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Original Research Article

DETECTION OF SPATIAL AUTOCORRELATION OF DIARRHOEA IN EAST JAVA USING THE MORAN'S INDEX TEST

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Abstract

Background: Diarrhoea is an infectious disease with a high level of morbidity and mortality in the community. Spatial analysis is one of the analytical techniques for managing diarrhoea data and helping the government formulate policies.

Objectives: This study aims to detect the spatial autocorrelation of diarrhoea in East Java using the Moran's Index.

Methods: This study was non-reactive. This study used secondary data sourced from the 2021 East Java Health Profile. The population in the study was all districts/cities in East Java. The sampling technique was carried out by total sampling. The research sample was 38 districts/cities. Data analysis through mapping and spatial autocorrelation detection.

Results: Mapping of diarrhoea showed that out of 38 districts/cities, there were 13 areas with a category of high diarrhoea, 12 areas with a category of moderate diarrhoea, and 13 areas with a category of low diarrhoea. The significance value of Moran's I test was obtained at 0.03 (<α=0.05). There were three areas included in the High-High category, one area included in the Low-Low category, and three areas included in the Low-High category.

Conclusion: The diarrhoea in districts/cities in East Java Province could affect the diarrhoea in adjacent districts/cities. The existence of spatial autocorrelation in diarrhoea should be a serious concern for all elements, both the government and the people of East Java. We need further research to identify factors affecting diarrhoea in East Java.

Keywords: Communicable Disease, Infectious Disease, Moran's Index, GIS

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INTRODUCTION

Diarrhoea has become one of the top ten causes of death in the world. Although, in recent years, deaths from diarrhoea have decreased, the incidence remains constant (Behera and Mishra, 2022). Diarrhoea is a common disease among children under 5. However, diarrhoea is a contributor to morbidity at all ages (Walker et al., 2010).

The high morbidity and mortality due to diarrhoea are quite worrying. WHO (2017) states that cases of diarrhoea reached 1,700,000

and caused 525,000 deaths in children under five. Meanwhile, diarrhoea is the 9th highest cause of death worldwide, with a total death of 1,600,000 people in all age groups (World Health Organization, 2018). Cases of diarrhoea in East Java for the last three years since 2019 have shown a declining trend. However, the incidence rate in 2021 is still relatively high, with more than 500,000 people experiencing diarrhoea (Dinas Kesehatan Provinsi Jawa Timur, 2020, 2021, 2022).

Diarrhoea is included in the class of infectious diseases. *Rotavirus* and *Escherichia coli* are two of diarrhoea's most common causative agents. The speed of transmission of diarrhoea is caused by this pathogen spreading through water contaminated with faeces. The speed of transmission is supported by the poor quality of water for consumption and low hygiene and healthy lifestyles in the community (World Health Organization, 2017).

Diarrhoea has a negative impact on the quality of life. As a control effort, spatial analysis through regional mapping and autocorrelation detection can be carried out to manage diarrhoea. Spatial analysis is a technique for identifying an event by involving geographic data to obtain information about the relationship between disease occurrence and region (Achmadi, 2005).

Objective(s): Therefore, this study aims to detect the spatial autocorrelation of the diarrhoea in East Java using the Moran's Index.

METHODS

Study Design

This study was non-reactive, namely research data collection was not carried out directly to study subjects.

Research Subject

This study used secondary data sourced from the 2021 East Java Health Profile. The population in the study was all districts/cities in East Java. The sampling technique was carried out by total sampling, namely taking all districts/cities as study samples. The study sample was 38 districts/cities.

Data Analysis

Data analysis was carried out in two stages. The first stage was mapping the diarrhoea in East Java by considering spatial dependencies. Mapping was done by categorizing the areas into three categories, areas with high diarrhoea, areas with moderate diarrhoea, and areas with low diarrhoea. The second stage is the detection of spatial autocorrelation with the Morans' I test. Data analysis was carried out with Geoda application.

