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# Impact of Diabetes on Clinical, Radiological, and Microbiological Parameters in Patients Suspected of Pulmonary Tuberculosis

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## ABSTRACT

Objective: Diabetes mellitus is a documented risk factor that modifies the clinical course and severity of pulmonary tuberculosis. Therefore, this study compares the clinical presentation, radiological features, and microbiological findings of pulmonary tuberculosis patients with and without diabetes mellitus.

Methodology: This cross-sectional experimental study was conducted in institute of Basic Medical Sciences (IBMS), Khyber Medical University. A total of 103 patients aged ≥18 years diagnosed with pulmonary tuberculosis, categorized into two groups based on their diabetic status: with Diabetes (n = 52) and without Diabetes (n = 51), were included in the study. A chi-square test was used to examine the association of clinical, radiological and microbiological findings between both groups. Additionally, a Mann Whitney test was employed to analyze the relationship between the means of demographic variables between groups.

Results: The study findings showed that the diabetic patients more frequently reported weight loss 48(92.3%) vs. 39(76.5%) and reduced appetite 47(90.4%) vs. 33(64.7%). On chest X-ray, lower zone involvement was significantly higher in diabetics 29(55.8%), while non-diabetics showed more upper 16(31.4%) and middle zone 18(35.3%) opacities. CT findings similarly showed predominant lower zone disease in diabetics 28(53.8%) and greater upper zone involvement in non-diabetics 17(33.3%). Microbiological tests including AFB culture (28.8% vs. 25.5%) and ZN staining (26.9% vs. 25.5%), did not differ significantly between groups.

Conclusion: This study concluded that diabetic patients exhibited significantly higher rates of weight loss, reduced appetite, and a greater burden of lower-zone lung involvement on both CXR and CT imaging, whereas non-diabetic patients more frequently showed upper and middle zone abnormalities and mediastinal changes.

***Keywords:*** *Pulmonary Tuberculosis, sputum, clinical symptoms, chest X-ray.*

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## 1. INTRODUCTION

Tuberculosis (TB) remains a major global health problem, with over 10 million new cases and approximately 1.3 million deaths reported annually [(1-4)]. About a quarter of the world's population is infected with the Mycobacterium tuberculosis bacteria causing an estimated 10.6 million active tuberculosis cases in 2022. Concurrently, diabetes mellitus (DM) has taken epidemic proportions with almost 537 million adults worldwide affected in 2021. The simultaneous occurrence of the two diseases has contributed to the TB--diabetes syndemic, a major public health problem [(2)].

Diabetes is present in about 13-16% of TB patients and TB occurs in almost 4% of diabetes patients. This two-way association causes higher incidence and mortality from TB and is associated with delayed sputum conversion, high relapse

and death rates and the risk of developing multidrug-resistant TB [3]. Recognizing this growing dual burden, the World Health Organization has recommended collaborative TB–diabetes care and control strategies since 2011 [4].

A systematic review and meta-analysis of 74 studies including 47 from India, 10 from Pakistan, four from Nepal, and two each from Bangladesh and Sri Lanka reported a pooled prevalence of diabetes mellitus among tuberculosis patients of 21%, with marked regional variation ranging from 11% in Bangladesh to 24% in Sri Lanka [5]. Pakistan faces a particularly high dual burden of both diseases, with type 2 diabetes mellitus affecting 16.98% of the population [6]. Furthermore, diabetes has been shown to be associated with a higher frequency of multidrug-resistant tuberculosis compared with the non-diabetic population in Pakistan [7].

Definitions and classification are central to this study. Pulmonary tuberculosis refers to active infection of the lung parenchyma by Mycobacterium tuberculosis complex confirmed or suspected on clinical, radiological and microbiological grounds. Diabetes mellitus comprises a group of metabolic disorders characterized by chronic hyper-glycaemia due to defects in insulin secretion, insulin action, or both; type 2 diabetes (T2DM) is the commonest form encountered in adults and is the principal diabetes phenotype implicated in TB comorbidity [8].

