Analysis of Factors Affecting Leprosy Cases in East Java Province with Spatial Autoregressive Model (SAR)

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ABSTRACT

Leprosy caused by Mycobacterium leprae is still a health problem in Indonesia. The incidence of leprosy in every regency/city in East Java Province indicates a spatial dependence. This study aims to describe the pattern of leprosy incidence and identify factors that influence the incidence of leprosy in East Java Province. This study used secondary data published by East Java Provincial Health Office and East Java Central Statistics Agency in 2018. The observation units in this study are 38 regencies/cities in East Java Province. The analytical method used is Spatial Autoregressive Model (SAR) which is a spatial approach based on area. Based on the results of analysis show that Moran's index value = 0.250 (p = 0.018) which means indicating a spatial dependency. The mean years' schools (p = 0.001) and the male population (p = 0.006) had a significant effect on the incidence of leprosy. Meanwhile, the percentage of healthy housing coverage (p = 0.111) and population density (p = 0.055) did not affect the incidence of leprosy. The spread pattern of leprosy in East Java Province is clustered in adjacent areas and factors that affect the incidence of leprosy are the mean years' schools and the male population.

Keywords: Spatial analysis, leprosy, spatial autoregressive model

INTRODUCTION

Leprosy, also known as Morbus Hansen disease, is a chronic infectious disease caused by Mycobacterium leprae (M. leprae) which first attacks the peripheral nerves and then attacks the skin, oral mucosa, respiratory tract, reticuloendothelial system, eyes, muscles, bones, and testes.[1] Leprosy remains a health problem in several developing countries including Indonesia. Based on data from Indonesia Health Profile, the prevalence rate of leprosy in Indonesia in 2018 was 0.7 cases per 10,000 population with a discovery rate of new cases 6.42 cases per 100,000 population. Besides, there are 9 provinces (26.47%) of the 34 provinces in Indonesia that are still not included in the leprosy elimination status (<1 per 10,000 population).[2]

East Java Province is included in the province with the leprosy elimination status starting in 2017. Although the prevalence rate of leprosy is <1 per 10,000 population, there are still 14 districts that are endemic to leprosy and the percentage of level 2 disabilities due to leprosy in East Java Province is still rather high. Based on data from East Java Province Health Profile, the prevalence rate of leprosy in East Java Province in 2018 was 0.93 per 10,000 population with a discovery rate of new cases was 8.55 per 10,000 population.[3]

The incidence of leprosy can be affected by several factors. According to the epidemiologic triangle theory by John Gordon about disease causation, this concept describes the disease as an outcome of imbalance of interactions between three essential components namely Host, Agent, and Environment. Agent refers to an infectious microorganism or pathogen that causes the disease, host refers to a variety of factors intrinsic to the host and Environment refers to factors extrinsic that affect the agent.[4] The mechanism of leprosy transmission occurs by direct contact with the patient (through lesions and prolonged and repeated contact) and through breathing. Poor management of leprosy cases can lead to progressive leprosy which can cause permanent damage to the skin, nervous system, limbs, and eyes.[5]

The incidence of infectious diseases such as leprosy needs to consider the effect of geographic location or spatial factors such as neighbourliness between areas. It is obvious from the incidence of leprosy in each district/city in East Java is variable and indicates a dependence between areas. So this becomes the basis for the use of spatial analysis to identify factors that affect the incidence of leprosy. Spatial Autoregressive Model (SAR) analysis is used to determine the existence of a relationship or dependence between a set of observations or locations. The result of a study by Makarima (2018) defined that the distribution of leprosy prevalence rates occurs in districts/cities in Central Java that are adjacent to each other. The factor that spatially influences the incidence of leprosy is a healthy house.[6]

The result of a study by Ernawati (2016) also defined that the distribution of leprosy prevalence is grouped in districts/cities in East Java that have adjacent areas. The factor that affects the spatial incidence of leprosy is population density. The use of spatial information appropriately is very useful to prevent the process of disease transmission.[7] Therefore this study aims to describe the distribution of leprosy case grouping based on districts/cities in East Java Province and identify factors that spatially affect the incidence of leprosy in East Java Province using Spatial Autoregressive Model (SAR) analysis.

