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STATISTICAL ANALYSIS OF TUBERCULOSIS DISTRIBUTION IN DAERAH ISTIMEWA YOGYAKARTA PROVINCE IN 2024

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Abstract

Tuberculosis remains one of the major public health problems worldwide, including in Daerah Istimewa Yogyakarta. This study aims to analyze the distribution pattern of tuberculosis cases in 2024 using descriptive and inferential statistical approaches to identify trends in case distribution based on regional and population characteristics. The data used in this study were secondary data obtained from regional health reports and analyzed using statistical methods such as frequency distribution, trend analysis, and correlation modeling to examine the relationship between the number of cases and demographic factors. The results show that the distribution of tuberculosis cases in the Special Region of Yogyakarta is uneven across districts and cities, with higher concentrations of cases occurring in areas with relatively high population density and varying access to health services. In addition, statistical analysis indicates an increasing trend in reported cases among the productive-age population. These findings suggest that population density, community mobility, and case detection play important roles in the spread of the disease. Overall, this study provides a statistical overview of the distribution of tuberculosis cases in the Special Region of Yogyakarta in 2024 and highlights the importance of a data-driven approach in controlling infectious diseases. The results are expected to serve as a reference for local governments and health policymakers in designing more effective and targeted prevention strategies, early detection programs, and tuberculosis control measures.
Keywords: Statistical Analysis; Tuberculosis; Case Distribution.

1. INTRODUCTION

Tuberculosis is an infectious disease that remains a major public health problem worldwide. It is caused by the bacterium Mycobacterium tuberculosis, which primarily attacks the lungs but can also affect other organs. Transmission occurs through the air when someone with active TB coughs or sneezes, inhaling the bacteria. Despite the availability of effective treatments, tuberculosis remains a leading cause of death from infectious diseases globally (Furin, Cox, & Pai, 2019).

The global burden of tuberculosis remains extremely high in many countries. The World Health Organization's annual report indicates that approximately 10 million people are infected with tuberculosis each year. Furthermore, more than one million deaths are reported annually from this disease. This indicates that tuberculosis remains a serious challenge to global public health (WHO, 2023).

The distribution of tuberculosis cases is uneven across the world. Most cases occur in developing countries with high population densities and low socioeconomic conditions. Poverty, malnutrition, and limited access to health services increase the risk of transmission of this disease. Therefore, epidemiological analysis is needed to better understand the patterns of tuberculosis transmission (Glaziou, Floyd, & Raviglione, 2018).

Southeast Asia is one of the regions with the highest tuberculosis burden in the world. Countries in this region contribute nearly half of the total global TB cases each year. This situation is influenced by demographic factors, urbanization, and high population mobility. Therefore, regional research is crucial to understanding the dynamics of tuberculosis spread in the region (Lönnroth et al., 2010).

Indonesia is one of the countries with the highest number of tuberculosis cases in the world. According to global epidemiological reports, Indonesia is among the countries with the highest number of TB cases. This high number of cases indicates that tuberculosis control remains a major challenge for national health systems. Therefore, epidemiological data analysis is essential to support effective health policies (Fukunaga et al., 2021).

The Indonesian government has implemented various programs to control the spread of tuberculosis. These programs include early detection, standard treatment, and patient monitoring during therapy. One strategy used is the DOTS (Directly Observed Treatment Shortcourse) approach. This strategy has proven effective in increasing TB treatment success in various countries (Uplekar et al., 2015).

The spread of tuberculosis is influenced by various demographic factors. Population density is one factor that can increase the risk of disease transmission. Areas with dense populations have higher levels of social interaction. This condition can accelerate the spread of the bacteria that cause tuberculosis (Lönnroth et al., 2010).

In addition to demographic factors, environmental conditions also play a significant role in the spread of tuberculosis. Poorly ventilated homes can increase the risk of airborne disease transmission. High-density environments can also accelerate bacterial transmission. Therefore, environmental factors are a crucial component in the epidemiological analysis of tuberculosis (Bates et al., 2015).