The pathophysiologic interplay between TB and diabetes is multifactorial. Hyper-glycaemia impairs innate and adaptive immune responses (including phagocyte function and cytokine signaling), fosters higher mycobacterial replication and may alter pulmonary pathology toward more extensive disease and cavitation. Conversely, TB disease can provoke glucose intolerance and transient hyper-glycaemia, which complicates diagnosis and glycemic management [9].

Clinically, patients with concurrent TB and diabetes may present with classical pulmonary symptoms (cough, fever, weight loss, night sweats, hemoptysis) but frequently demonstrate more severe systemic illness, higher sputum smear grades and prolonged positivity on culture or molecular tests. Radiologically, diabetic TB patients have been reported to show atypical or more extensive patterns including lower-lung field involvement, multi-lobar disease and cavitation findings that can delay recognition when clinicians expect “typical” upper-zone TB. Microbiologically, higher bacillary loads and slower bacteriologic conversion are recurrent observations in cohorts with poor glycemic control [10].

Diagnosis of pulmonary TB in persons with diabetes follows standard clinical, radiological and laboratory pathways: chest radiography or CT for imaging, and microbiological confirmation by smear microscopy, culture and nucleic-acid amplification tests (e.g., Xpert MTB/RIF) as initial diagnostic tools per WHO recommendations. Concurrent assessment of glycemic status (random/fasting plasma glucose, HbA1c) is required at TB presentation to identify known and previously undiagnosed diabetes and to guide integrated management [11].

Treatment of TB in patients with diabetes follows standard anti-TB regimens, but co-management demands attention to potential drug–disease and drug–drug interactions, effects of hyper-glycaemia on pharmacokinetics and immune recovery, and the need for intensified glucose control to improve TB outcomes. Growing evidence supports bidirectional screening, closer microbiological monitoring and integrated service delivery to improve clinical outcomes [12].

Significance of the study is that, in a high-burden setting such as Pakistan, determining how diabetes affects clinical presentation, radiological patterns, and microbiological parameters among patients suspected of pulmonary TB has direct implications for timely diagnosis, infection control and therapeutic strategy. Better characterization of these differences will support targeted screening, faster case detection, and improved co-management pathways.

Objective: To evaluate the impact of diabetes mellitus on clinical features, chest imaging findings, and microbiological parameters (sputum smear grade, molecular test results and culture conversion) among patients suspected of pulmonary tuberculosis in a tertiary care setting in Pakistan.

## 2. METHODOLOGY

This cross-sectional experimental study was conducted in institute of Basic Medical Sciences (IBMS), Khyber Medical University, and samples were collected from Khyber Teaching Hospital, Lady Reading Hospital Peshawar and Rehman Medical Complex, Peshawar. The duration of study was about _____. The Ethical approval was obtained by the _____. A total of 103 patients aged ≥18 years diagnosed with pulmonary tuberculosis based on clinical features, radiological findings, and microbiological evidence; and willingness to participate in the study were included. Patients were categorized into two groups based on their diabetic status: with **Diabetes (n = 52)** and without **Diabetes (n = 51).** Whereas, patients with extrapulmonary TB only, incomplete medical records, prior anti-TB treatment within the last six months, coexisting immunocompromised states other than diabetes (e.g., HIV), and those with severe systemic illnesses preventing reliable data collection were excluded from the study.

Demographic information, clinical symptoms, and relevant medical history were obtained using a structured proforma. Clinical features such as cough, fever, weight loss and reduced appetite were recorded. Radiological evaluation involved the results of chest X-ray (CXR) and computed tomography (CT) chest. In order to guarantee uniformity, radiological anomalies were grouped into a standardization (upper, middle, and lower zone involvement, cavitary lesions, pleural changes, hilar/mediastinal abnormalities, and diffuse/miliary patterns). Microbiological assessment included bronchoalveolar lavage (BAL) cytology, neutrophil and lymphocyte counts, Gram staining, AFB culture, Ziehl–Neelsen staining, and sputum color interpretation. All radiological interpretations were done by a single researcher not informed to clinical and diabetic status to reduce observer bias. Microbiological tests were processed using standard laboratory protocols.

