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Original Research

Descriptive Epidemiology of Tuberculosis-Diabetes Mellitus Co-Infection in Respira Paru Hospital: A Study of Incidence from 2021 to 2023

Bunga Bilbina Rizkika[1], Liena Sofiana[2,*] and Ardyawati Wira Oktaviana[3]

[1]Students in the Public Health Study Program, Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta 55164, Indonesia
[2]Public Health Study Program, Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta 55164, Indonesia
[3]Students in Master of Public Health Sciences, Universitas Sebelas Maret, Surakarta 57126, Indonesia

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***Correspondence:**
Liena Sofiana
Address: Prof. Dr. Soepomo Street Janturan Warungboto, Yogyakarta 55164, Indonesia.
Email: liena.sofiana@ikm.uad.ac.id

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ABSTRACT

Background: Tuberculosis (TB) and Diabetes Mellitus (DM) are global problems, especially in countries with high TB endemicity. The relationship between TB and DM is more dominant in developing countries where TB is endemic, and the prevalence of DM is increasing. The risk of death during TB treatment and the risk of relapse after treatment is higher in TB patients with comorbid DM. More than 10% of TB patients are also known to have DM. This study aims to determine the epidemiological picture of TB-DM incidence based on time, place and person. **Methods:** This study uses a descriptive quantitative design with a case study approach; the analysis used is univariate analysis using proportions. The population of TB-DM patients in 2021-2023 was recorded in medical records, with a purposive sampling technique obtained from 110 people. **Results:** The epidemiological picture of TB-DM cases based on the characteristics of the person is age ≥ 45 years (80.9%), male gender (71.8%), type of pulmonary TB (98.2%), bacteriologically confirmed TB diagnosis (73.6%), the final result of TB treatment is cured (52.7%), type of DM therapy is insulin injection (76.4%) and high random blood sugar levels > 200 mg/dL (64.5%). **Conclusions:** The epidemiological picture of TB-DM cases for three years (2021-2023) has an upward trend and the highest cases in 2022; the majority of TB-DM cases are male, aged > 45 years, with the most cases coming from Bantul Regency.

Keywords: Epidemiology; tuberculosis-diabetes mellitus; time; place; person

1. INTRODUCTION

Diabetes Mellitus raises the risk of tuberculosis thrice. It inhibits the innate and adaptive responses necessary to prevent the development of infectious illness to clinical disease. Diabetes mellitus is an independent risk factor for poor TB treatment outcomes and mortality. The fact that DM patients have decreased cellular immunity, renal failure, nutritional deficits, and pulmonary microangiopathy all contribute to their vulnerability to Mycobacterium tuberculosis.(1)

TB and DM have a bidirectional interaction, each impacting the other's presentation in various ways. Diabetes is

becoming recognized as a risk factor for tuberculosis and can exacerbate its symptoms, whereas tuberculosis can deteriorate glycemic control or produce impaired glucose tolerance (IGT) in TB patients. This association necessitates therapeutic changes, including using insulin to manage hyperglycemia during active tuberculosis infection when appropriate. Following the completion of TB therapy, anti-glycemic medications must be reviewed.[2] The co-existence of TB and DM can hurt TB therapy and may increase the incidence of multidrug resistance. Delayed sputum conversion from AFB positive to AFB negative and treatment failure are more likely in TB-DM patients than in non-diabetic TB patients.[3]

Diabetes Mellitus (DM) and Tuberculosis (TB) are global issues, particularly in nations with a high TB incidence. In underdeveloped countries where tuberculosis is common and diabetes is becoming more common, there is a more vital link between the two diseases. This is typically the case in industrialized nations.[4] Tuberculosis is becoming increasingly frequent. Every year, around 9 million new tuberculosis (TB) cases are recorded worldwide out of an estimated 15 million new and old TB cases. Tuberculosis (TB) affects one-third of the world's population and kills more than 1.5 million people every year. Diabetes, particularly type 2 diabetes, is caused by a combination of factors, including age, lifestyle changes, socioeconomic situations, and population expansion. Diabetes is estimated to affect 439 million people worldwide by 2030. More than 80% of people with diabetes reside in poor nations with low incomes. According to a study, TB-endemic nations are home to 70% of all people living with diabetes globally. Diabetes mellitus prevalence ranges from 2 to 9% in the 22 nations with the highest number of tuberculosis cases. According to WHO data, eight of the ten nations with the highest diabetes rates also have the most significant number of tuberculosis patients. Indonesia has the fourth-largest number of DM patients in the world. The rising prevalence of diabetes mellitus is also a contributing factor to the growing TB epidemic, as pulmonary TB is one of the most frequent causes of complications in this condition.[5]

