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STATISTICAL DATA ANALYSIS OF *TUBERCULOSIS* DISEASE IN YOGYAKARTA CITY IN 2024

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Abstrak

Tuberculosis (TB) is an infectious disease that remains a public health problem in Indonesia, including in the Special Region of Yogyakarta (DIY). This study aims to analyze the TB case detection rate and TB treatment success rate in Yogyakarta City and compare them with the average values in the Special Region of Yogyakarta (DIY) in 2024, based on official data from the Central Statistics Agency (BPS). The research method used was quantitative with a descriptive analytical approach using secondary data. Data were analyzed through tabulation, difference calculations, comparison ratios, and diagrammatic visualization. Furthermore, this study also developed a simple mathematical model in the form of a ratio comparison as a simulation to illustrate the trend of the TB detection rate indicator on a specific scale. The results showed that Yogyakarta City had a TB detection rate of 143.0, higher than Yogyakarta (83.0). However, the TB treatment success rate in Yogyakarta City, at 82.0, was slightly lower than Yogyakarta (84.4). The mathematical model simulation showed that the slope of the graph in Yogyakarta City was greater than in Yogyakarta, indicating a higher case detection rate. The conclusion of this study is that TB case detection in Yogyakarta City is quite good, but efforts are still needed to improve treatment success through strengthening patient compliance, therapy monitoring, and public health education.

Keywords: Tuberculosis, TB detection rate, treatment success rate, Yogyakarta City, DI Yogyakarta,

1. INTRODUCTION

Tuberculosis (TB) is a contagious infectious disease caused by the bacterium Mycobacterium tuberculosis. A communicable disease is a disease that can be transmitted (transmissible disease) or a communicable disease, resulting from an infection resulting from the presence of pathogenic microbial agents, including viruses, bacteria, fungi, protozoa, multicellular organisms, and aberrant proteins known as prions (Zahwa, N, *et al*., 2022). This disease can attack the lungs (pulmonary TB) or other organs such as bones, lymph nodes, brain, and kidneys. TB transmission occurs primarily through the air (airborne disease), namely when a person inhales droplets containing bacteria from someone with active TB. This disease progresses slowly and often does not immediately cause severe symptoms in the early stages, so many sufferers are diagnosed late.

Globally, Tuberculosis remains one of the leading causes of death from infectious diseases. Indonesia is among the countries with the highest Tuberculosis burden in the world (World Health Organization, 2023). The high incidence of Tuberculosis is influenced by various factors, such as population density, socioeconomic conditions, access to health services, community nutrition, and public awareness of clean and healthy lifestyles. The Tuberculosis

control program in Indonesia is implemented through active and passive case finding strategies, standard DOTS (Directly Observed Treatment Short course) treatment, and monitoring therapy success.

Important indicators in evaluating Tuberculosis control programs are the case finding rate and the treatment success rate. The case finding rate reflects the ability of health services to detect Tuberculosis cases in the community. The higher the case finding rate, the better the detection efforts are, as more cases are identified and can receive prompt treatment. Meanwhile, the treatment success rate reflects the proportion of patients who complete treatment and are cured. A high success rate indicates patient adherence to therapy and the effectiveness of the mentoring program.

Yogyakarta City is an urban area with high population mobility. The city is a center of education, tourism, and economic activity in the Special Region of Yogyakarta. These conditions can increase the potential for transmission of infectious diseases, including Tuberculosis, due to higher social interaction and community activity density compared to rural areas. Furthermore, the presence of immigrants and students from various regions can influence the dynamics of disease spread.

On the other hand, Yogyakarta City also has relatively comprehensive healthcare facilities, including hospitals, community health centers (Puskesmas), and private clinics. This situation has the potential to increase Tuberculosis case detection rates because people have easier access to testing. However, challenges in urban areas can also arise, such as low treatment adherence due to busy schedules, high mobility, and lack of direct patient supervision.

This study was conducted to analyze Tuberculosis detection rates and Tuberculosis treatment success rates in Yogyakarta City and compare them with the average values for the Special Region of Yogyakarta province in 2024, based on official data from the Central Statistics Agency (BPS). In addition to descriptive statistical analysis, this study also developed a simple mathematical model in the form of a linear function as a simulation to visualize the differences in indicators between Yogyakarta City and Yogyakarta Special Region. It is hoped that this research can provide information for evaluating health programs and provide a general overview of Tuberculosis control in urban areas.

2. LITERATURE REVIEW

2.1. Basic Concepts of Tuberculosis

Tuberculosis is a chronic infectious disease caused by Mycobacterium tuberculosis. This bacterium has a lipid-rich cell wall, making it resistant to various environmental conditions. The incubation period for Tuberculosis is quite long, and symptoms can vary. Common symptoms of pulmonary Tuberculosis include a cough lasting more than two weeks, fever, night sweats, weight loss, and shortness of breath.