METHOD

This research is secondary data analysis. The data used are sourced from East Java Province Health Profile in 2018 and East Java Central Statistics Agency (BPS) in 2018. The observation units used in this study are 38 districts/cities in East Java Province. Research variables include the response variable (Y), namely the incidence of leprosy cases in East Java Province and predictor variables (X), including the percentage of healthy housing coverage (X_1), population density (X_2), The mean years' schools (X_3) and the male population variable (X_4). The analytical method used is an analysis based on the neighbourliness between areas, namely the Spatial Autoregressive Model (SAR) using Geoda software.

RESULTS AND DISCUSSIONS

Administratively, there are 38 districts/cities in East Java Province which are divided into 29 districts and 9 cities. The number of leprosy incidents in East Java Province in 2018 based on its spread shows that the incidence of leprosy in four districts on the Madura island, namely Bangkalan, Sampang, Sumenep, and Pamekasan districts is very high. In addition, five other districts with the highest incidence of leprosy include Tuban District, Pasuruan District, Probolinggo District, Lumajang District, and Jember District. Meanwhile, the lowest incidence of leprosy occurred in six cities and three districts, namely Kediri City, Blitar City, Mojokerto City, Batu City, Pasuruan City, and Madiun City, Madiun District, Pacitan District, and Trenggalek

District. The distribution of leprosy in districts/cities in East Java Province in 2018 can be seen in Figure 1.

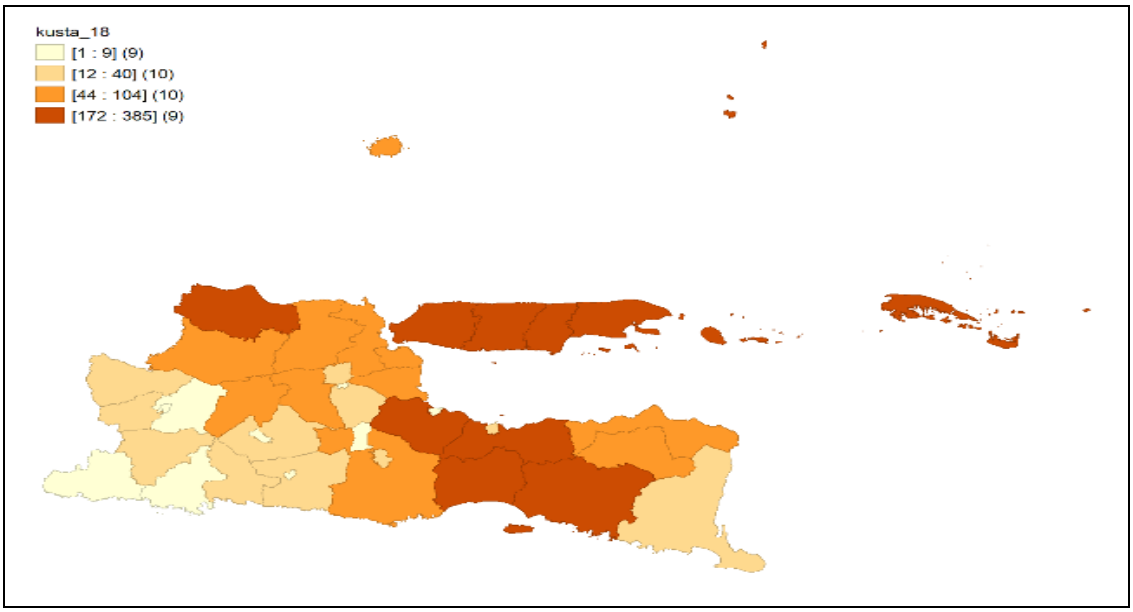

Figure 1. Distribution Map of Leprosy in East Java Province in 2018

Figure 1 shows a distribution map of leprosy, the darker colour of an area indicates higher incidence of leprosy in that area. Based on Figure 1, it can be seen that the distribution pattern of leprosy disease forms clusters, namely the areas with the highest incidence of leprosy are surrounded by areas with a high incidence of leprosy while the areas with the lowest incidence of leprosy are surrounded by areas with a low incidence of leprosy. The highest incidence of leprosy occurs in the majority of districts, while the lowest incidence of leprosy occurs in urban areas. So it can be concluded that there is an influence of spatial effects on the incidence of leprosy in East Java Province in 2018. Then a spatial dependency test is carried out to prove that statistically there is a spatial dependence on the incidence of leprosy in East Java Province in 2018.