The Global Health Observatory provides national estimates of adult diabetes prevalence. According to the most recent data, the median prevalence of diabetes in the 30 high-TB burden nations was 8% (interquartile range [IQR]: 6–9%). In Gabon, Mongolia, Pakistan, Papua New Guinea, and South Africa, the prevalence was 10% or higher, at 12%, 11%, and 12%, respectively. According to the International Diabetes Federation, between 2019 and 2045, the number of individuals with diabetes is expected to rise by roughly 50% worldwide, with a median increase of 99% (IQR: 69–151%) in high-TB burden nations.[6]

After China and India, the third-highest incidence of tuberculosis is seen in Indonesia. Eight hundred forty-two thousand new cases were reported in 2017. Data from the Indonesian Ministry of Health indicates that 0.4% of Indonesians had tuberculosis in 2018.[7] With a poor case detection rate in comparison to the national target, the identification and management of TB patients in do-it-yourself projects remains a significant health concern. Data from the Internet Tuberculosis Information System (SITB) shows that in 2019 (before the Covid-19 epidemic), DIY's (Daerah Istimewa Yogyakarta or Special Region of Yogyakarta) TB case detection rate reached 44.4%. The case detection rates during the COVID-19 pandemic in 2020–2021 were 33.9% and 34%, respectively. This indicates a decline of 10.5% and 10.4% throughout that time frame. Up to September 2022, the TB case detection rate was 36% (3,250 cases), predicted to reach 50% by the end of the year. This is higher than the 44.4% rate before the Covid-19 pandemic.[8] Patients with concomitant diabetes mellitus are at a higher risk of dying while receiving treatment for tuberculosis and of relapsing following therapy. It is estimated that about 10% of TB patients also have diabetes. Consequently, the number of TB patients will rise sharply in tandem with the growing number of DM patients.[9]

The annual rise in DM and TB infections has turned into a global public health emergency. Public health and clinical practice face difficulties due to the impact of diabetes on the prevalence and severity of tuberculosis, as well as the intricate connections between diabetes, obesity, nutrition, and tuberculosis. Diabetes mellitus and TB are significant health issues for those who are susceptible to them. Diabetes mellitus patients have physiologically compromised lungs, which hinder the body's natural defences against infection and hasten its spread. This study aimed to characterize the epidemiological picture of TB-DM incidence at the Respira Paru Hospital in Yogyakarta for 2021–2023.

2. METHODS

This research uses a quantitative descriptive design with a case study approach. This study was conducted to describe the characteristics of tuberculosis (TB) patients with diabetes mellitus (DM) based on secondary data obtained from medical records. This approach was chosen to provide a detailed and in-depth picture of the relationship between TB and DM, as well as the factors associated with these two conditions.

The research population consists of all TB-DM patients recorded at Respira Paru Hospital Yogyakarta during the period from 2021 to 2023, with a total of 110 individuals. The sample in this study is the entire population, which was taken using the total sampling method, considering the predetermined inclusion and exclusion criteria. Inclusion criteria include patients diagnosed with TB and DM who are recorded in the medical records, while exclusion criteria are patients with incomplete or unavailable data in the medical record system.

The data used in this research are secondary data taken from patient medical records and laboratory test result sheets available at the hospital. The research variables include, People: age, gender, type of TB, treatment outcome, diagnosis, type of DM therapy, and random blood sugar level, Location: patient's address, Time: the year the case or diagnosis occurred. The data collection process was carried out by accessing the patient's medical record archives through administrative procedures in accordance with hospital regulations.