Ethical Consideration

Ethical clearance in this study follows the ethical clearance used by the East Java Health Office to collect research data on the East Java Health Profile in 2021.

RESULTS

Mapping the diarrhoea in East Java, taking into spatial dependencies, shows that out of 38 districts/cities, there are 13 areas with high diarrhoea (13%-23%) marked with the darkest colour, 12 areas with moderate diarrhoea (11%-13 %) marked with a lighter colour, and 13 areas with low diarrhoea (7%-11%) marked with the brightest colour. Mapping the diarrhoea in East Java showed that areas with high diarrhoea tend to cluster in the northern part of East Java and parts of Madura Island. Mapping the diarrhoea in East Java can be seen in Figure 1.

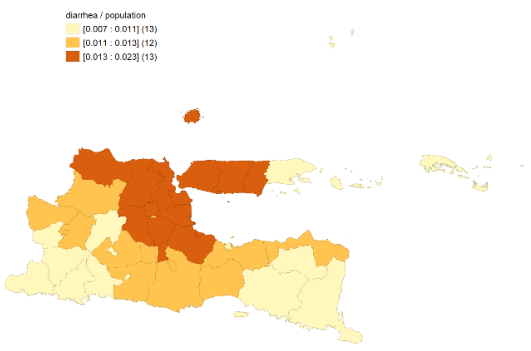
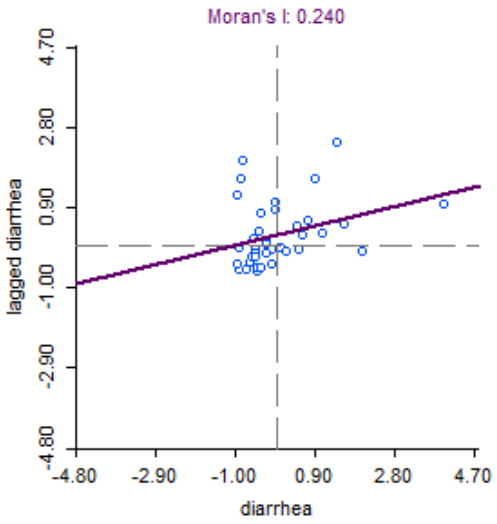


Figure 1. Mapping of Diarrhea in East Java

The spatial autocorrelation detection of diarrhoea in East Java using the Morans' I test showed a Moran's Index value of 0.240. The Moran scatterplot for detecting spatial autocorrelation can be seen in Figure 2.



Fogure 2. Moran's I Scatterplot

The significance value of Moran's I was issued to ensure a spatial autocorrelation in the diarrhoea. The significance value of the Moran's I test was obtained at 0.03 (<α=0.05), meaning that there was a spatial autocorrelation in the diarrhoea in East Java, that means the diarrhoea in a district/city will affect the diarrhoea in adjacent districts/cities. Spatial autocorrelation detection by identified the significance value from Moran's I test can be seen in Table 1.

Table 1. The Result of Moran's I Test

Variable	Moran's I	p-value	α
Diarrhoea	0.24	0.03*	0.05

*The test result value was significant

There was spatial autocorrelation in the results of the analysis. The test was continued to detect the spatial autocorrelation in each district/city using the Local Indicator of Spatial Autocorrelation (LISA). The results of the Local Indicator of Spatial Autocorrelation (LISA) test can be seen in Figure 3.

