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DIFFERENCES IN CHEST RADIOGRAPHIC LESIONS BETWEEN PULMONARY TUBERCULOSIS PATIENTS WITH AND WITHOUT DIABETES MELLITUS AT RADEN MATTAHER HOSPITAL, JAMBI, INDONESIA

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ABSTRACT

Background: Diabetes mellitus (DM) is one of the most common comorbidities in pulmonary tuberculosis (TB) and may alter the radiographic manifestations of the disease. Hyperglycemia impairs immune function and may contribute to more severe pulmonary involvement. However, studies investigating differences in chest radiographic findings between TB patients with and without DM have reported inconsistent results.

Methods: This observational analytic study employed a cross-sectional design using secondary data obtained from medical records at Raden Mattaher Regional Hospital, Jambi. A total of 198 pulmonary tuberculosis patients who met the inclusion and exclusion criteria were enrolled using total sampling. The variables analyzed included lesion location, lesion extent, and lesion type on chest radiographs. Data were analyzed using the Chi-square test with a significance level of $p < 0.05$.

Results: Of the 198 participants, 149 (75.3%) were pulmonary tuberculosis patients without DM and 49 (24.7%) had DM. Bilateral lesions were the most common radiographic finding (56.1%). No significant difference was observed in lesion location between the two groups ($p = 0.185$). However, significant differences were found in lesion extent ($p = 0.004$) and lesion type ($p = 0.003$). Patients with DM exhibited a higher proportion of extensive lesions, consolidations, and cavitary lesions than those without DM.

Conclusion: Diabetes mellitus was significantly associated with the extent and type of chest radiographic lesions in pulmonary tuberculosis patients but not with lesion location. Pulmonary tuberculosis patients

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with diabetes mellitus tended to present with more severe radiographic manifestations.

Keywords: pulmonary tuberculosis, diabetes mellitus, chest radiograph, radiological lesions.

INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide. According to the World Health Organization, approximately 10.6 million new TB cases were reported globally in 2022[1], with Southeast Asia contributing the largest proportion of cases. Indonesia ranks among the countries with the highest TB burden, highlighting the importance of identifying factors that may influence disease severity and treatment outcomes.[23]

Tuberculosis remains a major public health problem in Jambi Province. In addition to infectious factors, nutritional status plays an important role in the clinical manifestations and progression of tuberculosis. Previous studies in Jambi reported that underweight nutritional status was common among adult patients with pulmonary tuberculosis, emphasizing the importance of comprehensive assessment in TB management.[4]

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to defect in insulin secretion, insulin action, or both.[5] The increasing prevalence of DM has become a major challenge to TB control because DM is known to increase the risk of active ituberculosis by two to three times.[5,6] The interaction between TB and DM is bidirectional; tuberculosis may worsen glycemic control, while chronic hyperglycemia impairs host immunity.[7]

Hyperglycemia affects macrophage function, neutrophil chemotaxis, and cytokine production, thereby reducing the body's ability to eliminate *Mycobacterium tuberculosis*. These immunological alterations may result in more extensive pulmonary involvement and atypical radiographic manifestations.

Chest radiography remains an essential imaging modality for evaluating pulmonary tuberculosis. Typical radiographic findings include infiltrates, consolidations, and cavitary lesions, predominantly involving the upper lobes.[2] However, several studies have suggested that pulmonary tuberculosis patients with diabetes mellitus are more likely to develop bilateral lesions, lower lung involvement, and more extensive disease.[8]

Despite numerous studies on TB-DM comorbidity, evidence regarding differences in chest radiographic lesions among pulmonary tuberculosis patients with and without diabetes mellitus remains inconsistent. Furthermore, data from Jambi Province are still limited. Therefore, this study aimed to analyze the differences in chest radiographic lesions between pulmonary tuberculosis patients with and without diabetes mellitus at Raden Mattaher Regional Hospital, Jambi.