Modern epidemiological research utilizes a statistical approach to analyze disease spread. Statistical methods enable researchers to identify patterns of disease distribution within a population. Statistical analysis also helps understand the relationship between risk factors and disease incidence. Therefore, statistical approaches are an essential part of public health research (Brookmeyer & Stroup, 2013).

Descriptive statistics is a method frequently used in epidemiological research. This method is used to describe data characteristics such as the number of cases, regional distribution, and affected age groups. Presenting data in tabular and graphical form can facilitate the interpretation of disease spread patterns. This information provides an initial overview of the epidemiological conditions of a disease (Pagano & Gauvreau, 2018).

In addition to descriptive statistics, inferential statistics also plays a crucial role in health research. This method allows researchers to draw conclusions from a sample and extend it to a broader population. Inferential analysis can also be used to examine the relationship between variables influencing disease incidence. This allows for more accurate identification of risk factors contributing to the spread of TB (Daniel & Cross, 2018).

Trend analysis is a statistical method frequently used in epidemiological research on infectious diseases. This method is used to observe changes in the number of disease cases over time. By understanding disease trends, researchers can evaluate the effectiveness of existing control programs. Trend analysis also helps predict the likelihood of future disease progression (Lawless, 2011).

In addition to trend analysis, correlation analysis is also frequently used to understand the relationship between certain variables and disease incidence. In tuberculosis research, variables such as population density and economic level are often analyzed. Correlation analysis can provide insight into the factors most influential in disease spread. The results of this analysis can be used as a basis for health policymaking (Pagano & Gauvreau, 2018).

The productive age group is often reported to have a relatively high number of tuberculosis cases. This is related to the higher levels of social activity and mobility in this age group. Individuals in the productive age group also engage in more frequent social interactions in the workplace and community. This condition can increase the opportunity for tuberculosis transmission (Furin et al., 2019).

In addition to age, an individual's health condition also influences the risk of tuberculosis. Individuals with weakened immune systems are at greater risk of contracting TB. Diseases such as HIV/AIDS, diabetes, and malnutrition can increase susceptibility to tuberculosis infection. The relationship between TB and comorbidities has been widely discussed in global epidemiological research (WHO, 2023).

Developments in information technology provide new opportunities for health data analysis. Available epidemiological data can be analyzed using a variety of modern statistical methods. This approach enables researchers to more accurately identify patterns of disease spread. This allows health policies to be designed based on strong scientific evidence (Brookmeyer & Stroup, 2013).

Statistical approaches can also be used to map the distribution of disease cases by geographic region. Spatial analysis allows researchers to identify areas with high disease incidence rates. This information is crucial for determining priorities for public health interventions. Therefore, statistical analysis plays a crucial role in health policy planning (Lawless, 2011).

Area-based research is crucial for understanding the dynamics of tuberculosis spread. Each region has distinct demographic, social, and environmental characteristics. These factors can influence the incidence rate within a region. Therefore, area-based epidemiological analysis is crucial (Glaziou et al., 2018).

The Special Region of Yogyakarta is one of the regions in Indonesia that continues to report tuberculosis cases annually. Despite having relatively good healthcare facilities, TB cases continue to be found in various districts and cities. High levels of population mobility can influence the dynamics of disease spread. Therefore, statistical analysis of the distribution of TB cases in this region is crucial (WHO, 2023).

Based on this background, this study aims to analyze the spread of tuberculosis in the Special Region of Yogyakarta Province in 2024 using a statistical approach. The analysis was conducted to examine the distribution patterns of cases by region and population characteristics. The results are expected to provide an overview of the dynamics of tuberculosis spread in the region. Furthermore, this research is expected to serve as a basis for formulating more effective disease control policies (Fukunaga et al., 2021).

2. MATERIALS AND METHODS

2.1. Study Area and Research Time

The focus of this research is the Special Region of Yogyakarta. This region was selected based on the availability of comprehensive and detailed statistical data on disease cases by district/city and disease type. Furthermore, the Special Region of Yogyakarta (DIY) is a region with a relatively high population density and a variety of public health conditions that are interesting to study. The data period analyzed in this study is 2024, the latest data available from the Central Statistics Agency.