2.2. Tuberculosis Control Strategy

Tuberculosis control strategies are implemented through several approaches, namely case detection, rapid diagnosis, standard treatment, and patient support to ensure therapy adherence. The DOTS program emphasizes the importance of direct patient supervision while taking medication for at least 6 months. (Ministry of Health of the Republic of Indonesia, 2022).

2.3. Tuberculosis Case Detection Rate Indicator

The Tuberculosis case detection rate is an indicator that shows the percentage or success rate of health services in detecting Tuberculosis cases in the community. A high case detection rate indicates the quality of the surveillance and case reporting system.

2.4. Tuberculosis Treatment Success Indicators

The treatment success rate is an indicator that shows the percentage of patients declared cured or who have completed treatment. Factors that influence treatment success include medication adherence, drug side effects, family support, patient education, and the availability of healthcare services.

2.5. Statistical Approaches in Epidemiological Studies

Descriptive statistical analysis is used to describe health data in the form of tables, graphs, and measures of central tendency. This analysis is useful for understanding disease distribution patterns and serves as a basis for health policy decisions (Sugiyono, 2021).

2.6. Mathematical Models in Infectious Disease Studies

Mathematical models are used to predict disease trends and visualize relationships between variables. The ratio comparison model is a simple model often used to describe proportional relationships. In this study, the ratio comparison model was used to simulate the comparison of TB indicators between Yogyakarta City and Yogyakarta Special Region on a specific scale.

3. MATERIALS AND METHODS

3.1. Type of Research

This research is a quantitative study with a descriptive analytical approach. This approach was used because the data analyzed are in numerical form and aim to describe the condition of public health indicators.

3.2. Research Location and Time

The research was conducted in Yogyakarta City and the Special Region of Yogyakarta Province using statistical data from 2024. Data were analyzed during the reporting period of 2026.

3.3. Data Sources

The data used is secondary data sourced from the publication of the Central Statistics Agency (BPS) of the Special Region of Yogyakarta Province on statistical tables regarding disease cases by district/city and type. Central Statistics Agency of the Special Region of Yogyakarta Province. (2024), accessed through: https://yogyakarta.bps.go.id/. Ministry of Health of the Republic of Indonesia. (2022), World Health Organization. (2023). Global Tuberculosis Report 2023, and Sitr Mathematical Model on the Spread of Tuberculosis in Aceh Province.

3.4. Research Variables

The variables analyzed in this study include:
(1) Tuberculosis Case Detection Rate, an indicator that describes the health care system's ability to detect and report tuberculosis cases in the community. This variable reflects the effectiveness of screening and surveillance activities, as well as public access to TB diagnostic facilities.
(2) Tuberculosis Treatment Success Rate, an indicator that shows the percentage of tuberculosis patients who successfully complete treatment and are declared cured. This variable reflects the level of patient compliance, the effectiveness of therapy, and the quality of treatment monitoring and support.

These two variables are used to analyze the performance of the tuberculosis control program, particularly in terms of case detection and therapy success, and are compared between the City of Yogyakarta and the Special Region of Yogyakarta (DIY) Province.

3.5. Data Collection Techniques

Data collection was conducted using the documentation method, which involves collecting data officially published by the Central Statistics Agency (BPS). The data used was secondary data sourced from the 2024 health statistics publication, specifically those related to Tuberculosis (TB) indicators in Yogyakarta City and the Special Region of Yogyakarta Province (DIY).

The data collection process was conducted by accessing, reviewing, and recording relevant information from official BPS documents. The data obtained was then selected and adapted to the research needs, particularly those related to TB case detection rates and TB treatment success rates.

The documentation method was chosen because the data used is valid, reliable, and has been verified by official agencies, thus supporting the accuracy of the analysis in this study.

3.6. Data Processing Techniques

Data processing was carried out through the stages of editing, tabulation, and presentation of data in tables and graphs. Afterwards, differences in values and comparative ratios were calculated.

3.7. Data Analysis Techniques

Data analysis was conducted using descriptive statistics with the following steps:
(1) Presenting data in tables
(2) Comparing indicators for Yogyakarta City and Yogyakarta Special Region
(3) Calculating indicator differences
(4) Calculating ratio comparisons
(5) Constructing a simple mathematical simulation model

3.8. Mathematical Models and Simulations

The mathematical model used in this study is a ratio comparison model. Where R = ratio comparison. X_1 = indicator value for region 1. X_2= indicator value for region 2. The general form is $R = X_1/X_2$

4. RESULTS AND DISCUSSION

4.1. Tuberculosis Statistics Data Results for 2024

Based on data from the Central Statistics Agency (BPS) of the Special Region of Yogyakarta Province in 2024, the Tuberculosis detection rate and Tuberculosis treatment success rate in Yogyakarta City and Yogyakarta Special Region were obtained as shown in Table 1.