Spatial Dependence Test

The assumption that must be fulfilled in a spatial analysis based on neighbourliness between areas is the existence of spatial dependence. Testing for spatial dependencies can use the spatial autocorrelation test by looking at Moran's index value (Moran's I). The hypothesis used is:

H_0 : I = 0 (no spatial autocorrelation)
H_1 : I ≠ 0 (there is spatial autocorrelation)

Table 1. Result of Spatial Autocorrelation Test

Test	I	Z	P
Moran's I	0,250	2,347	0,018

Based on table 1, it can be seen that the Moran (I) index value = 0.25 with the result that H_0 is rejected, which means that there is spatial autocorrelation. This can also be seen in the calculated Z value (2.347) > Z table value at α 0.05, namely 1.96 and the probability value (p-value) < α with the result that it can be concluded that there is regional dependence or spatial dependency which means that if one region experiences an increase in cases then the surrounding area also experienced an increase in cases. Then to determine the best spatial regression analysis method using the Lagrange Multiplier test (LM Test). The results of the LM test can be seen in table 2 below.

Table 2. Result of Lagrange Multiplier Test

Test	P
Lagrange Multiplier (lag)	0,016
Robust LM (lag)	0,119
Lagrange Multiplier (error)	0,067
Robust LM (error)	0,929
Lagrange Multiplier (SARMA)	0,056

Based on table 2 it can be seen that the results of the Lagrange Multiplier test show the probability value (p-value) for the spatial lag method is 0.016 < α 0.05, which means that this method is feasible to use. As for other analysis methods, the probability value is > α 0.05. So it can be concluded that the best method that can be used to analyze the factors that spatially influence the incidence of leprosy in East Java

Province in 2018 is the spatial lag method or the Spatial Autoregressive Model (SAR).

Factors Affecting Leprosy

Based on the results of analysis, two predictor variables spatially influence the incidence of leprosy in East Java Province in 2018, including the mean years' school (X_3) and the male population (X_4). Meanwhile, the variable percentage of healthy housing coverage (X_1) and population density (X_2) did not affect the incidence of leprosy in East Java Province in 2018. The results of the analysis of factors that spatially affect the incidence of leprosy in East Java Province in 2018 can be seen in Table 3 below.

Table 3. Result of Spatial Autoregressive Model (SAR) Anlayisis

Variable	β	SE	Z	P
Weight Leprosy	0,324	0,126	2,564	0,010
Constant	364,720	77,752	4,691	0,000
Percentage of Healthy Housing Coverage (X_1)	-1,049	0,658	-1,594	0,111
Population Density (X_2)	0,013	0,007	1,922	0,055
Mean Years' School (X_3)	-38,619	11,203	-3,447	0,001
Male Population (X_4)	0,000	0,000	2,736	0,006

Table 3 shows the effect of each predictor variable on the response variable partially or individually. Based on table 3, it can be seen that the probability value for the percentage of healthy housing coverage (X_1) is 0.111 which means that spatially the percentage of healthy housing coverage has no significant effect on the incidence of leprosy in East Java Province in 2018. This is likely due to the percentage of healthy housing coverage in the East Java Province is quite high. According to data from the East Java Province Health Profile, there was an increase in the percentage of healthy housing coverage in 2018. Previously, the percentage of healthy housing coverage in 2017 was 68.63% then it became 74.94% in 2018. So that this causes a reduced risk of environment-based diseases, including leprosy.[3]

The results of this study are supported by the results of research conducted by Ernawati (2016) which shows that the percentage of healthy houses has no significant effect on the prevalence rate of leprosy in East Java Province.[7] Meanwhile, research results by Dzikrina (2013) state that a healthy house is one of the factors that influence the incidence of leprosy.[8] Although the research results show that a healthy house does not have a significant effect on leprosy, in theory, an unhealthy place to live is one of the risk factors for leprosy transmission.