2.2. Research Design

The research method used was library research with a quantitative descriptive approach. This approach was applied to process and analyze numerical data related to the number of disease cases in various districts/cities. Through this method, researchers were able to identify

disease distribution patterns, compare case numbers between regions, and examine trends in the most dominant types of disease based on available secondary data.

2.3. Data Collection and Sources

The data used in this study is secondary data obtained from the Central Statistics Agency (BPS), specifically through statistical publications regarding disease cases by district/city and disease type in the Special Region of Yogyakarta in 2024. Furthermore, the data is supported by scientific literature such as journals, research articles, and other reliable sources relevant to public health topics. The data collection process involved several stages:

a. Access and download data from the official BPS website
b. Identify relevant variables (disease type, number of cases, region)
c. Record and group data based on required categories

2.4. Data Analysis Procedure

a. Data Identification
   Researchers identified data on the number of disease cases by district/city and disease type available in the 2024 Yogyakarta Special Region Statistics (BPS) dataset.
b. Data Classification and Tabulation
   The collected data was then grouped by disease type and administrative region to facilitate comparative analysis.
c. Descriptive Analysis
   The data was analyzed using descriptive statistical methods to examine the distribution, frequency, and differences in the number of cases between regions and disease types.
d. Interpretation and Synthesis
   The analysis results were then interpreted to identify disease distribution patterns, areas with the highest number of cases, and the most dominant disease types. The results were then compiled into a systematic narrative to provide a comprehensive overview of public health conditions in Yogyakarta Special Region.

3. DISCUSSION RESULTS

As a first step in analyzing the distribution of tuberculosis cases in the Special Region of Yogyakarta, we present data on the number of cases by district and city. This presentation aims to provide an overview of the distribution of cases that occurred during 2024. The processed data is then presented in tabular form for easier understanding and analysis. The distribution of tuberculosis cases is shown in Table 1.

Table 1. Number of Tuberculosis Cases

Regency/City	Number of TB Disease Spread	Number of TB Cures
Kulon Progo	39,0	86,9
Bantul	69,0	90,5
Gunung Kidul	41,0	88,5
Sleman	115,0	81,0
Yogyakarta	143,0	82,0

Regency/City	Number of TB Disease Spread	Number of TB Cures
DI Yogyakarta	83,0	84,4

Based on the data analysis, statistical modeling was conducted to describe the pattern of tuberculosis distribution in the Special Region of Yogyakarta in 2024. This modeling aimed to determine the relationship between the number of tuberculosis cases and population density in each district and city. The modeling revealed a trend toward increasing cases in areas with higher population densities. The modeling results indicate that demographic factors and population distribution play a significant role in influencing the pattern of tuberculosis distribution in the study area.