Table 1. Tuberculosis detection and treatment success rates in 2024

Region	Tuberculosis Detection Rate	Tuberculosis Treatment Success Rate
Yogyakarta City	143,0	82,0
DI Yogyakarta	83,0	84,4

Table 1 shows that the TB detection rate in Yogyakarta City is significantly higher than the provincial average. Meanwhile, the treatment success rate in Yogyakarta City is slightly lower than the provincial average.

4.2. Comparative Analysis of TB Detection Rates

The Tuberculosis detection rate in Yogyakarta City in 2024 was 143.0, while the Yogyakarta Special Region (DIY) was 83.0. The difference between the two values is 60.0 points. The high detection rate in Yogyakarta City may indicate a more active screening and case reporting process, as well as better public access to health facilities.

The ratio of the Tuberculosis detection rate in Yogyakarta City to DIY can be calculated as follows:

$$R = 143.0 / 83.0 = 1.72$$

This means that the Tuberculosis detection rate in Yogyakarta City is approximately 1.72 times higher than the Tuberculosis detection rate in DIY.

4.3. Comparative Analysis of Treatment Success Rates

The Tuberculosis treatment success rate in Yogyakarta City was 82.0, while DIY was 84.4. The difference is -2.4 points. This value indicates that treatment success in Yogyakarta City is slightly lower than in the province. This could be influenced by factors such as medication adherence, drug side effects, limited support, or high population mobility, which makes it easier for patients to discontinue treatment.

4.4. Mathematical Model and Simulation

To visualize the difference in Tuberculosis detection rates between Yogyakarta City and the Special Region of Yogyakarta, a ratio comparison model with the form $R = X_1/X_2$ was used.

a. Tuberculosis Detection Rate Ratio

$$\text{Recovery} = 143.0/83.0$$
$$\text{Recovery} = 1.72$$

This means that the Tuberculosis detection rate in Yogyakarta is 1.72 times higher than the average for the Special Region of Yogyakarta.

b. Treatment Success Ratio

$$\text{Resuccess} = 82.0/84.4$$
$$\text{Resuccess} = 0.97$$

A value of 0.97 indicates that treatment success in Yogyakarta City is only 97% of the provincial average.

To clarify the interpretation of the ratio, a simulation was conducted on a 100-point scale as a standard of comparison.

$$\text{The detection rate for Yogyakarta City} = 1.72 \times 100 = 172\%$$
$$\text{The success rate for Yogyakarta City} = 0.97 \times 100 = 97\%$$

Table 2. Results of linear model simulation of Tuberculosis detection rate

Indicator	Ratio	Simulation (%)
Tuberculosis Detection	1.72	172%
Treatment Success	0.97	97%

The simulation in Table 2 shows that Yogyakarta City excels in case detection but lags slightly behind in treatment success. This is consistent with the original data, which shows that the TB detection rate in Yogyakarta City is higher than the provincial average.

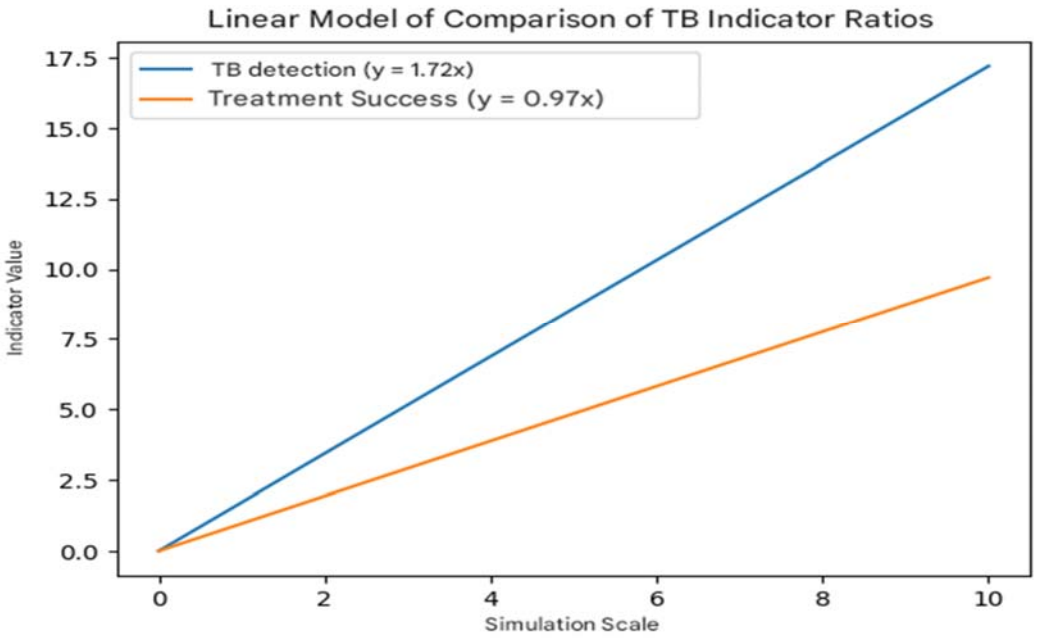

Figure 1. Simulation graph of a linear model of Tuberculosis detection rates in 2024