Data analysis was conducted univariately to describe the frequency distribution and proportion of each research variable. The data obtained were then processed using statistical software. The analysis results are presented in the form of frequency distribution tables and diagrams to provide a clear and structured overview of the characteristics of TB-DM patients at Respira Paru Hospital Yogyakarta.

This research has received ethical approval from the Health Research Ethics Committee of Respira Paru Hospital Yogyakarta with registration number 030/KEPK/VII/2024. All research procedures were carried out in accordance with the principles of health research ethics, such as maintaining patient data confidentiality, avoiding data misuse, and ensuring that data is only used for research purposes. The data used has been anonymized to protect patient identities.

3. RESULTS

Based on data analysis, the description of TB-DM incidence based on people includes age, gender, type of TB, TB diagnosis, final results of TB treatment, type of DM therapy, and random blood sugar levels are presented in Table 1. The proportion of respondents' ages that were most confirmed with TB-DM at the Respira Paru Hospital in 2021-2023 was the age group ≥ 45 years at 80.9%, the proportion of respondents' gender that was mostly confirmed with TB-DM at the Respira Paru Hospital in 2021-2023 was male at 71.8%, the proportion of respondents' TB types that were most confirmed with TB-DM at the Respira Paru Hospital in 2021-2023 was pulmonary TB at 98.2%, the proportion of respondents' TB diagnoses that were most confirmed with TB-DM at the Respira Paru Hospital in 2021-2023 was bacteriologically confirmed at 73.6%, the proportion of the final results of the respondents' TB treatment that were most confirmed as TB-DM at the Respira Paru Hospital in 2021-2023 were those declared

Table 1. Characteristics based on people including age, gender, type of TB, TB diagnosis, final results of TB treatment, type of DM therapy, and random blood sugar levels

Variable	n=110	%
Age		
≥ 45 years	89	80.9
< 45 years	21	19.1
Sex		
Male	79	71.8
Female	31	28.2
Types of TB		
Pulmonary TB	108	98.2
Extrapulmonary TB	2	1.8
Diagnosis of TB		
Clinically diagnosed	29	26.4
Bacteriologically confirmed	81	73.6
Final result of TB treatment		
Failed	2	1.8
Died	8	7.3
Completed treatment	27	24.5
Lost to follow up	15	13.6
Cured	58	52.7
Types of DM therapy		
Insulin injection	84	76.4
Oral hypoglycemic drugs	26	23.6
Current blood sugar levels		
Normal (< 200 mg/dL)	39	35.5
High (> 200 mg/dL)	71	64.5

cured at 52.7%, the proportion of the type of DM therapy for respondents that were most confirmed as TB-DM at the Respira Paru Hospital in 2021-2023 was the type of insulin injection DM therapy at 76.4%, the proportion of random blood sugar levels at the start of treatment for respondents that were most confirmed as TB-DM at the Respira Paru Hospital in 2021-2023 was high random blood sugar levels (> 200 mg/dL) at 64.5%, the highest number of confirmed cases of TB-DM at the Respira Paru Hospital was in 2022, as many as 44 people (40%).

Based on the location, namely the address of TB-DM patients, they are spread across five districts/cities in the Special Region of Yogyakarta, with the most cases coming from Bantul Regency at 63.6% (Figure 1). The distribution of TB-DM cases in Bantul Regency in 2021-2023, the highest cases in the highest Kapanewon in Bantul Regency, namely in Sewon Kapanewon, with 17 people (24.3%). In the distribution of TB-DM cases in Sleman Regency in 2021-2023, the highest cases were in the Kapanewon Berbah, Depok, Gamping, Kalasan, Mlati, and Seyegan, with two people (5%). Regarding the distribution of TB-DM cases in Yogyakarta City in 2021-2023, the highest cases were in Danurejan Kapanewon, with three people (7.5%). In the distribution of TB-DM cases in Kulon Progo Regency in 2021-2023, the highest cases were in Kapanewon Galur, Kokap, Panjatan, and Samigaluh, with two people (5%). The distribution of TB-DM cases in Gunung Kidul Regency in 2021-2023, the highest cases were in Kapanewon Panggang with three people (7.5%). Based on time, namely the period 2021-2023, the highest number of confirmed TB-DM cases at RS Paru Respira was in 2022 at 40% (Figure 2).