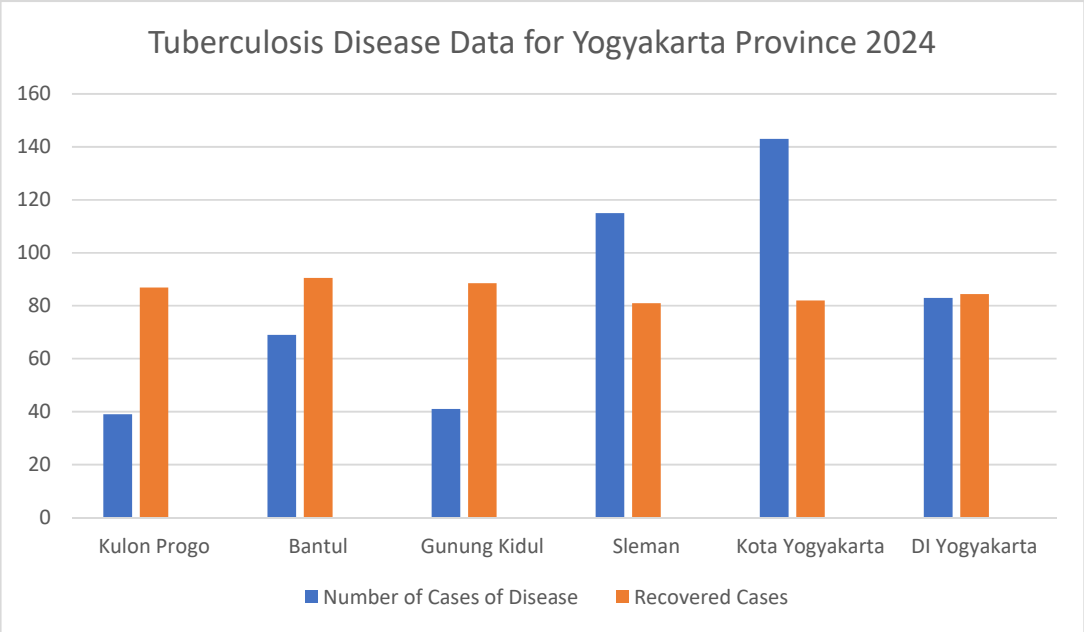

Figure 1. Data on the Form of the Trunk Diagram of TB Disease in DI Yogyakarta Province in 2024

Figure 1 presents data on the number of TB cases in the Special Region of Yogyakarta Province in 2024 in the form of a bar chart. The chart shows differences in the number of TB cases between regencies and cities, with Yogyakarta City and Sleman Regency having the highest number of cases compared to other regions. Meanwhile, Kulon Progo and Gunungkidul Regencies showed relatively lower numbers of cases. The variation in the height of the bars in each region indicates differences in the risk of TB transmission, influenced by population density, social mobility, and access to health services in each region.

These differences in the number of cases indicate that the distribution of TB in the Special Region of Yogyakarta is uneven across regions. Areas with high community activity and higher population density tend to have higher case numbers. This suggests that environmental factors, population mobility, and access to health services can influence the rate of disease spread. Therefore, analyzing this data is crucial for understanding the patterns of tuberculosis transmission and providing a basis for designing more effective disease control strategies in each region.

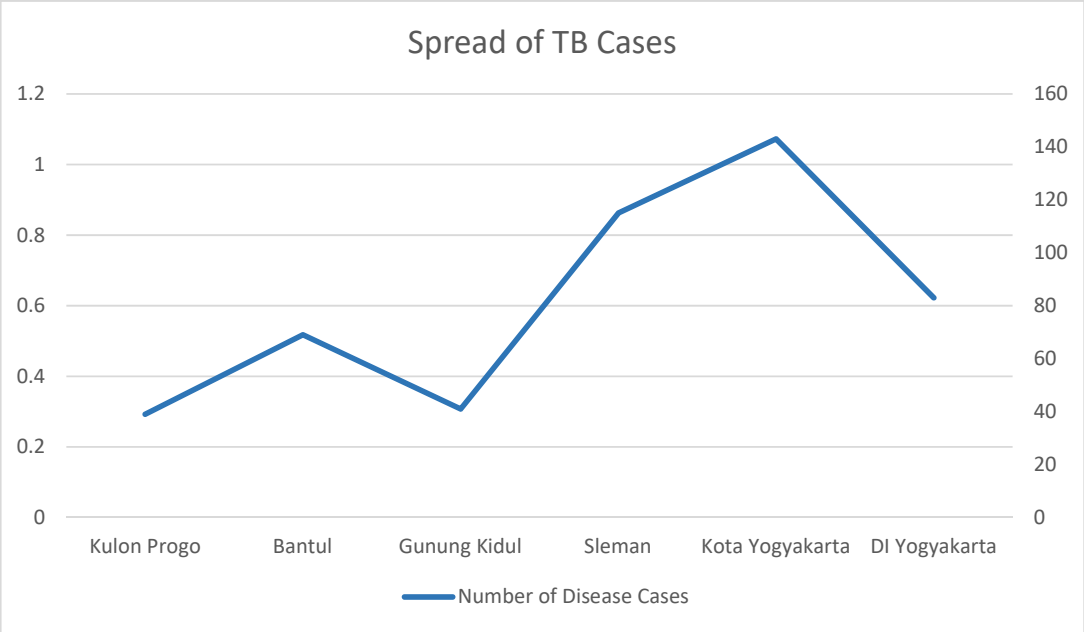

Figure 2. Data on the Number of Tuberculosis Cases Found

Figure 2 shows the distribution of tuberculosis cases found in several regions in the Special Region of Yogyakarta: Kulon Progo, Bantul, Gunung Kidul, Sleman, Yogyakarta City, and the province as a whole. The graph shows distinct variations in the number of tuberculosis cases across regions. Kulon Progo has a relatively lower number of cases compared to other regions, while Bantul has seen a significant increase in cases. Meanwhile, Gunung Kidul has seen a decrease in cases compared to Bantul, indicating differences in disease distribution patterns between regions.

