

**ORIGINAL RESEARCH**

# Frequency of Newly Diagnosed Diabetes Mellitus in Tuberculosis Patients: A Cross-Sectional Study

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## ABSTRACT

**Background:** The coexistence of diabetes mellitus (DM) and tuberculosis (TB) is a growing public health concern, with both diseases having a bidirectional relationship. **Objective:** This study aims to determine the frequency of newly diagnosed diabetes in TB patients and identify potential risk factors. **Methods:** A cross-sectional study was conducted on 320 TB patients. Data were collected through clinical assessments, including detailed medical histories, physical examinations, and laboratory tests (Fasting Plasma Glucose, Oral Glucose Tolerance Test, and HbA1c). Newly diagnosed diabetes was defined by an FPG level of  $\geq 126$  mg/dL, an OGTT result of  $\geq 200$  mg/dL, or an HbA1c level  $\geq 6.5\%$ . Demographic characteristics, TB type, and treatment outcomes were also assessed. **Results:** The prevalence of newly diagnosed diabetes in TB patients was 20.3%. Of these, 12.5% were diagnosed via FPG, 5.6% through OGTT, and 2.2% based on HbA1c levels. Diabetic TB patients were older (mean age: 55.2 years) and had a higher BMI (mean BMI: 27.1 kg/m<sup>2</sup>) compared to non-diabetic TB patients (mean age: 45.8 years, BMI: 23.8 kg/m<sup>2</sup>). Pulmonary TB patients exhibited a higher frequency of diabetes (22.3%) compared to those with extrapulmonary TB (16.7%). **Conclusion:** It is concluded that newly diagnosed diabetes is prevalent in 20.3% of TB patients, with older age, higher BMI, and pulmonary TB being significant risk factors. Diabetes in TB patients is associated with prolonged treatment durations and higher treatment failure rates. Routine screening for diabetes in TB patients, particularly those at risk, is crucial for improving treatment outcomes.

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## INTRODUCTION

The coexistence of diabetes mellitus (DM) and tuberculosis (TB) is an emerging global health concern, particularly in regions with high TB burden [1]. Both diseases represent significant public health challenges, with TB being one of the leading causes of morbidity and mortality, while diabetes mellitus is a rapidly growing epidemic. Modern research shows that diabetes shapes a two-way relationship with tuberculosis because the condition makes people more susceptible to tuberculosis development yet it worsens the treatment process for TB patients [2][3]. The rising number of diabetes cases throughout low- and middle-income countries drives an increasing number

of tuberculosis patients who also have diabetes [4]. This coinfection between diseases adds to treatment difficulties while simultaneously deteriorating both diagnosis times and treatment success rates thus leading to inferior health results. The abundant levels of diabetes in patients with tuberculosis bring substantial consequences to the treatment and management of both infections requiring evaluation of diabetes diagnosis frequency among these patients. The medical management of tuberculosis becomes challenging in diabetic patients because diabetes causes drug metabolism changes and delayed healing time and increases dangerous side effects of treatment [5][6].

The risk factors that affect tuberculosis manifestation also increase the likelihood of diabetes development [7] including poor nutrition together with age along with low socioeconomic status as well as immunocompromised medical conditions. Research shows that an impaired immune system resulting from diabetes opens patients with this condition to a higher risk of infections especially tuberculosis. Diabetic patients display elevated blood glucose that functions as *Mycobacterium tuberculosis* food source and aids its bacterial growth [8]. Medical research about diabetes mellitus diagnosis frequency among tuberculosis patients has become increasingly important because tuberculosis infections appear to trigger both unrecognized and uncontrolled diabetes [9]. TB infection leads to "stress-induced hyperglycemia," where the body develops high blood glucose levels as an outcome of systemic inflammation during the infection process. TB medication can affect blood sugar control, which might worsen the condition of people with either undetected or improperly managed diabetes; patients need supplementary care methods [10]. Research shows that diabetes exists at higher rates among persons with tuberculosis when compared to the occurrence rate of diabetes in the overall population [11]. The presence of diabetes among patients has reached high levels, exceeding 20%–40 % within specific regions. The difficulty in diagnosing and treating these diseases grows worse because their shared clinical indications include fatigue, weight loss and malaise. Unidentified diabetes in TB patients extends patient treatment delays, which can lead to inferior clinical results [12]. The lack of proper diabetes control in TB patients results in longer treatment times and greater possibilities for treatment failure. The TB treatment sector now advises regular diabetes assessments for TB patients, mainly in populations at high risk, to improve diabetes management [13]. At present, the relationship between diabetes and tuberculosis exists as a combined clinical issue that requires immediate public health intervention. Both countries with high rates of tuberculosis and those with increasing diabetic numbers encounter fresh difficulties when implementing their TB control operations [14]. Medical organizations need to treat TB and diabetes together by implementing diabetes screening solutions inside standard TB medical treatment procedures. Healthcare systems operating under resource constraints should focus on early identification and suitable management of both diseases because it will decrease operational loads while enhancing treatment results.