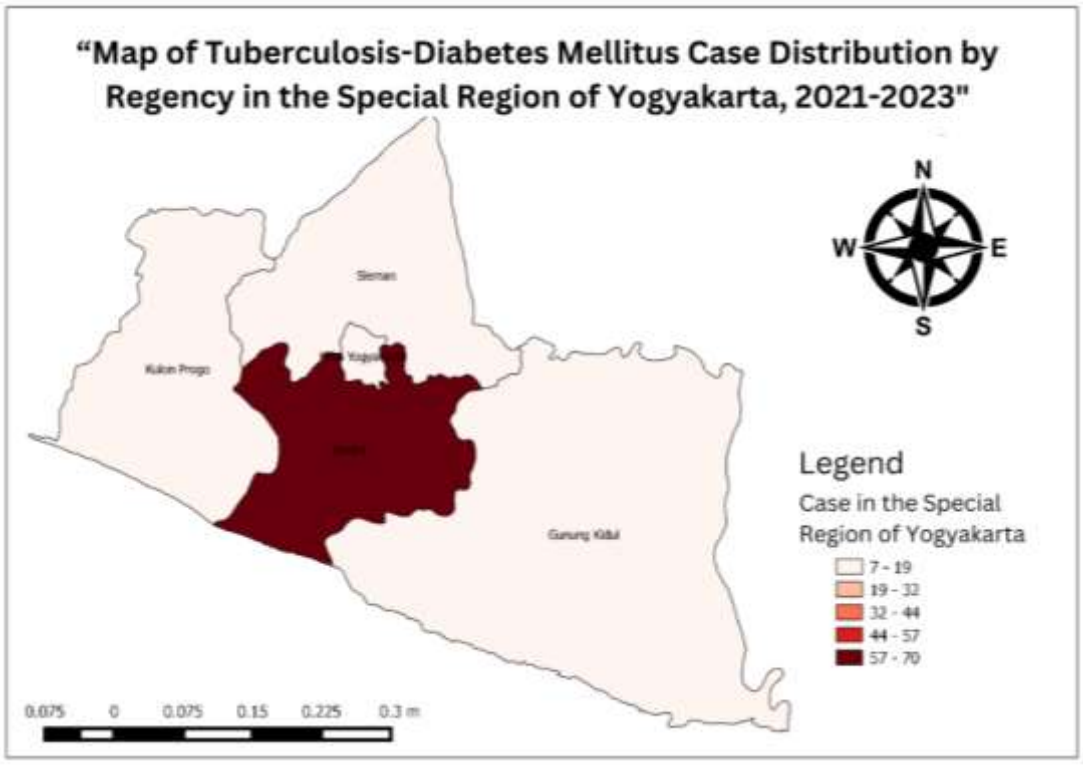

Figure 1. Map of distribution of TB-DM cases in 5 districts in Special region of Yogyakarta 2021-2023

4. DISCUSSION

The majority of TB-DM cases are found in older people. 50% of individuals with diabetes mellitus who have pulmonary tuberculosis are in the 50–59 age.[10] The incidence of TB-DM is influenced by age.[11] Age has a significant impact on TB and DM. A vulnerable age is an age that tends to increase the risk of disease. At this vulnerable age, physiological changes and immunity will drop rapidly, and there will be changes in unhealthy behaviours and lifestyles. People with diabetes mellitus (DM) are more likely to develop glucose intolerance because of decreased body defences against infection and lower body function in blood glucose metabolism. Diabetes mellitus and tuberculosis (TB) may become more comorbid as a result of this.[12] The function of pancreatic cells and the amount of insulin they secrete will decline with age.[7] As people

age, their pancreatic beta cells' ability to generate insulin declines.[13]

