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COMPARISON OF PULMONARY TUBERCULOSIS TREATMENT OUTCOME IN DIABETIC VERSUS NON-DIABETIC PATIENTS VISITING TERTIARY CARE HOSPITAL OF PESHAWAR: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Pulmonary tuberculosis remains a major public health challenge in Pakistan, despite the availability of standardized treatment regimens. The rising prevalence of diabetes mellitus in tuberculosis-endemic regions has added complexity to disease control efforts. Diabetes alters host immune responses, influences disease severity, and may compromise treatment effectiveness. Understanding how diabetes affects tuberculosis presentation and outcomes is essential for improving patient management and strengthening control strategies in high-burden settings.

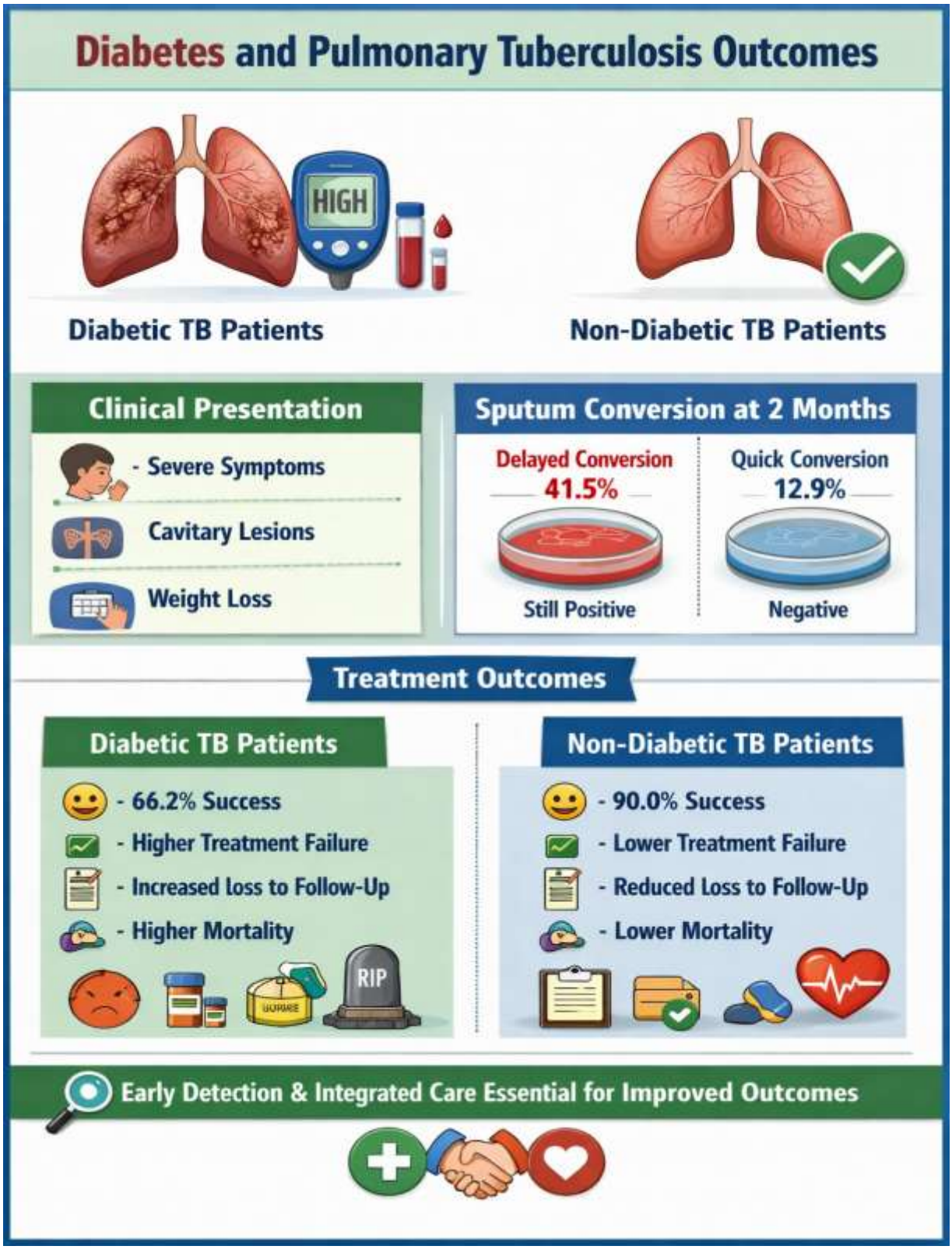
Objective: To compare the clinical presentation and treatment outcomes of pulmonary tuberculosis in diabetic and non-diabetic patients presenting to a tertiary care hospital.

