JUSINDO (Jurnal Sehat Indonesia)
Vol. 8 No. 2, November 2026, pp. 967-974
e-ISSN: 2775-3077
https://doi.org/10.59141/-.v8i2.576

Chest X-Ray Findings in Patients with Tuberculosis and Diabetes Mellitus at Prof. Dr. Chairuddin P. Lubis Hospital, Medan

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Keywords:
Tuberculosis; Diabetes mellitus; Chest X-ray; Radiological findings; Pulmonary lesions.

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Abstract

Pulmonary tuberculosis (TB) and diabetes mellitus (DM) are major global health burdens with significant bidirectional interactions. DM increases the risk of developing active TB and may influence its radiographic presentation, often resulting in atypical findings. Chest radiography remains an essential diagnostic tool for evaluating patients with TB and DM. This study aimed to describe the chest radiographic findings among patients with TB and DM at Prof. Dr. Chairuddin P. Lubis Hospital, Universitas Sumatera Utara, Medan. This retrospective descriptive study analyzed secondary data from 124 patients with TB and DM who underwent chest radiography in 2024. Data were analyzed using univariate descriptive statistics to determine the distribution of radiographic findings. Most patients were male (54.8%). Pulmonary infiltrates were the most common finding (83.9%), followed by fibrosis (34.7%), consolidation (27.4%), cavitation (15.3%), calcification (11.3%), and pleural effusion (8.1%). No cases of miliary opacities or tuberculomas were identified. Based on the radiographic extent of pulmonary lesions, moderately advanced disease predominated (74.2%), while minimal and far-advanced disease were observed in 16.1% and 6.5% of patients, respectively. Patients with TB and DM most frequently exhibited pulmonary infiltrates and moderately advanced disease on chest radiographs. The absence of miliary patterns and tuberculomas further illustrates the variability of radiographic manifestations of TB in patients with DM. Comprehensive chest radiographic assessment remains important for identifying atypical pulmonary TB manifestations and supporting timely clinical diagnosis.

INTRODUCTION

Tuberculosis (TB) remains a major global public health concern despite decades of disease control efforts. According to the World Health Organization (WHO), TB continued to affect millions of people worldwide in 2024, with the COVID-19 pandemic having created additional challenges for disease detection and treatment. The disease disproportionately affects low- and middle-income countries, including Indonesia, which consistently ranks among the countries with the highest TB burdens globally. Pulmonary TB is the most common and infectious form of the disease and is frequently evaluated using chest radiography, which plays a critical role in assessing disease extent and associated complications (World Health Organization [WHO], 2024).

Diabetes mellitus (DM) has become increasingly prevalent worldwide, posing a growing challenge to global public health (Hossain et al., 2024; Khanijau et al., 2026). The global prevalence of DM has increased substantially over the past two decades, driven by lifestyle changes and population aging, with type 2 diabetes accounting for the majority of cases (Sun et al., 2022). Indonesia has also experienced a marked increase in diabetes prevalence, which is projected to rise from 9.19% in 2020 to 16.09% by 2045, reflecting significant lifestyle and demographic transitions. Diabetes contributes substantially to morbidity and mortality through complications affecting multiple organ systems and its interactions with infectious diseases (Sun et al., 2022; Wahidin et al., 2024).

The coexistence of TB and DM represents a syndemic characterized by bidirectional interactions. DM is associated with an approximately twofold increase in the risk of developing active TB, partly due to hyperglycemia-associated immune dysfunction. Patients with both conditions frequently exhibit more extensive pulmonary involvement on imaging, including cavitary lesions, and may experience delayed treatment responses (Cáceres et al., 2022). Conversely, active TB can induce stress hyperglycemia and exacerbate poor glycemic control in patients with diabetes. This comorbidity is increasingly recognized as a significant challenge to achieving the goals of the WHO End TB Strategy (Foe-Essomba et al., 2021; Wilkinson, 2021).

