulfilled that the data used is normally distributed.

## Multicollinearity Test

**Table 3.** Multicollinearity Test

| Model | Collinearity Statistics | |
|---|---|---|
| | **Tolerance** | **VIF** |
| Population density | .823 | 1.215 |
| Sanitation | .823 | 1.215 |

The results of the multicollinearity test are presented in Table 3. Showing the VIF value for the two independent variables < 10 and the Tolerance value > 0.100. This concludes that there is no multicollinearity in the independent variables used.

## Regression Model

The analysis was carried out using SPSS software, which obtained the following regression coefficient results.

**Table 4.** Multiple linear regression model coefficients

| **Variable** | **Coefficient** |
|---|---|
| Constant | 0.584 |
| Population density | 0.026 |
| Proper Sanitation | 0.427 |

a. Dependent Variable: Cases DBD/100.000

Table 4. Shows the regression coefficients to obtain a multiple regression model, namely as follows.

$$Y = 0.584 + 0.026\ X_1 + 0.427X_2$$

With $X_1$ = Population density and $X_2$ = Proper Sanitation.

## Simultaneous Test – F test

**Table 5**. ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3091.731 | 2 | 1545.866 | 15.757 | .001[b] |
| | Residual | 882.935 | 9 | 98.104 | | |
| | Total | 3974.667 | 11 | | | |

a. Dependent Variable: Cases DBD/100.000

b. Predictors: (Constant), Sanitation, Population Density

*Source : Results from SPSS*

Based on Table 5, the results of the overall analysis of the independent variables on the dependent variable have a probability value (F-statistic) of 0.001, which is a value smaller than 0.05. Therefore, it can be concluded that the independent variables together have an effect on the dependent variable or there is a minimum of one independent variable that has an effect on the dependent variable.

## Partial Regression Coefficient Test (t-test)

**Table 6.** Partial Test Results

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | Population Density | .026 | .008 | .590 | 3.407 | .008 |
| | Sanitation | .427 | .163 | .453 | 2.613 | .028 |

*Source : Results from SPSS*

Based on the results of multiple linear regression estimation in Table 6, the results show that the two independent variables have a probability value smaller than the value $\alpha$ (5%). Because the probability values for these two variables are smaller than the 0.05 significance level, $H_0$ is rejected. This means that population density and adequate sanitation have a positive and significant influence on dengue cases in Riau Province.

## Coefficient of Determination

**Table 7.** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .882[a] | .778 | .728 | 9.905 |

a. Predictors: (Constant), Sanitation, Population Density

*Source : Results from SPSS*

Based on Table 7. SPSS output above, it is known that the coefficient of determination or R Square value is 0.778. This R Square value comes from recognizing the correlation coefficient value. The coefficient of determination is 0.778 or equal to 77.8%, meaning that the independent variables ($X_1$ and $X_2$) simultaneously influence the dengue fever case variable (Y) by 77.8%. Meanwhile, the remainder (100%-77.8%=22.2%) was influenced by other variables not examined in this research.

Thus, a multiple linear regression model was obtained for the factors influencing dengue fever in Riau province as follows:

$$Y = 0.584 + 0.026\ X_1 + 0.427X_2$$

Based on the results of the regression equation above, the relationship between each independent variable in the model that influences dengue cases in Riau Province can be explained as follows:

a) The effect of population density on the number of cases of dengue fever

Based on the regression estimation results, the results show that population density has a positive and significant influence of $\alpha$=5% on dengue fever cases in Riau Province in 2022. The investment coefficient value shows a positive sign of 0.026 with a probability of 0.08, meaning that population density ($X_1$) has an influence which is significant in dengue cases in Riau Province. This means that if there is an increase in population density by 1 person, it will increase dengue fever cases in Riau Province by 0.026 per 100,000 population assuming other variables remain constant.

This is also in accordance with the results of previous research which stated that population density influences the incidence of dengue fever each year with a strong relationship value of a moderate relationship. (Nurdin, N., 2020)

b) The effect of proper sanitation on the number of cases of dengue fever

Based on the results of the regression estimation, the results show that adequate sanitation has a positive and significant influence of $\alpha$=5% on dengue fever cases in Riau Province in 2022. The investment coefficient value shows a positive sign of 0.427 with a probability of 0.028, meaning that adequate sanitation ($X_2$) has a significant influence on dengue fever cases in Riau Province. This means that if there is an increase in proper sanitation by 1 unit, it will increase dengue fever cases in Riau Province by 0.427 per 100,000 population assuming other variables remain constant.

## 4. Conclusion

Based on research that has been carried out, it is concluded that population density has a positive and significant influence of $\alpha$=5% on dengue fever cases in Riau Province in 2022. The investment coefficient value shows a positive sign of 0.026, meaning that population density ($X1$) has a significant influence on cases. DHF in Riau Province. This means that if there is an increase in population density by 1 population, it will increase dengue fever cases in Riau Province by 0.026 per 100,000 population assuming other variables remain constant. And proper sanitation has a positive and significant influence of $\alpha$=5% on dengue cases in Riau Province in 2022. The investment coefficient value shows a positive sign of 0.427, meaning that proper sanitation ($X2$) has a significant influence on dengue cases in Riau Province. This means that if there is an increase in proper sanitation by 1 unit, it will increase dengue fever cases in Riau Province by 0.427 per 100,000 population assuming other variables remain constant.

And looking at the coefficient of determination, it can be interpreted that the variables of population density and adequate sanitation simultaneously influence the variable of dengue fever cases (Y) by 77.8%. Meanwhile, the remainder (100%-77.8%=22.2%) is influenced by other variables not examined in this study.

Of course, dengue fever is not only influenced by population density and proper sanitation, there are many other risk factors that influence the emergence of dengue fever. Therefore, it is recommended that the Riau Provincial Health Service pay attention to the risk factors for dengue fever as a whole because they are interconnected so that the eradication of the infectious disease dengue can be carried out more effectively.

And for future researchers to further explore the factors that influence dengue fever cases in Riau province, especially sanitation factors, why proper sanitation has a positive influence on dengue fever cases in Riau province. Of course, there are many other factors that need to be studied more deeply regarding this dengue fever case.

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