Methods: A cross-sectional comparative study was conducted from January 2024 to December 2024 in a tertiary care hospital. A total of 135 newly diagnosed sputum smear–positive pulmonary tuberculosis patients were enrolled using non-probability consecutive sampling. Participants were categorized into diabetic (n = 65) and non-diabetic (n = 70) groups. Pulmonary tuberculosis was confirmed by sputum smear microscopy and chest radiography, while diabetes mellitus was identified through prior diagnosis or laboratory criteria. All patients received standard first-line anti-tuberculous therapy according to national guidelines. Clinical severity at presentation, sputum smear conversion at two months, and final treatment outcomes were recorded and compared between groups.

Results: Diabetic patients were older, with a mean age of 47 years compared with 32 years in non-diabetic patients. More severe clinical features were observed among diabetics, including prolonged cough (70.8% vs 42.9%), significant weight loss (75.4% vs 48.6%), and cavitary lung lesions (53.8% vs 25.7%). Delayed sputum smear conversion at two months was more frequent in diabetic patients (41.5%) than in non-diabetic patients (12.9%). Treatment success was achieved in 66.2% of diabetic patients compared with 90.0% of non-diabetic patients, while higher rates of treatment failure, loss to follow-up, and mortality were observed among diabetics.

Conclusion: Diabetes mellitus was associated with more severe pulmonary tuberculosis, delayed bacteriological response, and poorer treatment outcomes. Early identification of diabetes and integrated management of both conditions are critical to improving tuberculosis treatment success in high-burden populations.

Keywords: Diabetes Mellitus, Pakistan, Pulmonary Tuberculosis, Sputum Conversion, Treatment Outcome, Tuberculosis, Weight Loss.



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INTRODUCTION

Tuberculosis (TB) continues to rank among the leading causes of death from infectious diseases worldwide, with countries such as Pakistan carrying a disproportionate share of the global burden. Despite the widespread implementation of standardized anti-tuberculous treatment regimens under national and international TB control programs, unfavorable treatment outcomes remain common and continue to undermine disease control efforts (1). These adverse outcomes are particularly evident among patients with coexisting medical conditions that compromise immune function and alter the body's response to therapy (2). As a result, understanding host-related factors that influence TB treatment success has become a critical priority in high-burden settings. Among these factors, diabetes mellitus has emerged as one of the most important comorbidities influencing both the development and progression of tuberculosis. The global prevalence of diabetes is rising rapidly, especially in low- and middle-income countries where TB remains endemic, creating a convergence of two major public health threats (3). Chronic hyperglycemia associated with diabetes impairs both innate and adaptive immune mechanisms, including macrophage activation, cytokine signaling, and T-cell–mediated responses. This immune dysfunction increases susceptibility to Mycobacterium tuberculosis infection and contributes to delayed bacterial clearance once infection is established (4). Consequently, diabetes not only increases the risk of developing active TB but also complicates its clinical course. Clinically, patients with concurrent diabetes and pulmonary tuberculosis often present with more extensive lung involvement, higher bacillary loads, and atypical radiological or symptomatic features, which may delay diagnosis and prolong infectiousness (5,6).