METHODS

This observational analytic study employed a cross-sectional design. The study was conducted at the Medical Record Department of Raden Mattaher Regional Hospital, Jambi, using secondary data obtained from patients' medical records.

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The study population consisted of all patients diagnosed with pulmonary tuberculosis from January 2024 to December 2025. Data collection was performed from April to May 2026. Patients aged 18 years or older with complete medical records, including diabetes mellitus status and chest radiographic findings, were included in the study.

A total of 198 patients met the inclusion and exclusion criteria and were selected using the total sampling technique. The independent variable was diabetes mellitus status, while the dependent variables included lesion location, lesion extent, and lesion type based on chest radiographic findings.

Lesion location was classified as right lung, left lung, or bilateral involvement. Lesion extent was categorized into minimal, moderate, and extensive lesions according to the American Thoracic Society classification. Lesion types included infiltrates, consolidations, and cavities.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) ver.27. Descriptive statistics were presented as frequencies and percentages. Differences between groups were assessed using the Chi-square test, and a p-value of less than 0.05 was considered statistically significant.

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Jambi.

RESULTS

A total of 198 pulmonary tuberculosis patients who fulfilled the inclusion and exclusion criteria were included in this study. Of these patients, 149 (75.3%) had pulmonary tuberculosis without diabetes mellitus, while 49 (24.7%) had pulmonary tuberculosis with diabetes mellitus.

Table 1. Characteristics of study participants

Variables	Frequency (n)	Percentage (%)
Sex		
Male	134	67.7
Female	64	32.3
Age group (years)		
18–25	19	9.6
26–35	19	9.6
36–45	32	16.2
46–55	43	21.7
≥56	85	42.9

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Diabetes mellitus status		
Without DM	149	75.3
With DM	49	24.7

Most participants were male (67.7%) and belonged to the age group of 56 years and older (42.9%).

Table 2. Distribution of chest radiographic findings

Variables	Frequency (n)	Percentage (%)
Lesion location		
Left lung	50	25.3
Right lung	37	18.7
Bilateral	111	56.1
Lesion extent		
Minimal	83	41.9
Moderate	83	41.9
Extensive	32	16.2
Lesion type		
Infiltrates	167	84.3
Consolidation	18	9.1
Cavities	13	6.6

Bilateral lesions were the most common radiographic finding (56.1%). Minimal and moderate lesions each accounted for 41.9% of cases, while infiltrative lesions represented the predominant lesion type (84.3%).

Table 3. Association between diabetes mellitus and lesion location

Lesion location	Without DM n (%)	With DM n (%)	p-value
Left lung	41 (27.5)	9 (18.4)	

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Right lung	30 (20.1)	7 (14.3)	
Bilateral	78 (52.3)	33 (67.3)	
Total	149 (100)	49 (100)	0.185

No statistically significant association was found between diabetes mellitus status and lesion location (p = 0.185).

Table 4. Association between diabetes mellitus and lesion extent

Lesion extent	Without DM n (%)	With DM n (%)	p-value
Minimal	69 (46.3)	14 (28.6)	
Moderate	63 (42.3)	20 (40.8)	
Extensive	17 (11.4)	15 (30.6)	
Total	149 (100)	49 (100)	0.004

There was a statistically significant association between diabetes mellitus status and lesion extent (p = 0.004).

Table 5. Association between diabetes mellitus and lesion type

Lesion type	Without DM n (%)	With DM n (%)	p-value
Infiltrates	133 (89.3)	34 (69.4)	
Consolidation	10 (6.7)	8 (16.3)	
Cavities	6 (4.0)	7 (14.3)	
Total	149 (100)	49 (100)	0.003

A statistically significant association was observed between diabetes mellitus and lesion type (p = 0.003). Patients with diabetes mellitus had higher proportions of consolidation and cavitary lesions than patients without diabetes mellitus.