4.5. Mathematical-Based Batik Motif Model

To integrate local wisdom, the ratio model is visualized in the form of a batik motif with a repeating diagonal pattern, similar to mathematical batik.

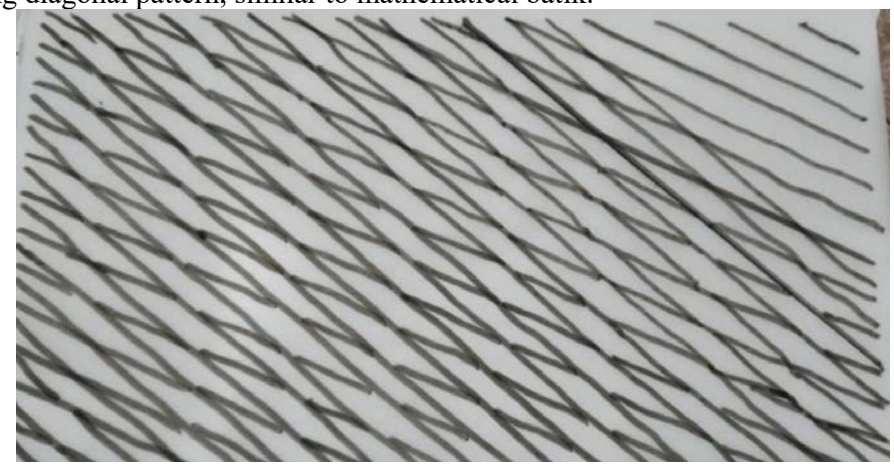

Figure 2. Mathematical-Based Batik Motif Model

Figure. 2 illustrates the steep diagonal line, which represents the Tuberculosis detection rate (1.72), and the more gradual diagonal line represents the treatment success rate (0.97). The repeating pattern illustrates the dynamics of TB spread and control.

4.6. Epidemiological Interpretation and Program Implications

The high Tuberculosis detection rate in Yogyakarta City can be interpreted as the health system's success in detecting cases. However, this indicator may also reflect the high caseload in the region. With high population mobility, the likelihood of Tuberculosis transmission in urban environments also increases. Therefore, preventative measures are needed through public education, active screening, and improving the quality of diagnostic services.

On the other hand, the slightly lower treatment success rate in Yogyakarta City is a concern. Low treatment success can increase the risk of relapse and drug resistance (drug-resistant TB). Patient support programs through medication monitoring (PMO) should be strengthened to ensure patient complete therapy.

A comparison of indicators from Yogyakarta City and the Special Region of Yogyakarta (DI Yogyakarta) shows that Tuberculosis control is determined not only by detection capacity but also by the treatment monitoring system. Strengthening the health information system and patient reporting is essential to increase program effectiveness.

4.7. Research Limitations

This study used secondary data, so the analysis was limited to indicators available in BPS publications. This study did not analyze direct causal factors such as patient compliance, socioeconomic conditions, or the availability of health services in detail. Furthermore, the mathematical model used was still simple (linear), so it did not fully depict the complex dynamics of Tuberculosis transmission.

4.8. Recommendations

Based on the analysis, the following recommendations can be made:
(1) Increase active screening activities in densely populated areas,
(2) Strengthen medication monitoring (PMO) to ensure patients do not discontinue treatment,
(3) Increase public education regarding TB prevention and symptoms,
(4) Develop a technology-based patient monitoring system to improve therapy adherence.

5. CONCLUSION

The conclusions of this study are: (1) The Tuberculosis detection rate in Yogyakarta City in 2024 is 143.0, higher than the rate in Yogyakarta Special Region (DIY) of 83.0; (2) The Tuberculosis treatment success rate in Yogyakarta City, at 82.0, is slightly lower than that in the Special Region of Yogyakarta (DIY), at 84.4; (3) a linear mathematical model simulation shows that the slope of the graph in Yogyakarta City is greater, thus indicating a tendency for higher case detection; (4) Improved monitoring strategies and treatment adherence are needed to increase therapy success in Yogyakarta City.

6. ACKNOWLEDGMENTS

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