A house that is a residence must meet the requirements of a healthy house such as having a healthy toilet, clean water facilities, wastewater disposal facilities and garbage disposal, good house ventilation and adequate lighting, suitable housing density and a house floor that is not made of soil. Based on the epidemiological triangle theory, the interaction between the environment, host and agent can cause disease. An unhealthy house or place of residence is one of the environmental factors that influence the incidence of leprosy. The probability of people living in houses with healthy house sanitation conditions contracting leprosy are smaller than people who live with unsanitary household sanitation.[9]

Based on the results of the analysis using the SAR method, it can be seen that the population density variable (X_2) has no significant effect on the incidence of leprosy in East Java Province in 2018 (p-value = 0.055). This is because the population density in cities is relatively higher compared to districts, while the incidence of leprosy in the majority of cities is very low, but the incidence of leprosy in some cities is relatively high, such as Surabaya. Surabaya City has the highest population density with 8,231.74 km^2/person, which means that every 1 km^2 is inhabited by 8,232 people. The results of this study are different from the results of research conducted by Ernawati (2016) which explains that population density has a significant effect on the prevalence rate of leprosy in East Java and the results by Wijayanti (2019) study, explains that there is a significant relationship between population density and the incidence of leprosy in Sumenep District.[7,10]

Population factors such as population density affect the process of transmission or spread of a disease from one person to another. Population density is a determinant factor that contributes to the occurrence of a disease, one of which is leprosy. Environmental health problems tend to arise in densely populated areas such as urban areas.

Population density will determine the speed at which a disease is transmitted. Dense occupancy conditions and settlements occupied by various kinds of people will have a big influence on the risk of transmission. In densely populated areas, there is a greater probability of contact with people affected by leprosy. So that the higher population density in an area, the higher incidence of leprosy in that area.[10]

The results of the analysis using the SAR method in this study indicate that the variable average length of school (X_3) has a significant effect on the incidence of leprosy in East Java Province in 2018 (p-value = 0.001). The results of the analysis show a negative correlation, which means that if the mean years' school in an area increases, it will reduce the incidence of leprosy in that area. The results of this study are supported by the results of research by Noviani (2014) which states that there is a negative influence between the mean years' school on leprosy cases in Central Java Province.[11]

The mean years' school is defined as the number of years the population has spent formal education. The length of school for residents who complete SD is calculated for 6 years, junior high school completion is calculated for 9 years, high school graduation is calculated for 12 years regardless of whether they have lived in class or not. The mean years' school is used to determine the level of community education in an area.[12] Based on data from Central Statistics Agency in 2018, the mean years' school for the East Java Province was ranked the second-lowest among other provinces on Java island. This shows that the mean years' school in East Java Province is still low. The mean years' school for district/city residents in East Java Province tends to be high in urban areas. This indicates that the level of education in urban areas tends to be higher than in district areas.[13]

The level of education is one of the factors that can influence the incidence of leprosy. People who have a low level of education are at greater risk of getting leprosy than people who have a high level of education. This is because people who have a low level of education tend to have low knowledge. Low knowledge about leprosy can lead to low disease prevention behavior. In addition, the low level of education can result in a slow search for treatment and diagnosis of the disease, this can lead to more disability in lepers.[14]

Based on the results of analysis, the male population variable (X4) has a significant effect on the incidence of leprosy in East Java Province in 2018 (p-value = 0.006). The analysis results show a positive correlation, which means that if the male population in an area increases, it will increase the incidence of leprosy in that area. Based on data from the East Java Health Profile in 2018, the proportion of male leprosy sufferers in East Java is 60.1%, this figure is higher than the proportion of female leprosy sufferers, which is 39.9%. This shows that men are more susceptible to leprosy than women.[3] The results of this study are supported by the research results by Juniardi (2015) which states that the percentage of the male population has a significant effect on the number of leprosy cases in East Java Province.[15]

Gender is a risk factor for leprosy. Men are more at risk of getting leprosy than women. This is because men usually pay less attention to personal hygiene than women. Men have a habit of rarely showering because these bad bathing habits can increase the risk of contracting leprosy. Poor personal hygiene will make it easier for the body to be attacked by various diseases such as skin diseases, oral diseases, gastrointestinal diseases, and other infectious diseases.[16]

CONCLUSION

Based on the results of study, it can be concluded that there is a relationship between areas in the incidence of leprosy in East Java Province in 2018. If one area has an increase in leprosy cases, the surrounding area will also experience an increase in leprosy cases so that there is a clustering of leprosy cases in districts/cities in East Java Province that have an adjacent area. From several predictor variables, the factors that can affect the incidence of leprosy in East Java Province in 2018 are the mean years' school and the male population.

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