Chest radiography remains an essential imaging modality for the diagnosis and monitoring of pulmonary TB, particularly in resource-limited settings such as Indonesia, where it is widely used for initial assessment and evaluation of disease progression and treatment response (Van't Hoog et al., 2022). Accumulating evidence suggests that the chest radiographic manifestations of pulmonary TB differ significantly between patients with and without DM. Several studies conducted across diverse geographic settings have reported that patients with TB-DM comorbidity tend to exhibit more extensive pulmonary involvement, higher frequencies of cavitary lesions, greater lower-lobe involvement, and atypical radiographic patterns compared with patients with TB who do not have diabetes (Fadillah et al., 2023; Huang et al., 2017; Mood et al., 2021; Zhan et al., 2022). For instance, a study conducted by Mood et al. (2021) in India found that pulmonary infiltrates were present in 82% of patients with TB-DM comorbidity compared with 62% of patients with TB without diabetes, while cavitation was observed in 58% and 42% of patients, respectively. A retrospective study by Huang et al. (2017) in Taiwan demonstrated that poor glycemic control, defined as a glycated hemoglobin (HbA1c) level greater than 8%, was significantly associated with more severe chest radiographic manifestations, including larger pulmonary cavities and a higher frequency of bilateral lung involvement. Similarly, a study conducted in Indonesia by Fadillah et al. (2023) reported that patients with TB-DM comorbidity exhibited more extensive fibrotic changes and higher frequencies of pulmonary consolidation than their counterparts without diabetes. These radiographic differences have important clinical implications because they may influence diagnostic accuracy, treatment response assessment, and prognostic evaluation. However, despite the growing body of literature on TB-DM comorbidity, research specifically examining the spectrum of chest radiographic findings among patients with TB and DM in Indonesian hospital settings remains limited, particularly in North Sumatra Province, which has one of the highest TB burdens in the country (Nadhira et al., 2025). Most existing studies have been

conducted in tertiary referral hospitals on the island of Java, with relatively limited data available from populations in Sumatra (e.g., Subkhan et al., 2024). Furthermore, the chest radiographic characteristics of patients with TB-DM comorbidity may vary across populations because of genetic, environmental, clinical, and healthcare-related factors, emphasizing the importance of obtaining locally relevant evidence (Cáceres et al., 2022).

METHOD

This retrospective descriptive study used secondary data obtained from radiology examination request forms and chest radiography reports of patients diagnosed with pulmonary tuberculosis (TB) and diabetes mellitus (DM) at Prof. Dr. Chairuddin P. Lubis Hospital, Universitas Sumatera Utara, Medan. Medical records were collected from September to December 2024. The required sample size was estimated at 100 patients using a 10% margin of error. The inclusion criteria comprised patients diagnosed with pulmonary TB and DM who were undergoing treatment at the hospital, while patients with additional comorbidities were excluded. Data were analyzed using IBM SPSS Statistics software. Univariate analysis was performed to summarize patient characteristics and chest radiographic findings. Bivariate analysis was conducted using the chi-square test to examine associations between independent and dependent variables, with statistical significance set at $p < 0.05$. Multivariable binary logistic regression was subsequently performed to identify independent variables significantly associated with the dependent variable and assess their adjusted associations.

Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara, Medan, before data collection.

RESULTS AND DISCUSSION

The study included 124 patients diagnosed with pulmonary tuberculosis (TB) with concomitant diabetes mellitus (DM) who underwent chest radiographic examination at Prof. Dr. Chairuddin P. Lubis Hospital, Universitas Sumatera Utara, in 2025.

To obtain a general overview of sex distribution among patients with pulmonary TB and comorbid diabetes mellitus, respondent characteristics were identified.

Table 1. Respondent Characteristics

Sex	n	%
Male	68	54.8%
Female	56	45.2%
Total	**124**	**100.0%**

Based on the table above, 68 patients (54.8%) were male and 56 patients (45.2%) were female.