Males made up the bulk of the TB-DM patients in this study. Men work outside the home more often than women, while women are housewives. There are also disparities in the immunological systems of men and women, and men are more likely than women to engage in certain behavioural aspects like drinking alcohol and smoking. According to the findings of prior research, men are more likely than women to have TB-DM. This supports Firmansyah's findings that men are more likely than women to get TB-DM. This is consistent with Utomo's findings that men are more likely than women to get TB-DM.[14] Men's propensity for harmful behaviours, such as alcohol and tobacco use, which can exacerbate both diseases, is the cause of the higher frequency of TB-DM in men.[15] Other studies have shown that men are more likely than women to get TB. This variance is influenced by biological processes and risk factors and exposure (e.g., smoking, occupational exposure, indoor air pollution from cooking, and industrial exposure).[7]

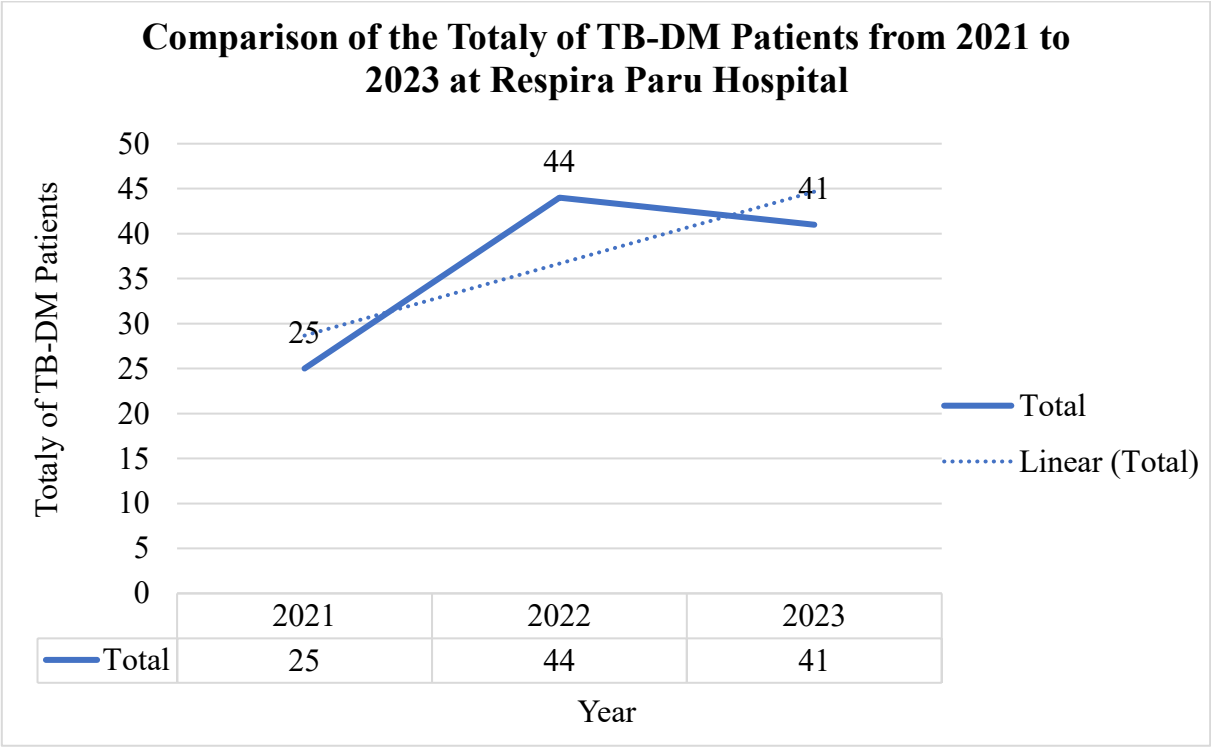

Figure 2. Overview of TB-DM incidents based on time (year)

Males are more prone than females to have unhealthy lifestyles such as smoking, drinking alcohol, ingesting caffeine, working longer hours outdoors, and living in a polluted environment, all of which might impair immunity, particularly in TB patients with diabetes mellitus.[12] Males are 1.66 times more likely than females to develop TB-DM. In this survey, the majority of females (36.2%) and men (40.4%) only had TB.[16]