Data was analyzed using SSPS version 23.0. The demographic details and signs and symptoms were reported in frequencies and percentages. Quantitative variables were reported as means with standard deviations. A chi-square test was used to examine the association of clinical, radiological and microbiological findings between both groups. A Shapiro-Wilk test was used to check the normality of data. Additionally, a Mann Whitney test was employed to analyze the relationship between the means of demographic variables between groups. A p-value of $< 0.05$ was reflected as statistically significant.

## 3. RESULTS

A total of 103 patients with suspected of pulmonary tuberculosis were included in the study, of whom 52 (50.5%) had diabetes and 51(49.5%) did not. The mean age of patients with diabetes was 49.21 ± 11.8 years, compared to 50.54 ± 14.18 years in non-diabetic patients, with no significant difference ($p = 0.251$). Similarly, there were no significant differences in weight (59.96 ± 11.8 kg vs. 57.88 ± 11.7 kg, $p = 0.858$) or height (5.44 ± 0.26 ft vs. 5.42 ± 0.27 ft, $p = 0.818$) between the two groups. A significantly higher proportion of diabetic patients were taking medications 8(15.4%), ($p = 0.016$) and had chronic illnesses 13(25.0%), ($p = 0.007$) compared to non-diabetic patients. No significant differences were observed in the history of tuberculosis ($p = 0.854$) or presence of BCG scar ($p = 0.594$) between diabetic and non-diabetic groups, as depicted in Table I.

All patients in both groups reported cough (100%). Fever was present in all diabetic patients 52(100%) and in 48(94.1%) non-diabetic patients, showing no significant difference ($p = 0.076$). Weight loss was more common in diabetic patients 48(92.3%) as compare to non-diabetic 39(76.5%), ($p = 0.027$), as was reduced appetite 47(90.4%) vs. 33(64.7%), ($p = 0.002$). Radiological evaluation revealed significant differences between the groups. On chest X-ray, upper zone involvement was more frequent in non-diabetic patients 16(31.4%), middle zone involvement 18(35.3%), and lower zone involvement 29(55.8%) is significantly observed in diabetic group ($p < 0.001$). Cavitary lesions, hilar shadows, pleural changes, and miliary patterns were observed predominantly in non-diabetic patients, while other non-specific findings were comparable between groups. CT chest findings reflected these differences: upper zone involvement was more common in non-diabetic patients 17(33.3%) ($p = 0.018$), middle zone involvement was similar 16(31.4%) and lower zone involvement was markedly higher in diabetic patients 28(53.8%), Hilar/mediastinal abnormalities, cavitary lesions, pleural abnormalities, and miliary patterns were predominantly seen in non-diabetic patients, while other non-specific findings were more frequent in diabetics, as depicted in table II.

Bronchoalveolar lavage (BAL) cytology and microbiological analysis showed no significant differences between diabetic and non-diabetic patients. The mean neutrophil percentage in BAL fluid was 53.42 ± 22.05% in diabetics and 55.15 ± 18.17% in non-diabetics ($p = 0.704$), while lymphocyte percentages were 46.55 ± 22.18% and 45.27 ± 18.36%, respectively ($p = 0.784$). BAL cytology was positive in 1(1.9%) diabetic patient and 5(9.8%) non-diabetic patients, with no statistically significant difference ($p = 0.088$). Gram staining revealed Gram-negative rods in 6(11.5%) of diabetics and 5(9.8%) of non-diabetics, while Gram-positive rods were observed in 1(1.9%) diabetic patient. AFB culture positivity was similar between groups 15(28.8%) in diabetics and 13(25.5%) in non-diabetics, ($p = 0.702$), and Ziehl-Neelsen staining for MTB was positive in 14(26.9%) of diabetics and 13(25.5%) of non-diabetics ($p = 0.869$). Sputum color distribution showed brown sputum in 18(34.6%) of diabetics and 20(39.2%) of non-diabetics, red in 6(11.5%) and 7(13.7%), white in 10(19.2%) and 17(33.3%), and yellow in 18(34.6%) and 7(13.7%), with no statistically significant differences ($p = 0.078$), as depicted in Table III