To understand the pattern of radiological findings in TB-DM patients, common chest radiographic features such as infiltrates, cavitation, consolidation, and others were evaluated. These data are important for identifying the distribution of characteristic pulmonary lesions in patients with this comorbidity.

Table 2. Radiological Findings

Radiological Findings	n (n =124)	Percentage (%)
Infiltrate		
- Present	104	83.9%
- Absent	20	16.1%
Calcification		
- Present	14	11.3%
- Absent	110	88.7%
Consolidation		
- Present	34	27.4%
- Absent	90	72.6%
Cavitation		
- Present	19	15.3%
- Absent	105	84.7%
Pleural Effusion		
- Present	10	8.1%
- Absent	114	91.9%
Fibrosis		
- Present	43	34.7%
- Absent	81	65.3%
Tuberculoma Nodule		
- Absent	124	100.0%
Miliary Pattern		
- Absent	124	100.0%

From the table above, infiltrates were identified in 104 patients (83.9%), making them the most frequent radiological finding. Consolidation was present in 34 patients (27.4%). Fibrosis was observed in 43 patients (34.7%), cavitation in 19 patients (15.3%), and pleural effusion in 10 patients (8.1%). Calcification was noted in 14 patients (11.3%). No cases of tuberculoma nodules or miliary pattern were identified (0%).

The severity of pulmonary lesions in TB-DM patients was assessed based on the extent of lesions observed on chest radiographs. Lesions were categorized as minimal, moderately advanced, and far advanced to estimate disease progression.

Table 3. Extent of Lesions

Extent of Lesion	n (n = 124)	Percentage (%)
Minimal Lesion		
- Yes	20	16.1%
- No	104	83.9%
Moderately Advanced Lesion		
- Yes	92	74.2%
- No	32	25.8%
Far Advanced Lesion		
- Yes	8	6.5%
- No	116	93.5%

Pulmonary lesions were classified according to severity or extent of lung involvement. Minimal lesions were identified in 20 patients (16.1%). Moderately advanced lesions were the

most common pattern, found in 92 patients (74.2%). Far advanced lesions were observed in 8 patients (6.5%).

Several studies have concluded that both men and women are at increased risk of developing TB–DM comorbidity; however, men appear to be more frequently affected than women (Workneh et al., 2017). One study reported that men were more likely to experience TB–DM comorbidity compared with women. A study conducted in Medan showed that 68.6% of TB–DM cases occurred in men, while only 31.43% occurred in women (Amelia et al., 2024). Similarly, a study from Brazil reported that the majority of TB–DM cases were male (66.9%) (Evangelista et al., 2020). Research from South Korea demonstrated that the prevalence of diabetes mellitus among patients with tuberculosis increased with age in both sexes and peaked in the 65–74-year age group among men (42.1%). Overall, men were more likely to suffer from both TB and DM than women (Jeong et al., 2023). These findings are consistent with the results of this study, in which 68 patients (54.8%) were male and 56 patients (45.2%) were female. High-risk behaviors such as smoking and alcohol consumption are currently reported to be approximately seven times more common in men than in women among adults with diabetes in South Korea; these risk factors may therefore contribute to the higher prevalence of TB–DM observed in men (Jeong et al., 2023).

Pulmonary infiltrates are the most frequent radiological finding in both TB–DM and non-diabetic TB patients, with a higher incidence reported in patients with diabetes (82%) compared to non-diabetic TB patients (62%) (Mood et al., 2021). This aligns with the findings of the present study, in which infiltrates were identified in 104 patients (83.9%), making them the most common radiographic feature. Specific studies focusing on calcification on chest radiographs in TB–DM patients remain limited. However, computed tomography–based studies have reported calcifications in up to 28.57% of TB–DM patients (Yang et al., 2023). Therefore, definitive conclusions regarding calcification cannot be drawn from the present study, where calcification was observed in 11.3% of patients on chest radiographs.