The most frequent kind of tuberculosis in this research was pulmonary tuberculosis (98.2%). According to other research, pulmonary TB is the most frequent kind of tuberculosis suffered by TB-DM patients. According to the findings of this study, 96.3% of TB-DM events included pulmonary TB, whereas 3.4% involved extrapulmonary TB.[17] Mycobacterium tuberculosis infects the lungs more frequently, and pulmonary tuberculosis has more apparent clinical signs such as persistent cough, phlegm, and shortness of breath. Hence, it is more commonly detected in TB-DM patients than extrapulmonary TB. Patients with pulmonary tuberculosis (TB) are more prone to develop diabetes mellitus (DM) than those with extrapulmonary TB.[18] According to research conducted in Iran,[19] 24% of TB patients also have diabetes, making diabetes a substantial risk factor for the development of pulmonary tuberculosis as compared to persons who do not have it. Extrapulmonary organ involvement is less common in people with TB-DM than in persons without TB.[20]

TB is diagnosed with clinical diagnosis (26.4%) and bacteriological confirmation (73.6%)—microscopic

investigation of BTA to determine transmission potential and treatment efficacy. The Respira Hospital in Yogyakarta diagnoses Sewaktu-Pagi (In the morning), verified in the third, sixth, and twelve months. If one is pronounced positive, it is proclaimed positive for tuberculosis; another supporting TB diagnosis is radiography in the form of a chest X-ray.[21] Bacteriologically verified TB diagnosis is more prevalent in diabetic individuals due to its relevance in verifying the diagnosis. Bacteriological testing is the first stage in confirming the diagnosis of tuberculosis. All individuals suspected of having tuberculosis should have a bacteriological investigation to confirm the diagnosis. Tuberculosis can be diagnosed using results from bacteriological or clinical investigations. A bacteriological diagnosis of TB cannot be verified unless Mycobacterium tuberculosis is present. When TB affects more than one organ, the most seriously afflicted organ is referred to as.[22]

Insulin injections account for 76.4% of DM treatment, whereas oral hypoglycemic drugs account for 23.6%. DM treatment with insulin injections is frequently used in patients with tuberculosis and diabetes because insulin can provide quicker, more flexible, and consistent blood sugar management, particularly in cases with significant infections and complicated medication interactions. Single insulin is less commonly used than insulin coupled with oral hypoglycemic drugs. Rapid-acting insulin (insulin aspart) is more widely used than long-acting insulin (insulin detemir), both alone and in combination. Patients with HbA1c levels above 9% can get insulin treatment as monotherapy (single insulin) or an oral hypoglycemic drug.[23] This demonstrates that the diabetic medication administered to TB-DM patients does not affect their metabolic status.[24]

TB-DM cases are dispersed across the Special Region of Yogyakarta's five districts/cities, with Bantul Regency reporting the highest in 2021-2023. According to the Bantul Regency government's report, the Sewon Sub-district is one of the sub-districts in the Bantul Regency with the highest TB potential, with several TB suspects discovered. The rise in TB-DM cases in 2023 was due to TB screening initiatives for DM patients financed by the Global Fund to follow up on these TB-DM cases.[25] Individuals with diabetes mellitus have been screened for TB symptoms and X-rays since 2021, thanks to funding from the Global Fund's TB component monies for the fiscal year 2021-2023.[26]

The limitation in the study used secondary data that relies on the completeness of medical records, so the accuracy of the data may be affected. The research was conducted in one hospital, so the results cannot be generalized to a broader population.

5. CONCLUSION

The three-year epidemiological picture of TB-DM cases (2021–2023) shows an increasing tendency, with the maximum number occurring in 2022. Most TB-DM cases are male, over 45, and originate from Bantul Regency. As a result, better monitoring of the annual rise in cases is still required, along with patient examinations after treatment or medication, TB-DM patient screening and diagnosis, disease prevention education, including maintaining a clean and healthy lifestyle, and monitoring and evaluating the TB-DM management program.

Ethical Approval

This research has received ethical approval from the Health Research Ethics Committee of Respira Paru Hospital Yogyakarta with registration number 030/KEPK/VII/2024.

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Competing Interests

All the authors declare that there are no conflicts of interest.

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Underlying Data

Derived data supporting the findings of this study are available from the corresponding author on request.

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