**Table I: Demographic details of patients with suspected of Pulmonary tuberculosis (n=103).**

| Variables | Diabetes Yes (n=52) Mean ± SD n(%) | Diabetes No (n=51) Mean ± SD n(%) | p-value |
|---|---|---|---|
| **Age (Years)** | 49.21±11.8 | 50.54±14.18 | 0.251* |
| **Weight (kg)** | 59.96± 11.8 | 57.88± 11.7 | 0.858* |

| | | | | |
|---|---|---|---|---|
| **Height (feet)** | | 5.44 ± 0.26 | 5.42 ± 0.27 | 0.818* |
| **Taking any medicine** | **Yes** | 8(15.4%) | 1(2.0%) | 0.016 |
| | **No** | 44(84.6%) | 50(98.0%) | |
| **History of TB** | **Yes** | 12(23.1%) | 11(21.6%) | 0.854 |
| | **No** | 40(76.9%) | 40(78.4%) | |
| **Chronic illness** | **Yes** | 13(25.0%) | 3(5.9%) | 0.007 |
| | **No** | 39(75.0%) | 48(94.1%) | |
| **BCG Scar** | **Yes** | 31(59.6%) | 33(64.7%) | 0.594 |
| | **No** | 21(40.4%) | 18(35.3%) | |

**Mann Whitney test***
**Chi square test**

**Table II: Clinical, and Radiological Parameters in Patients Suspected of Pulmonary Tuberculosis among diabetic and non-diabetics.**

| **Variables** | | | **Diabetes Yes (n=52)** | **Diabetes No (n=51)** | **P value** |
|---|---|---|---|---|---|
| **Clinical symptoms and signs** | **Cough** | **Yes** | 52(100.0%) | 51(100.0%) | _____ |
| | | **No** | 0(0.0%) | 0(0.0%) | |
| | **Fever** | **Yes** | 52(100.0%) | 48(94.1%) | 0.076 |
| | | **No** | 0(0.0%) | 3(5.9%) | |
| | **Weight loss** | **Yes** | 48(92.3%) | 39(76.5%) | 0.027 |
| | | **No** | 4(7.7%) | 12(23.5%) | |
| | **Reduced apatite** | **Yes** | 47(90.4%) | 33(64.7%) | 0.002 |
| | | **No** | 5(9.6%) | 18(35.3%) | |
| **Radiological Findings** | **Chest X-ray (CXR) abnormalities** | **All upper zone shadows/opacity** | 8(15.4%) | 16(31.4%) | <0.001 |
| | | **All middle zone shadows/opacities** | 10(19.2%) | 18(35.3%) | |
| | | **All lower zone shadows/opacities** | 29(55.8%) | 4(7.8%) | |
| | | **cavitary, abscess, mycetoma** | 0(0.0%) | 2(4.0%) | |
| | | **hilar shadow** | 0(0.0%) | 6(11.8%) | |
| | | **CP angle blunted, hydropneumothorax** | 2(3.8%) | 1(2.0%) | |
| | | **miliary, bilateral shadows** | 0(0.0%) | 1(2.0%) | |
| | | **Other non-specific findings (hemoptysis, lingular shadow)** | 3(5.7%) | 3(5.88%) | |
| | **CT chest findings** | **Upper zone involvement** | 7(13.5%) | 17(33.3%) | 0.018 |
| | | **Middle zone involvement** | 14(26.9%) | 16(31.4%) | |
| | | **Lower zone involvement** | 28(53.8%) | 5(9.8%) | |
| | | **Hilar/mediastinal abnormalities** | 0(0.0%) | 7(13.7%) | |
| | | **Cavitary / mass / mycetoma** | 0(0.0%) | 3(5.0%) | |
| | | **Pleural abnormalities** | 1(1.9%) | 2(4.0%) | |
| | | **Miliary pattern** | 0(0.0%) | 1(2.0%) | |
| | | **Other / non-specific** | 2(3.8%) | 0(0.0%) | |

| | | | | | |
|---|---|---|---|---|---|
| | | **findings (Lingular consolidation, Persistent hemoptysis)** | | | |