In addition, diabetes has been shown to affect the pharmacokinetics of anti-tuberculous drugs, leading to suboptimal serum drug concentrations and reduced therapeutic efficacy (7). These biological and clinical interactions help explain why numerous international studies have consistently reported delayed sputum conversion, higher rates of treatment failure and relapse, and increased mortality among diabetic TB patients compared with their non-diabetic counterparts (8,9). Beyond individual patient outcomes, these effects have broader implications for TB transmission dynamics and threaten to reverse gains made in TB control, particularly in regions experiencing a rapid rise in diabetes prevalence. The dual burden of tuberculosis and diabetes is especially relevant in Pakistan, where both conditions are highly prevalent and place considerable strain on already challenged health systems. However, despite the recognized global importance of this comorbidity, there remains a notable lack of local evidence examining how diabetes influences tuberculosis treatment outcomes, particularly in Khyber Pakhtunkhwa province. The absence of region-specific data limits the ability of clinicians and policymakers to design integrated management strategies tailored to local needs and epidemiological patterns (10,11). Generating such evidence is essential to improving patient care, optimizing treatment protocols, and strengthening TB control policies in high-burden settings. In this context, the present study was designed to address this critical knowledge gap by comparing treatment outcomes of pulmonary tuberculosis among diabetic and non-diabetic patients presenting to a tertiary care hospital in Peshawar. The objective of the study was to determine whether the presence of diabetes mellitus is associated with poorer tuberculosis treatment outcomes, thereby providing locally relevant evidence to inform clinical practice and guide future tuberculosis control strategies.

METHODS

This cross-sectional comparative study was conducted in the Department of Medicine of a tertiary care hospital over a one-year period from January 2024 to December 2024. Adult patients aged 18 years and above with newly diagnosed, sputum smear–positive pulmonary tuberculosis were enrolled after obtaining written informed consent. A non-probability consecutive sampling technique was employed, and a total of 135 eligible patients were included in the study. Based on diabetic status, participants were categorized into two groups: patients with diabetes mellitus and pulmonary tuberculosis (n = 65) and non-diabetic patients with pulmonary tuberculosis (n = 70). Pulmonary tuberculosis was diagnosed using standard diagnostic criteria, including positive sputum smear microscopy for acid-fast bacilli and chest radiographic findings consistent with active pulmonary disease. Diabetes mellitus was identified either through a documented prior diagnosis or by laboratory confirmation at admission using standard diagnostic criteria, including fasting blood glucose levels and glycated hemoglobin (HbA1c) (12). Patients with extrapulmonary tuberculosis, a history of previous anti-tuberculous treatment, suspected or confirmed drug-resistant tuberculosis, HIV infection, pregnancy, malignancy, or severe chronic liver or kidney disease were excluded to minimize confounding factors affecting treatment outcomes. All enrolled patients received standard first-line anti-tuberculous therapy in accordance with national tuberculosis treatment guidelines. Patients with diabetes continued their prescribed antidiabetic treatment as per hospital protocols, and glycemic control was monitored throughout the treatment period. Baseline data, including demographic characteristics, clinical presentation, and radiological findings, were systematically recorded using a structured data collection proforma. Sputum smear examination was repeated after two months of treatment to assess sputum conversion. Patients

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were followed until completion of therapy, and final treatment outcomes were classified as treatment completed successfully, treatment failure, loss to follow-up, or death, in line with standard tuberculosis program definitions. Data were entered and analyzed using statistical software. Continuous variables were summarized as means with standard deviations, while categorical variables were expressed as frequencies and percentages. Comparative analyses between diabetic and non-diabetic groups were performed using appropriate statistical tests based on data type and distribution, including independent sample t-tests and chi-square tests. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Review Committee of the hospital and all procedures were conducted in accordance with ethical principles for medical research. Patient confidentiality was strictly maintained throughout the study, and no identifying information was disclosed.