A significant increase in cases was observed in Sleman and Yogyakarta City. This indicates that regions with high levels of population activity tend to have a higher number of tuberculosis cases. This condition can be influenced by several factors such as population density, community mobility, and more intensive social interaction. Therefore, urban areas or areas with high economic activity have the potential to experience a greater rate of disease spread.

Overall, the graph shows that the distribution of tuberculosis cases in the Special Region of Yogyakarta is uneven across regions. These differences in case numbers indicate that environmental factors, population density, and access to healthcare can influence the rate of disease spread. Therefore, statistical analysis of this data is crucial for a deeper understanding of tuberculosis distribution patterns. The results of this analysis can also be used as a basis for designing more effective disease prevention and control strategies in each region.

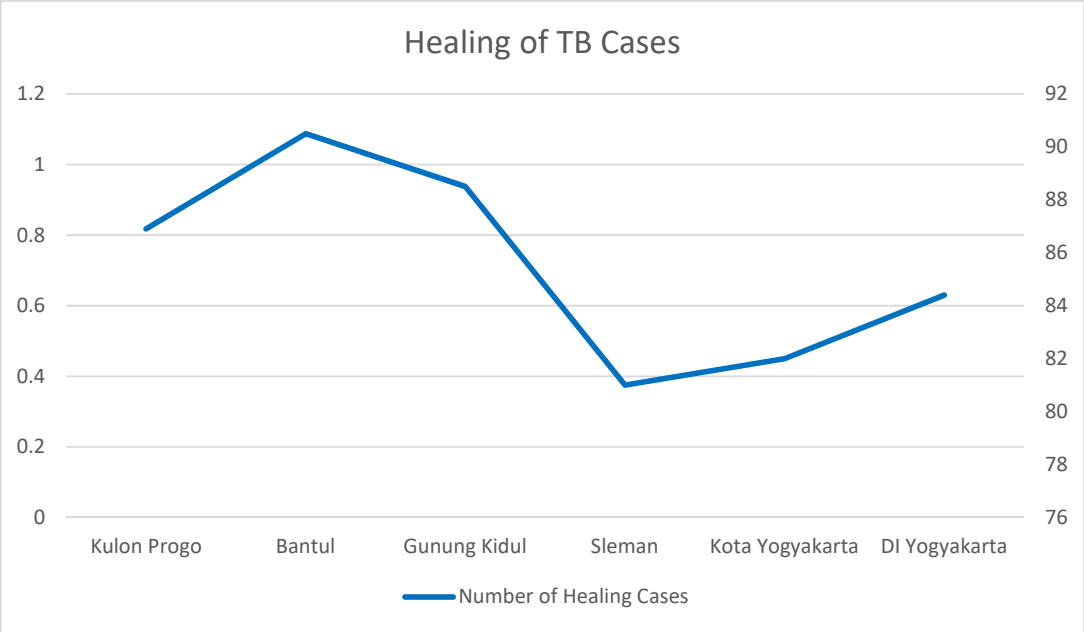

Figure 3. Data on the Number of Cases of Tuberculosis Disease That Have Been Successfully Treated

Figure 3 displays a graph of TB case cure rates in several districts/cities in the Special Region of Yogyakarta in 2024. The graph shows variations in cure rates between regions. Bantul Regency showed a relatively higher cure rate compared to other regions, while Sleman Regency showed a lower cure rate. Meanwhile, Kulon Progo, Gunung Kidul, and Yogyakarta City had cure rates in the intermediate category.