**Table III: Microbiological findings and sputum characteristics in pulmonary tuberculosis patients with and without diabetes.**

| **Variables** | | | **Diabetes Yes Mean ± SD (n=52)** | **Diabetes No Mean ± SD (n=51)** | **P value** |
|---|---|---|---|---|---|
| **Microbiological findings** | **Bronchoalveolar lavage (BAL)** | **Neutrophils (%)** | 53.42±22.05 | 55.15±18.17 | 0.704* |
| | | **Lymphocytes (%)** | 46.55±22.18 | 45.27±18.36 | 0.784* |
| | **Cytology** | **Positive** | 1(1.9%) | 5(9.8%) | 0.088 |
| | | **Negative** | 51(98.1%) | 46(90.2%) | |
| | **Gram staining** | **Gram -ve rods** | 6(11.5%) | 5(9.8%) | 0.579 |
| | | **Gram +ve rods** | 1(1.9%) | 0(0.0%) | |
| | | **No** | 45(86.5%) | 46(90.2%) | |
| | **AFB Culture** | **Positive** | 15(28.8%) | 13(25.5%) | 0.702 |
| | | **Negative** | 37(71.2%) | 38(74.5%) | |
| | **Ziehl-Neelsen staining MTB** | **Positive** | 14(26.9%) | 13(25.5%) | 0.869 |
| | | **Negative** | 38(73.1%) | 38(74.5%) | |
| | **Color of sputum** | **Brown** | 18(34.6%) | 20(39.2%) | 0.078 |
| | | **Red** | 6(11.5%) | 7(13.7%) | |
| | | **White** | 10(19.2%) | 17(33.3%) | |
| | | **Yellow** | 18(34.6%) | 7(13.7%) | |

**Mann Whitney test***
**Chi square test**

## 4. DISCUSSION

In this study, out of 103 patients suspected of pulmonary tuberculosis, diabetic and non-diabetic groups were demographically comparable; however, diabetes was associated with more pronounced systemic symptoms and a distinct radiological pattern characterized by predominant lower lung zone involvement, while non-diabetic patients more frequently exhibited typical upper and middle zone disease. Microbiological findings were comparable between the two groups, indicating that diabetes primarily influences clinical presentation and radiological distribution rather than microbiological parameters.

In previous study of 63 diabetic and 63 non-diabetic pulmonary TB patients, diabetes was linked to more hemoptysis (27% vs. 12.7%) and weight loss (96.8% vs. 84.1%), greater lower lung involvement (46% vs. 17.5%) and cavitations (42.9% vs. 20.6%), delayed sputum conversion (55.6% vs. 92.1%), lower cure rates (61.9% vs. 81%), and higher treatment failure (14.3% vs. 1.6%) [13]. Similarly, in our study, diabetic patients showed higher weight loss (92.3% vs. 76.5%), reduced appetite (90.4% vs. 64.7%), predominant lower lung zone involvement on CXR (55.8% vs. 7.8%) and CT (53.8% vs. 9.8%), with comparable microbiological positivity, reflecting more severe clinical and radiological disease and delayed clearance compared with non-diabetics.

In a previous investigation of 415 TB patients, diabetics were more likely to present with hemoptysis, AFB positivity, cavitary lesions, higher ESR and CRP, lower albumin, and elevated fasting glucose, though mycobacterial load was not significantly linked to HbA1c [14]. Similarly, in our study, diabetic patients exhibited more systemic symptoms and comorbidities, with predominant lower lung zone involvement on CXR and CT, while microbiological positivity remained comparable. These findings collectively indicate that diabetes worsens clinical severity, radiological involvement, and systemic disease in TB patients.