### Objective

This study aims to determine the frequency of newly diagnosed diabetes in TB patients and identify potential risk factors.

### Methodology

This cross-sectional study was conducted and a cohort of 320 patients diagnosed with active tuberculosis was selected for this study.

### Inclusion Criteria

- Adults aged 18 years and above.
- Diagnosed with active tuberculosis (pulmonary or extrapulmonary) based on clinical, radiological, and microbiological criteria (smear-positive sputum or culture-positive for *Mycobacterium tuberculosis*).
- Patients who provided informed consent to participate in the study.

### Exclusion Criteria

- Pregnant or breastfeeding women.
- Patients with known pre-existing diabetes mellitus diagnosed before the TB diagnosis.
- Individuals with any severe comorbid conditions (such as cancer, severe cardiovascular disease, etc.) that could interfere with the study outcomes.

### Data Collection

Data collection involved both clinical assessments and laboratory investigations. A detailed medical history was obtained from all participants to identify potential risk factors for diabetes, such as family history, age, gender, smoking status, and dietary habits. Physical examinations were performed to detect symptoms indicative of diabetes, including unexplained weight loss, excessive thirst, frequent urination, and fatigue. After the clinical assessment, all patients underwent a screening test for diabetes using the Fasting Plasma Glucose (FPG) test, which is the standard diagnostic method for identifying diabetes. Patients with FPG levels of 126 mg/dL or higher were considered to have diabetes mellitus. Additionally, the study employed the Oral Glucose Tolerance Test (OGTT) for patients with FPG levels between 100-125 mg/dL, which indicated impaired fasting glucose, to further confirm the presence of diabetes. Glycated hemoglobin (HbA1c) levels were measured to assess long-term blood glucose control, with levels of 6.5% or higher being indicative of diabetes. Blood samples were also collected to assess kidney function, liver enzymes, and serum electrolytes, which are important for managing both TB and diabetes.

### Diagnostic Criteria for Diabetes Mellitus

The diagnosis of newly diagnosed diabetes mellitus in the study was based on established diagnostic criteria. These criteria included a Fasting Plasma Glucose (FPG) level of 126 mg/dL or higher, a 2-hour plasma glucose level of 200 mg/dL or more following an OGTT, or an HbA1c level of 6.5% or greater. Any patient meeting one or more of these criteria during the screening process was classified as having newly diagnosed diabetes. This approach ensured that patients who were previously undiagnosed but met the

threshold for diabetes diagnosis were identified and included in the study group.

### Data Analysis

Data were analyzed using SPSS v21. Descriptive statistics were employed to summarize the demographic characteristics of the study population, including age, gender, and the clinical features of TB. The frequency of newly diagnosed diabetes was calculated as a percentage of the total sample of TB patients. Chi-square tests were used to examine the relationships between categorical variables such as gender, smoking status, and the presence of diabetes, while t-tests were applied to compare continuous

variables such as age and body mass index between diabetic and non-diabetic patients.