Previous studies have reported consolidation in approximately 22% of TB–DM patients (Mood et al., 2021), which is comparable to the 27.4% observed in this study. Other reports have noted consolidation in patients with caseous pulmonary TB and type 2 diabetes mellitus, although the exact prevalence was not specified (Wang et al., 2015). A study conducted in Pakistan found pleural effusion in 6% of TB–DM patients (Amin et al., 2011). Additionally, atypical radiological patterns were reported in 28% of TB–DM cases, including lobar or segmental consolidation, lymphadenopathy, pleural effusion, miliary lesions, pericardial effusion, large non-cavitary nodules or masses, and multiple cavities within a single lesion; however, pleural effusion was not analyzed separately (Huang et al., 2017). In this study, pleural effusion was identified in 8% of TB–DM patients.

Fibrotic changes were reported in 35% of TB–DM patients in one study (Fadillah et al., 2023), which is consistent with the 34.7% observed in this study. In contrast, another study reported fibrosis in 95.2% of cases (Tampubolon et al., 2022); however, this discrepancy may be explained by the fact that most patients in that study had far-advanced lesions (61.9%), whereas only 6.5% of patients in the present study had far-advanced disease. Miliary lesions have been reported in 2% of TB–DM patients in one study (Amin et al., 2011) and in 4.8% of cases in another, while nodular lesions were observed in 9.5% of patients in another study

(Tampubolon et al., 2022). A study from Saudi Arabia reported nodular lesions in 15.2% of TB–DM patients (Abd El-Hamid El-Kady & Turkistani, 2021). In contrast, no miliary or nodular lesions were identified in the present study (0%), consistent with findings from a previous study conducted at Royal Prima General Hospital, Medan, where the prevalence of miliary and nodular lesions was also 0% (Cahyadi et al., 2024).

In this study, minimal lesions were identified in 20 patients (16.1%), moderately advanced lesions were the most common pattern, found in 92 patients (74.2%), and far-advanced lesions were observed in 8 patients (6.5%). These findings differ from those reported in a study at Prof. Dr. R. D. Kandou Hospital, Manado, where far-advanced lesions predominated (61.9%), followed by moderately advanced (28.6%) and minimal lesions (9.5%) (Tampubolon et al., 2022). Similarly, a study conducted at Royal Prima General Hospital, Medan, reported far-advanced lesions as the most dominant pattern (48.6%), followed by minimal (30.0%) and moderately advanced lesions (21.4%). Type 2 diabetes mellitus may delay healing and accelerate the progression of tuberculous lesions due to metabolic disturbances and impaired immune function (Cahyadi et al., 2024). The observed discrepancies may be explained by differences in nutritional status, duration of treatment, glycemic control (HbA1c levels), and immune status, all of which play important roles in disease progression. Previous studies have demonstrated a positive association between nutritional status and pulmonary TB, influenced by body mass index and TB-related metabolic changes. Moreover, TB–DM patients with HbA1c levels greater than 8% tend to exhibit more severe radiological lesion patterns. Patient knowledge also contributes to treatment outcomes; individuals with better understanding of tuberculosis are more likely to demonstrate positive health behaviors and treatment adherence, thereby improving recovery rates (Cahyadi et al., 2024).

CONCLUSION

This study demonstrated that pulmonary infiltrates were the most common chest radiographic finding among patients with pulmonary tuberculosis (TB) and diabetes mellitus (DM), occurring in 83.9% of the 124 patients. Other radiographic findings included fibrosis, consolidation, cavitation, calcification, and pleural effusion, whereas no miliary patterns or tuberculomas were identified. Regarding the extent of pulmonary involvement, moderately advanced disease predominated (74.2%), followed by minimal (16.1%) and far-advanced disease (6.5%). Overall, these findings indicated that patients with TB-DM comorbidity frequently exhibited substantial pulmonary involvement, particularly pulmonary infiltrates and moderately advanced disease. Comprehensive chest radiographic assessment remains important for evaluating the extent and variability of pulmonary lesions in patients with TB-DM comorbidity and may contribute to timely diagnosis and appropriate clinical management.

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