A previous observational study of pulmonary TB patients with diabetes, particularly poorly controlled, showed higher

prevalence of cough (98.1% vs. 85%), fever (87% vs. 70%), hemoptysis (35.2% vs. 15%), and weight loss (90.7% vs. 72%) compared to non-diabetics, along with higher sputum positivity (90% vs. 75%) and greater bacillary loads (50% poorly controlled vs. 30% well-controlled and 20% non-diabetics), and more lower lung field (31.5% vs. 10.2%) and multi lobar involvement (68.5% vs. 45.3%) [10]. Similarly, in our study of 103 patients, diabetics exhibited higher weight loss (92.3% vs. 76.5%), reduced appetite (90.4% vs. 64.7%), and more chronic comorbidities, with predominant lower lung zone involvement on CXR (55.8% vs. 7.8%) and CT (53.8% vs. 9.8%), while microbiological positivity was similar, highlighting that diabetes primarily aggravates clinical symptoms, radiological severity, and systemic disease in TB patients.

In a cohort of 3,109 TB patients and 12,767 household contacts, diabetes in index patients did not increase TB infection or incident infection risk, and exposure to diabetic patients was associated with a lower TB disease incidence among contacts (aCRR 0.33, 95% CI: 0.13–0.85), suggesting that DM may not uniformly enhance TB transmissibility [15]. In contrast, our study of 103 pulmonary TB patients focused on clinical, radiological, and microbiological differences between diabetics and non-diabetics and, compared with the non-diabetic group, our study results showed that diabetes was related to higher symptoms severity, greater lower lung zone involvement based on CXR and CT, and higher systemic comorbidities, while microbiological positivity was similar, suggesting that even though DM may not increase transmissibility, there are high disease severity and increased systemic manifestations in patients with TB.

In one study of 124 sputum-positive TB patients including 68 patients with diabetes, mortality and two-month smear conversion were similar in diabetics and non-diabetics, and treatment completion was similar too, with a significant reduction in HbA1c in diabetics after six months (mean difference 1.76, P = 0.001) [16]. On the contrary, in our study of 103 patients, we found that diabetics presented more severe clinical symptoms, had greater lower lung zone involvement on CXR and CT, and more chronic comorbidities though the microbiological positivity was similar among both groups. This implies that although diabetes may not have a significant impact on short-term outcomes of morbidity (death) or sputum conversion, this biomarker is linked to greater disease burden and systemic involvement in TB patients.

In a study conducted at Ayub Teaching Hospital, the prevalence of newly diagnosed patients with TB was 25.8% with greater prevalence among females (14.8% vs. 11.0%) and significant association (P = 0.03), justifying the need of routine screening for DM [17]. Similarly in our study of 103 patients with pulmonary TB, a significant percentage of diabetics had more severe clinical features, decreased appetite and predominant lower lung zone involvement on CXR and CT with microbiological positivity being comparable, emphasis being laid on the fact that diabetes not only frequently coexists with TB, but also makes the severity of disease worse.

In a cross-sectional study on diabetic diagnosis and treatment among 100 patients of smear-positive TB infection at JPMC Karachi, Karachi, it was found that diabetes was diagnosed in 18% of patients who have diabetes (highly expected among smokers, sedentary lifestyle patients and those with a family history of diabetes while age, gender and body mass index did not show a significant effect) [18]. Similarly, as we studied 103 cases of pulmonary TB in diabetics, clinical symptoms were more severe, appetite decreased, the area of involvement of both lung fields was predominantly in the lower part of the lungs on a CXR and CT, and there was more prevalence of chronic comorbidities, though microbiological positivity was comparable. Both studies highlight the need for both the identification and control of diabetes in patients with TB in order to improve the overall outcome.

A meta analyses conducted by 25 studies, 25 cases including 16905 DR-TB patients, 11.5% with diabetes, it was evident that DM is associated with an increased risk of unsuccessful treatment, failure while reduced cure and treatment completion rates suggesting the importance of glycemic control and monitoring [19]. On comparison, our study of 103 pulmonary TB patients found the diabetics to have more severe clinical features, more worse involvement in the lower lung zones in the CXR and CT, and more chronic comorbidities, and the microbiological positivity was similar, indicating even in drug sensitive TB, diabetes leads to more severe disease severity and systemic involvement, and hence, there is a need for integrated TB and diabetes management.