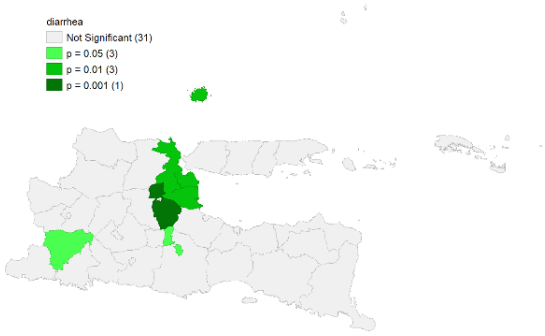


Figure 3. The Test Result of Local Indicator of Spatial Autocorrelation (LISA)

Spatial autocorrelation detection in each district/city showed that there were 7 out of 38 areas with significant test results, with 1 region had a significance value of <0.001; 3 regions had a significance value <0.01; and 3 areas had a significance value of <0.05, so the diarrhoea in that area affects the diarrhoea in other adjacent areas. Meanwhile, the other 31 areas showed a significance value of >0.05 so the diarrhoea in that area did not affect the diarrhoea in other adjacent areas. Testing continued to detect categories in each area that show significant results. Area categories based on the Local Indicator of Spatial Autocorrelation (LISA) test can be seen in Figure 4.

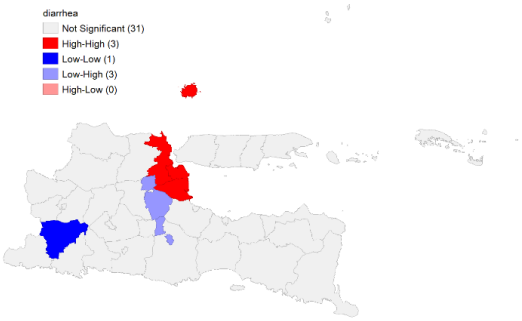


Figure 4. The Categorization of Areas Based on *Local Indicator of Spatial Autocorrelation* (LISA)

Categorizing areas based on the Local Indicator of Spatial Autocorrelation (LISA) test shows that 31 regions did not show spatial autocorrelation. Seven other areas show spatial autocorrelation, with three areas included in the High-High category meaning that this region has high diarrhoea and other areas around it

have high diarrhoea, one area included in the Low-Low category meaning this area had low diarrhoea, and other areas around it had low diarrhoea, three areas were included in the Low-High category meaning that this area had low diarrhoea but was surrounded by areas that have a high diarrhoea.

DISCUSSION

13 areas with high diarrhoea were grouped in the northern part of East Java and parts of Madura Island. The north part of East Java tends to fall i of urban areas. Residents in urban areas tend to be more at risk of experiencing diarrhoea than rural residents. This is due to the large population in urban areas, limited land and exacerbated by poor environmental sanitation (Srivastava et al., 2022).

Spatial autocorrelation detection indicated that the diarrhoea in one area could affect the diarrhoea in other adjacent areas. Spatial autocorrelation detection in each district/city showed that there were 3 areas included in the High-High category, 1 area included in the Low-Low category, and 3 areas included in the Low-High category. The spatial concept states that events in an area can affect events in other adjacent areas (Djuraidah, 2020).

Diarrhoea is an infectious disease that can be transmitted through water contaminated with the patient's faeces. Poor environmental sanitation in an area, such as the habit of defecating in rivers, water sources contaminated with pathogens, and unhealthy behaviour will increase the population in that area experiencing diarrhoea and affect residents in other adjacent areas to contract diarrhoea (World Health Organization, 2022).

The limitation of this study was not identifying risk factors for diarrhoea by considering spatial dependencies on diarrhoea in East Java.

CONCLUSION

There were 13 areas with a high incidence of diarrhoea. The diarrhoea in a district/city in East Java can affect the diarrhoea in adjacent districts/cities.

SUGGESTIONS

The existence of spatial autocorrelation in the incidence of diarrhoea should be a serious concern for all elements, both the government and the people of East Java. Further research is needed to identify factors that have a spatial effect on diarrhoea in East Java.

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DECLARATION OF CONFLICTING INTEREST

The author declared there was no conflict of interest in this study.

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AUTHOR CONTRIBUTION

Author 1:
Main conceptual of this study, supervised this study, and analysis of the data.
Author 2:
Analysis the data, technical editing and writing the manuscript.

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