### RESULTS

Data were collected from 320 TB patients, with 65 diabetic and 255 non-diabetic patients. Diabetic patients were older (55.2 years) compared to non-diabetic patients (45.8 years). More males were in both groups, with a higher percentage in the non-diabetic group (67%). Diabetic patients had higher BMI (27.1 kg/m<sup>2</sup>) compared to non-diabetic patients (23.8 kg/m<sup>2</sup>) and had higher blood pressure (130/85 mmHg). Diabetic patients also had a higher prevalence of pulmonary TB (76.9%) and longer TB symptom duration (4.2 months).

**Table 1: Demographic and Baseline Values of Tuberculosis Patients**

Characteristic	All TB Patients (n=320)	Diabetic TB Patients (n=65)	Non-Diabetic TB Patients (n=255)
Age (Mean $\pm$ SD)	48.3 $\pm$ 14.7	55.2 $\pm$ 12.6	45.8 $\pm$ 14.1
Gender			
- Male	210 (65.6%)	39 (60%)	171 (67%)
- Female	110 (34.4%)	26 (40%)	84 (33%)
Smoking History	120 (37.5%)	29 (44.6%)	91 (35.7%)
BMI (Mean $\pm$ SD, kg/m <sup>2</sup> )	24.6 $\pm$ 4.3	27.1 $\pm$ 4.5	23.8 $\pm$ 3.9
Blood Pressure (Mean $\pm$ SD, mmHg)	122/80 $\pm$ 15/10	130/85 $\pm$ 16/12	120/78 $\pm$ 14/9
Presence of Comorbidities (%)	85 (26.6%)	22 (33.8%)	63 (24.7%)
Pulmonary TB (%)	224 (70%)	50 (76.9%)	174 (68.2%)
Extrapulmonary TB (%)	96 (30%)	15 (23.1%)	81 (31.8%)
Duration of TB Symptoms (Mean $\pm$ SD, months)	3.5 $\pm$ 2.1	4.2 $\pm$ 2.5	3.3 $\pm$ 2.0

A total of 12.5% of patients were diagnosed with diabetes through fasting plasma glucose (FPG), 5.6% were diagnosed using the oral glucose tolerance test (OGTT), and 2.2% had an HbA1c  $\geq$  6.5%. Among TB patients, 22.3% with pulmonary TB and 16.7% with extrapulmonary TB were diagnosed with diabetes.

**Table 2: Prevalence of Newly Diagnosed Diabetes Mellitus in Tuberculosis Patients**

Diagnostic Criteria	Number of Patients	Percentage (%)
Fasting Plasma Glucose (FPG)	40	12.5%
Oral Glucose Tolerance Test (OGTT)	18	5.6%
HbA1c $\geq$ 6.5%	7	2.2%
TB Type		
Pulmonary TB	50	22.3%
Extrapulmonary TB	15	16.7%

Age and BMI were identified as significant risk factors, with an odds ratio (OR) of 1.18 for age, indicating a 18% increased likelihood of developing diabetes for each additional year of age. BMI had an OR of 1.27, suggesting a 27% increased likelihood of developing diabetes with each unit increase in BMI. Smoking history was not found to be a significant risk factor, with an OR of 1.05, indicating a minimal effect on the likelihood of developing diabetes in TB patients.

**Table 3: Risk Factors for Newly Diagnosed Diabetes in Tuberculosis Patients**

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)
Age	1.18	1.07–1.31
BMI	1.27	1.15–1.41
Smoking History	1.05	0.92–1.19

A significantly higher proportion of diabetic TB patients (58%) experienced prolonged treatment duration compared to non-diabetic patients (34%). Treatment failure was also more common in diabetic TB patients, with 12% experiencing failure compared to only 5% of non-diabetic patients.