In this observational study, the TB patients with diabetes were more likely to be aged 60-70 years, have greater lower lung zone lung involvement (85% vs. 40%, p = 0.0079), have more infiltrates (52% vs. 32%) and cavitary lesions while hematology parameters were similar [20]. Similarly, in our study of 103 pulmonary TB patients, diabetics showed more weight loss, poorer appetite, more comorbidities, and predominant lower lung zone involvement on CXR (55.8%) and CT (53.8%), and comparable microbiological positivity, collectively showing the clinical and radiological increased severity of TB in diabetes, justifying the importance of the integrated screening and management.

In the Chinese study of 1,417 pulmonary TB patients, 312 (22%) patients had diabetes; they had more fatigue (58.3% vs. 47.5%), more weight loss (8.21 +-6.2 vs. 5.74 +- 4.0 kg), more anemia (88.9 vs. 77.6%), more central lobe shadows, and cavitary lesions; however, drug susceptibility was similar between the groups [21]. Comparably, among 103 TB patients in

our study, diabetics had higher weight loss (92.3 vs. 76.5%), decreased appetite (90.4 vs. 64.7%); had higher chronic comorbidities 25 vs. 5.9%), and predominately have lower lung zones involvement on CXR (55.8 vs. 7.8%) and CT (53.8 vs. 9.8%), with comparable microbiological positivity (AFB culture 28.8 vs. 25.5%; ZN Both of the studies suggest an increase in the clinical and radiological severity of TB with diabetes, and thus the importance of early identification and combined management.

In this observational study in 40 pulmonary TB patients, diabetics had higher rates of dyspnea (80% vs. 40%), hemoptysis (75% vs. 35%), lower zone involvement (75% vs. 40%; p = 0.0079) and presence of cavitary lesions (p = 0.031) without differences in the hematological parameters [22]. Using our patient cohort of 103 patients with TB, we found that diabetics had greater weight loss (92.3 vs. 76.5 per cent), decreased appetite (90.4 vs. 64.7 per cent), higher rates of chronic comorbidities (25 vs. 5.9 per cent), and predominant lower lung zone involvement on CXR (55.8 vs. 7.8 per cent) and CT (53.8 vs. 9.8 per cent), but similar levels of microbiological positivity. Together, these results show that diabetes markedly adversely affects the clinical presentation and radiological involvement in TB, thus underlining the importance of coordination of TB and DM screening and management.

There are a number of limitations to this study. The fact of its observational design makes it hard to establish causal regulatory relationships between diabetes and TB severity. Being a single-center study, the results may not be generalized to other populations and areas. The sample size, especially for subgroup analyses, was fairly small, and this may have limited statistical power. Additionally, data on long term treatment outcomes and glycemic control during treatment was not comprehensively assessed. In spite of these limitations, the study reveals the important impact of diabetes on the clinical and radiological severity of pulmonary TB. These findings highlight the need for routine screening for diabetes among TB patients as well as close monitoring of TB among high-risk diabetic groups. Integrating TB and DM management strategies may lead to improved outcomes among patients, decreased complications, and public health policies that aim to control both diseases.

## 5. CONCLUSION

This study concluded that there were noticeable differences in clinical, radiological and microbiological profiles among the patients with pulmonary tuberculosis on the basis of the diabetic status. Diabetic patients had significantly higher rates of weight loss, decreased appetite, and weight loss with greater extent of lower zone lung involvement on both CXR and CT imaging while in non-diabetic there were more upper and middle zone abnormalities and mediastinal abnormalities. Although the microbiological parameters were mostly similar in the two groups, the positivity for cytology was higher in non-diabetics. Overall, diabetes was linked to more widespread lower-zone disease and had a higher degree of accompanying symptoms and thus it is important to develop a targeted clinical look-up and management plan in TB patients with comorbid diabetes.

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