These differences in cure rates indicate variations in the effectiveness of tuberculosis treatment and management across regions. Factors such as access to healthcare, patient compliance with therapy, and the quality of disease control programs can influence treatment success. Areas with higher cure rates indicate more optimal detection and treatment. Therefore, analysis of this cure data is important for evaluating the success of tuberculosis control programs and as a basis for improving treatment strategies in areas with low cure rates.

4. BATIK MOTIF

Philosophy:

a. Geometric Shape (Irregular Crystal)

The main motif is in the form of geometric shapes resembling irregular crystals that depict the dynamics of the ups and downs of tuberculosis cases in people's lives. The asymmetrical shape reflects the uncertainty and complexity of the spread of the disease, which is influenced by various factors such as the environment, immunity, and health awareness. The interconnected lines within it symbolize the graph of the development of cases, which sometimes rise as a symbol of widespread spread, and sometimes decrease as a sign of the success of treatment and prevention efforts. This motif confirms that tuberculosis is a disease that has a fluctuating pattern and requires continuous attention and treatment.

b. Secondary Motif: Textured Circles (Cells/Microorganisms)

The small, textured circle motif with dots in it symbolizes the bacteria that causes tuberculosis, namely Mycobacterium tuberculosis. The repetitive circular shape shows the ever-evolving nature of the spread of bacteria and can move from one individual to another. The difference in the size of the circle reflects an uneven level of exposure, where some individuals or regions are more vulnerable than others. Its spread across the fabric illustrates

that the disease can be present in a variety of environments, so vigilance, healthy lifestyles, and collective awareness are needed to prevent its spread.

c. Balancing Motif: Flowers and Leaves

Floral and leaf motifs are present as a counterbalance that brings the meaning of hope, healing, and new life. The flower symbolizes the hope that grows in the midst of difficult conditions, as a symbol that every sufferer has a chance to be healed. The leaves that surround it depict the gradual recovery process as well as the body's strength in fighting infection. In addition, the leaves also symbolize the support of the surrounding environment, such as family and medical personnel, who play an important role in the healing process. The placement of flowers in different parts shows that hope is never lost, but rather always accompanies every phase of human life.

d. Background Motif: Oval Shape (Body/Lung Cells)

The background motif in the form of an oval shape resembling body cells or lung tissue depicts the main organs affected by tuberculosis. The spread of this form throughout the fabric suggests that the infection can affect different parts of the body, although the lungs are the main center of disease attacks. This motif is also a reminder of the importance of maintaining a healthy respiratory system and conducting early detection of disease symptoms, so that treatment can be carried out quickly and appropriately.

e. Fringe Motifs: Wavy Lines and Small Chains

The fringe motif in the form of wavy lines symbolizes the long journey in dealing with tuberculosis, starting from the beginning of exposure, the diagnosis process, treatment, to achieving recovery. The rising and falling waveform illustrates that the journey is full of challenges and does not always go smoothly. Along this curved line there are small interconnected chains, which have a deep meaning as a symbol of the interconnectedness between individuals in the process of spreading and curing diseases. The chain symbolizes that tuberculosis does not only impact one person, but also involves the surrounding environment, both in terms of transmission and healing support. In addition, this small chain can also be interpreted as a symbol of business continuity—that the treatment process must be carried out regularly, continuously, and uninterrupted in order to achieve optimal results. Thus, the wavy lines and small chains together depict life's journey full of connections, struggles, and hopes toward healing.

f. Propeller Motif (Symbol of Movement and Spread)

The motif that resembles a propeller and is located adjacent to a microbe-like circle has a meaning as a symbol of movement and interaction in the spread of tuberculosis. Its rotating shape illustrates how bacteria can spread through the air, specifically through the respiratory system, so that it is closely related to the surrounding circle that symbolizes disease-causing microorganisms. The proximity of these two motifs shows a direct relationship between the source of the disease and its transmission mechanism in the environment. In addition, the propeller is also interpreted as a symbol of air circulation which plays an important role in prevention, because clean air and good ventilation can help reduce the spread of disease. The number of only two reflects the balance between two opposing but related conditions, namely between spread and prevention, sickness and recovery, and threat and hope, so that this whole motive implies the importance of awareness and the role of humans in controlling tuberculosis.