**Table 4: Impact of Diabetes on Tuberculosis Treatment Outcomes**

Outcome	Non-Diabetic TB Patients	Diabetic TB Patients
Prolonged Treatment Duration (%)	34%	58%
Treatment Failure (%)	5%	12%

## DISCUSSION

The findings of this study provide important insights into the prevalence of newly diagnosed diabetes mellitus (DM) in tuberculosis (TB) patients, as well as the demographic and clinical factors associated with the development of diabetes during TB treatment. The results highlight a significant frequency of newly diagnosed diabetes among TB patients, with approximately 20.3% of the participants identified as diabetic during the course of TB treatment. This figure is consistent with previous studies that have reported a higher prevalence of diabetes among TB patients compared to the general population, especially in regions where both conditions are prevalent [15][16]. The prevalence of newly diagnosed diabetes in TB patients in this study was 20.3%, with the majority of cases identified through the Fasting Plasma Glucose (FPG) test. A substantial portion of these cases was also detected using the Oral Glucose Tolerance Test (OGTT) and HbA1c levels, further emphasizing the importance of comprehensive screening strategies for detecting undiagnosed diabetes. This finding aligns with other research that has highlighted the importance of screening for diabetes in TB patients, especially in populations with high TB and diabetes co-prevalence. In many cases, diabetes in TB patients may go undiagnosed due to overlapping symptoms, such as weight loss, fatigue, and general malaise, which are common to both conditions. The significant prevalence found in this study underscores the necessity of incorporating routine diabetes screening in TB management protocols. This study found that newly diagnosed diabetes was more prevalent in older TB patients, with the mean age of diabetic TB patients being 55.2 years compared to 45.8 years in non-diabetic patients. Age has long been recognized as a key risk factor for the development of diabetes, and this finding supports previous research that shows the likelihood of diabetes increases with age, particularly in populations already at risk for TB. Additionally, the study found that diabetic TB patients had a significantly higher mean BMI (27.1 kg/m<sup>2</sup>) compared to non-diabetic TB patients (23.8 kg/m<sup>2</sup>). This suggests that obesity, which is a well-established risk factor for diabetes, plays an important role in the onset of diabetes in TB patients. The association between higher BMI and newly diagnosed diabetes is in line with global trends linking obesity with insulin resistance and the development of type 2 diabetes. Interestingly, smoking status did not show a significant association with the presence of diabetes in TB patients. Although smoking is a known risk factor for both TB and diabetes, the findings of this study suggest that other factors, such as age and BMI, may

be more influential in the development of diabetes in this cohort. This is consistent with previous studies that suggest diabetes in TB patients is more strongly associated with metabolic and demographic factors rather than behavioral ones like smoking [17]. The study also found a significant difference in the prevalence of newly diagnosed diabetes between patients with pulmonary TB and those with extrapulmonary TB. Specifically, diabetic patients were more likely to have pulmonary TB (22.3%) compared to those with extrapulmonary TB (16.7%). This may reflect the more systemic and severe nature of pulmonary TB, which could exacerbate or trigger the onset of diabetes through mechanisms such as stress-induced hyperglycemia. Pulmonary TB often involves more extensive lung damage, systemic inflammation, and a prolonged course of treatment, all of which could contribute to metabolic disturbances and the development of diabetes. The logistic regression analysis revealed that age and BMI were significant predictors of newly diagnosed diabetes in TB patients. Older patients and those with higher BMI had a significantly higher likelihood of being diagnosed with diabetes. These findings are consistent with established literature that links age and obesity with increased risk of type 2 diabetes [18]. However, the study did not find a significant association between smoking and the development of diabetes, which may suggest that, in this cohort, metabolic factors (age and BMI) are more influential than lifestyle factors such as smoking in determining the onset of diabetes. The results of this study underscore the importance of routine diabetes screening in TB patients, particularly those who are older, have higher BMI, or have pulmonary TB.

## CONCLUSION

It is concluded that a significant proportion of tuberculosis (TB) patients, approximately 20.3%, are newly diagnosed with diabetes mellitus during TB treatment. The study identified older age, higher body mass index (BMI), and pulmonary TB as key risk factors for the development of diabetes in TB patients. The findings suggest that diabetes can complicate TB treatment, leading to longer treatment durations and an increased risk of treatment failure. These results emphasize the importance of routine diabetes screening in TB patients, particularly those who are older, have higher BMI, or have pulmonary TB. Early diagnosis and integrated management of both TB and diabetes are essential for improving patient outcomes and minimizing the burden of both diseases.

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