DISCUSSION

This study demonstrated that pulmonary tuberculosis was more common among males than females, with male patients accounting for 67.7% of all participants. This finding is consistent with previous studies in Indonesia reporting that male patients are more susceptible to tuberculosis because of greater mobility, occupational exposure, and smoking habits, which may increase the risk of infection and disease recurrence.[9] This finding is consistent too with the Global Tuberculosis Report, which indicates that men are disproportionately affected by tuberculosis worldwide. Several factors may explain this difference,

including smoking habits, occupational exposure to air pollutants, alcohol consumption, and delays in seeking healthcare services.[10] In addition, sex hormones may influence immune responses against *Mycobacterium tuberculosis*. Estrogen has been reported to enhance immune function, whereas testosterone may suppress cellular immunity, making males more susceptible to tuberculosis infection.

Regarding age distribution, the majority of participants belonged to the age group of 56 years and older. This finding supports previous studies showing that advanced age is associated with immunosenescence,[7] a gradual decline in immune function characterized by impaired macrophage activity and reduced T-cell responses. Elderly individuals are therefore more vulnerable to infectious diseases, including tuberculosis. Furthermore, the prevalence of diabetes mellitus increases with age, resulting in a higher probability of TB-DM comorbidity among older adults.[11]

The present study found that bilateral lesions were the most common radiographic manifestation in both groups. However, statistical analysis showed no significant association between diabetes mellitus status and lesion location. Although patients with diabetes mellitus had a higher proportion of bilateral lesions than non-diabetic patients, the difference did not reach statistical significance.

These findings are consistent with previous studies conducted by Husein and Majdawati, which reported no significant relationship between diabetes mellitus and the anatomical distribution of pulmonary tuberculosis lesions. The absence of a statistically significant association suggests that diabetes mellitus may not directly affect the location of pulmonary lesions. Instead, lesion distribution may be influenced by other factors, such as bacterial load, duration of illness, nutritional status, smoking habits, and the patient's immune response.

Nevertheless, several studies have reported conflicting findings. Some authors have demonstrated that patients with diabetes mellitus are more likely to exhibit lower lung field involvement and bilateral pulmonary lesions. The discrepancies among studies may be attributable to differences in sample size, study design, glycemic control, and radiological classification systems. Moreover, the present study did not evaluate glycemic control parameters such as glycated hemoglobin (HbA1c), which may have influenced the radiographic presentation of pulmonary tuberculosis.

A significant association was observed between diabetes mellitus and the extent of chest radiographic lesions. Patients with diabetes mellitus exhibited a substantially higher proportion of extensive lesions than patients without diabetes mellitus. Extensive pulmonary involvement may reflect a more severe disease process and impaired host defense mechanisms.[8]

Several biological mechanisms may explain this finding. Chronic hyperglycemia has been shown to impair macrophage phagocytic function, reduce neutrophil chemotaxis, and suppress the production of cytokines such as interferon-gamma and interleukin-12, both of which play crucial roles in granuloma formation and containment of *Mycobacterium tuberculosis*. Impairment of these immune mechanisms allows the bacteria to proliferate more extensively within the lungs, leading to greater tissue destruction and more severe radiographic abnormalities.

The findings of this study are in accordance with previous reports indicating that pulmonary tuberculosis patients with diabetes mellitus are more likely to experience extensive pulmonary involvement and multilobar disease. In addition, prolonged hyperglycemia may increase oxidative stress and chronic inflammation[12], which further contribute to lung tissue damage and disease progression.