RESULTS

A total of 135 patients with newly diagnosed sputum smear–positive pulmonary tuberculosis were included in the analysis. Among these, 65 patients (48.1%) had coexisting diabetes mellitus, while 70 patients (51.9%) were non-diabetic. Patients with diabetes were older, with a mean age of 47 years, compared with a mean age of 32 years among non-diabetic patients. Male predominance was observed in both groups, with males accounting for 64.6% of diabetic patients and 62.9% of non-diabetic patients, while females constituted 35.4% and 37.1%, respectively, indicating a broadly comparable gender distribution between the groups. At the time of presentation, diabetic patients demonstrated more severe clinical and radiological disease features. Prolonged cough was reported in 70.8% of diabetic patients compared with 42.9% of non-diabetic patients. Marked weight loss was observed in 75.4% of diabetic patients, whereas 48.6% of non-diabetic patients exhibited this feature. Radiological evidence of cavitary lung lesions was also more frequent among diabetic patients (53.8%) than among non-diabetic patients (25.7%), reflecting a higher disease burden at diagnosis in the diabetic group. The bacteriological response to treatment at two months differed notably between the groups. Persistent sputum smear positivity was observed in 41.5% of diabetic patients, compared with 12.9% of non-diabetic patients, indicating delayed sputum smear conversion among patients with diabetes. Conversely, sputum smear negativity at two months was achieved in 58.5% of diabetic patients and 87.1% of non-diabetic patients. Final treatment outcomes further demonstrated disparities between the two groups. Treatment was successfully completed in 43 diabetic patients (66.2%) and in 63 non-diabetic patients (90.0%). Treatment failure occurred in 13.8% of diabetic patients and 4.3% of non-diabetic patients. Loss to follow-up was documented in 15.4% of diabetic patients compared with 4.3% among non-diabetic patients, while mortality was higher in the diabetic group (4.6%) than in the non-diabetic group (1.4%). When outcomes were categorized overall, good outcomes were achieved in 66.2% of diabetic patients and 90.0% of non-diabetic patients, whereas poor outcomes were observed in 33.8% and 10.0%, respectively.

Table 1: Age and Gender Distribution

Group	Number of Patients	Mean Age (years)	Male	Female
Diabetic TB patients	65	47	42 (64.6%)	23 (35.4%)
Non-diabetic TB patients	70	32	44 (62.9%)	26 (37.1%)

Table 2: Final Treatment Outcomes

Outcome	Diabetic TB (n=65)	Non-diabetic TB (n=70)
Treatment completed successfully	43 (66.2%)	63 (90.0%)
Treatment failure	9 (13.8%)	3 (4.3%)
Lost to follow-up	10 (15.4%)	3 (4.3%)
Death	3 (4.6%)	1 (1.4%)

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Table 3: Overall Treatment Outcome Comparison

Group	Good Outcome	Poor Outcome
Diabetic TB	43 (66.2%)	22 (33.8%)
Non-diabetic TB	63 (90.0%)	7 (10.0%)