Figure 4. Batik Motif

5. CONCLUSION

Based on the results of statistical analysis that has been carried out, it can be concluded that the spread of tuberculosis cases in the Special Region of Yogyakarta in 2024 shows that there is a variation in the number of cases in each district and city. Data analyzed through diagram visualization and statistical modeling show that the distribution of cases is uneven across regions. Some regions show a relatively higher number of cases than others. This shows that regional factors have an influence on the pattern of the spread of tuberculosis.

The results of the analysis also showed that areas with higher community activity tended to have a larger number of tuberculosis cases. This difference can be influenced by several factors such as population density, community mobility, and social interaction that occurs in an area. This condition allows for faster disease transmission if it is not balanced with effective control efforts. Therefore, environmental and social factors are important aspects in understanding the pattern of the spread of tuberculosis.

In addition, analysis of the cure rate of tuberculosis cases showed that there was a difference in the effectiveness of treatment between regions in the Special Region of Yogyakarta. Some regions show higher treatment success rates, while others still show relatively lower cure rates. This can be influenced by access to health services, patient compliance in undergoing therapy, and the quality of the treatment program implemented. Thus, the success of the treatment of tuberculosis depends not only on the number of cases found, but also on the effectiveness of the treatment process.

The statistical modeling carried out in this study provides an overview of the distribution pattern and cure rate of tuberculosis cases in each region. The modeling results help in identifying trends in case distribution as well as factors that have the potential to influence the spread of disease. The information obtained from this analysis can be used as a basis for understanding the dynamics of the spread of tuberculosis more comprehensively. With a statistical approach, the pattern of disease spread can be analyzed more systematically and measurably.

Overall, this study shows that statistical analysis has an important role in studying the spread of tuberculosis in the Special Region of Yogyakarta. The results of this study are expected to contribute to the formulation of more effective health policies in efforts to prevent and control tuberculosis. Local governments and related parties can use the results of this analysis as a basis for designing more targeted early detection, treatment, and disease control strategies. Thus, efforts to control tuberculosis can be carried out more optimally in the future.

6. REFERENCES

Bates, M., Marais, B. J., & Zumla, A. (2015). Tuberculosis comorbidity with communicable and noncommunicable diseases. *Cold Spring Harbor Perspectives in Medicine*, 5(11)

Brookmeyer, R., & Stroup, D. F. (2013). *Monitoring the health of populations: Statistical principles and methods for public health surveillance*. Oxford University Press.

Daniel, W. W., & Cross, C. L. (2018). *Biostatistics: A foundation for analysis in the health sciences* (11th ed.). Wiley.

Fukunaga, R., Glaziou, P., Harris, J. B., Date, A., Floyd, K., & Kasaeva, T. (2021). Epidemiology of tuberculosis and progress toward achieving global targets — Worldwide, 2019. *MMWR. Morbidity and Mortality Weekly Report*, 70(12), 427–430.

Furin, J., Cox, H., & Pai, M. (2019). Tuberculosis. *The Lancet*, 393(10181), 1642–1656.

Glaziou, P., Floyd, K., & Raviglione, M. (2018). Global epidemiology of tuberculosis. *Seminars in Respiratory and Critical Care Medicine*, 39(3), 271–285.

Lawless, J. F. (2011). *Statistical models and methods for lifetime data* (2nd ed.). Wiley.

Lönnroth, K., Jaramillo, E., Williams, B. G., Dye, C., & Raviglione, M. (2010). Drivers of tuberculosis epidemics: The role of risk factors and social determinants. *Social Science & Medicine*, 68(12), 2240–2246.

Pagano, M., & Gauvreau, K. (2018). *Principles of biostatistics* (2nd ed.). CRC Press.

Uplekar, M., Weil, D., Lönnroth, K., Jaramillo, E., Lienhardt, C., Dias, H. M., ... & Raviglione, M. (2015). WHO's new End TB strategy. *The Lancet*, 385(9979), 1799–1801.

World Health Organization. (2023). *Global tuberculosis report 2023*. Geneva: World Health Organization.