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In addition to hyperglycemia, several factors may influence the severity of pulmonary tuberculosis, including nutritional status. Tuberculosis may worsen nutritional conditions through increased metabolic demands, decreased appetite, and impaired nutrient absorption, which may subsequently affect the clinical manifestations of the disease.[13]

The present study also demonstrated a significant association between diabetes mellitus and lesion type. Infiltrative lesions remained the predominant radiographic finding in both groups; however, patients with diabetes mellitus had higher proportions of consolidation and cavitary lesions. Cavitation is generally regarded as a marker of severe pulmonary tuberculosis because it reflects extensive caseous necrosis and destruction of lung parenchyma.[14]

The increased prevalence of cavitary lesions among diabetic patients may be explained by alterations in immune function associated with chronic hyperglycemia. Reduced immune surveillance and delayed bacterial clearance facilitate the progression of infection, resulting in more extensive tissue necrosis and cavity formation. Moreover, patients with cavitary lesions often harbor higher bacterial loads, which may increase disease transmission and complicate treatment outcomes.[15]

Similarly, consolidation was more common among patients with diabetes mellitus. Consolidation represents alveolar filling by inflammatory exudates and is frequently associated with active and progressive pulmonary disease. The higher proportion of consolidation observed in diabetic patients supports the hypothesis that diabetes mellitus contributes to more severe inflammatory responses and worsens the radiographic manifestations of tuberculosis.

Despite these differences, infiltrative lesions remained the most common lesion type in both groups. This finding is consistent with the classical radiographic appearance of active pulmonary tuberculosis, in which infiltrates represent the earliest and most frequent abnormality detected on chest radiographs.

The coexistence of tuberculosis and diabetes mellitus has important clinical implications. Patients with both conditions often experience delayed sputum conversion, prolonged treatment duration, and an increased risk of treatment failure and relapse.[16] In addition, comprehensive management and continuous education programs for patients with diabetes mellitus are essential to improve disease control and prevent complications associated with chronic hyperglycemia, particularly in individuals with comorbid conditions such as tuberculosis.[17] Therefore, routine screening for diabetes mellitus among tuberculosis patients and early detection of tuberculosis in diabetic individuals are essential to improve patient outcomes.

The results of this study emphasize the importance of integrated management strategies for TB-DM comorbidity. Collaboration between tuberculosis control programs and diabetes management services may facilitate earlier diagnosis, optimize treatment, and reduce the burden of disease.

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design does not permit the establishment of causal relationships between diabetes mellitus and radiographic abnormalities. Second, the use of secondary data from medical records made the study dependent on the completeness and accuracy of documentation. Third, factors such as glycemic control, duration of diabetes mellitus, smoking history, nutritional status, and other comorbidities were not evaluated. Future studies using prospective designs and incorporating these variables are warranted to provide a more comprehensive understanding of the relationship between diabetes mellitus and pulmonary tuberculosis.

Nevertheless, this study provides valuable evidence regarding differences in chest radiographic lesions between pulmonary tuberculosis patients with and without diabetes mellitus at Raden Mattaher Regional Hospital, Jambi, and may serve as a reference for future research and clinical practice.

CONCLUSION

This study demonstrated that pulmonary tuberculosis was more prevalent among males and older adults, with most patients aged 56 years and above. Bilateral lesions represented the most common radiographic finding among the study population.

No significant association was found between diabetes mellitus status and the location of chest radiographic lesions in patients with pulmonary tuberculosis. However, statistically significant associations were observed between diabetes mellitus and both the extent and type of chest radiographic lesions. Patients with diabetes mellitus exhibited a higher proportion of extensive lesions, as well as a greater prevalence of consolidation and cavitary lesions, compared with patients without diabetes mellitus.

These findings suggest that diabetes mellitus contributes to the severity of radiographic manifestations of pulmonary tuberculosis. Chronic hyperglycemia and impaired immune responses may facilitate more extensive pulmonary involvement and more severe lung tissue damage in patients with tuberculosis and diabetes mellitus.

The present study highlights the importance of early detection and comprehensive management of diabetes mellitus among patients with pulmonary tuberculosis. Integrated screening and monitoring strategies for both diseases are essential to improve treatment outcomes and reduce the burden of TB-DM comorbidity. Future studies incorporating glycemic control parameters, duration of diabetes mellitus, and additional clinical variables are warranted to further elucidate the relationship between diabetes mellitus and radiographic manifestations of pulmonary tuberculosis.

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