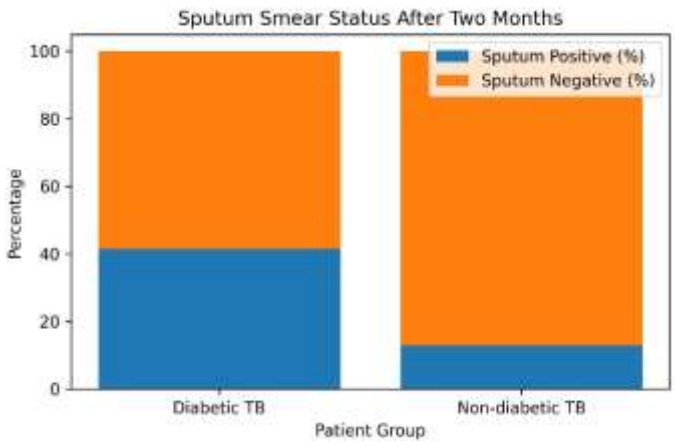

Figure 1 Sputum Smear Status After Two months

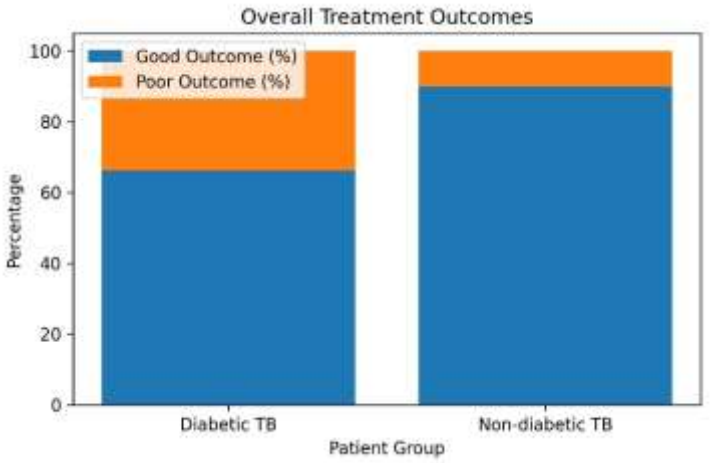

Figure 2 Overall Treatment Outcomes

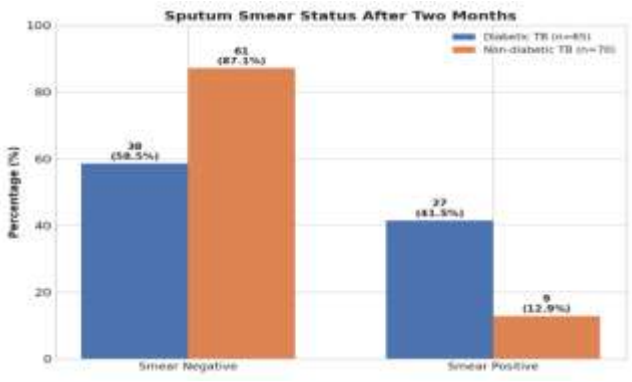

Figure 3 Sputum Smear Status After Two Months

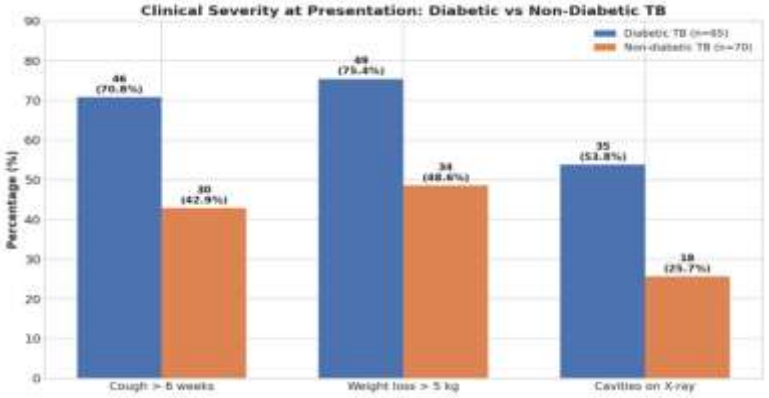

Figure 2 Clinical Severity at Presentation: Diabetic vs Non-Diabetic Tb

DISCUSSION

The findings of the present study demonstrated that the coexistence of diabetes mellitus was associated with poorer clinical and treatment outcomes among patients with pulmonary tuberculosis when compared with non-diabetic counterparts. Patients with diabetes were older at presentation and exhibited more severe clinical and radiological manifestations, including prolonged cough, marked weight loss, and a higher frequency of cavitary lung lesions. These observations are consistent with existing evidence indicating that diabetes is linked to more extensive pulmonary involvement and a higher bacillary burden at the time of tuberculosis diagnosis, likely reflecting both delayed presentation and impaired host immune responses (13,14). Such disease severity at baseline may partly explain the unfavorable outcomes observed in this group. A key observation of this study was the delayed sputum smear conversion among diabetic patients. A substantially higher proportion of individuals with diabetes remained sputum smear–positive after two months of standard anti-

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tuberculous therapy compared with non-diabetic patients. This finding aligns with prior reports demonstrating that diabetes adversely affects bacteriological response during tuberculosis treatment, primarily due to chronic hyperglycemia–induced impairment of innate and adaptive immunity, reduced macrophage function, and altered cytokine signaling (15,16). Delayed sputum conversion is clinically important, as it not only reflects suboptimal treatment response but also increases the risk of ongoing transmission and subsequent treatment failure. The overall treatment success rate in the diabetic cohort was notably lower, while rates of treatment failure, loss to follow-up, and mortality were higher than those observed in non-diabetic patients. These results are in agreement with studies conducted in high tuberculosis burden settings, including Pakistan, which have consistently identified diabetes mellitus as an independent predictor of adverse tuberculosis treatment outcomes (17,18). Several mechanisms have been proposed to explain this association, including immune dysregulation, altered pharmacokinetics of anti-tuberculous drugs leading to reduced serum drug levels, and challenges related to treatment adherence in patients managing multiple chronic conditions (19). Collectively, these factors may contribute to the observed disparities in treatment outcomes between diabetic and non-diabetic patients.

Although glycemic control was not stratified in the current analysis, existing literature suggests that poor glycemic regulation is a critical determinant of tuberculosis outcomes. Uncontrolled diabetes has been associated with delayed sputum conversion, higher relapse rates, and increased mortality among tuberculosis patients (20,21). The higher burden of adverse outcomes observed among diabetic patients in this study indirectly underscores the importance of optimal glycemic control during anti-tuberculous therapy. Future studies incorporating objective measures of glycemic control, such as serial glycated hemoglobin levels, would provide more robust insight into this relationship. The findings of this study support current international recommendations advocating integrated management of tuberculosis and diabetes. Global guidelines emphasize bidirectional screening and coordinated care to improve treatment outcomes and reduce disease burden in populations where both conditions are prevalent (22). Implementing such strategies at the local level could strengthen tuberculosis control efforts, reduce treatment failure, and improve overall patient outcomes in high-risk regions. Several limitations should be acknowledged when interpreting these results. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other settings. Bacteriological response was assessed using sputum smear microscopy rather than culture, which may underestimate persistent infection. In addition, the lack of stratification by glycemic control precluded assessment of its direct impact on treatment outcomes. Despite these limitations, the study provided valuable local evidence highlighting the negative influence of diabetes on tuberculosis treatment outcomes and reinforced the need for integrated disease management approaches. Future multicenter, prospective studies incorporating microbiological culture data and detailed glycemic assessments would further strengthen the evidence base and inform targeted interventions (23).

CONCLUSION

The present study concluded that diabetes mellitus adversely influenced both the clinical severity and treatment outcomes of pulmonary tuberculosis. Patients with coexisting diabetes experienced more severe disease at presentation and demonstrated poorer responses to standard anti-tuberculous therapy, resulting in unfavorable treatment outcomes compared with non-diabetic patients. These findings underscored diabetes mellitus as a critical risk factor for suboptimal tuberculosis management. Early identification of diabetes among tuberculosis patients, sustained clinical monitoring, and integrated management of both conditions were therefore essential to improve treatment success and strengthen tuberculosis control efforts, particularly in high-burden settings.

AUTHOR CONTRIBUTIONS

Author	Contribution
Muhammad Yaseen*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Maryam Hussain	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing

Author	Contribution
	Has given Final Approval of the version to be published
Mehroon Razzaq	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Shahnawaz Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Khayam	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Aamir Islam	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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