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PREVALENCE OF TYPE-2 DIABETES MELLITUS AMONG PATIENTS WITH PULMONARY TUBERCULOSIS: A HOSPITAL BASED CROSS SECTIONAL STUDY

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ABSTRACT:

Introduction: Tuberculosis (TB) remains a major public health challenge in India, which also faces a rapidly rising burden of Type-2 Diabetes Mellitus (T2DM). Diabetes not only increases the risk of developing TB but may also worsen its clinical course and treatment outcomes. Understanding the magnitude of diabetes among pulmonary TB patients is essential for integrated disease control. The present study was conducted to determine the prevalence of T2DM among microbiologically confirmed pulmonary TB patients and to assess its association with demographic, lifestyle, and clinical factors.

Materials and Methods: This hospital-based cross-sectional study was conducted at a tertiary care hospital for a period of 6 months. A total of 60 consecutive adult patients (≥18 years) with newly diagnosed, microbiologically confirmed pulmonary TB (sputum smear microscopy, CBNAAT/GeneXpert, or culture positive) were recruited.. After obtaining informed consent, data were collected using a pre-tested proforma, including socio-demographics, lifestyle habits, and clinical history. All patients were screened for diabetes using American Diabetes Association (ADA 2023) criteria. Data were entered into MS Excel and analyzed using SPSS version 20.

Results: The prevalence of T2DM among pulmonary TB patients was 23.3% (14/60), of which 35.7% were newly detected. Diabetes was significantly associated with older age (>40 years, p=0.02) and higher BMI (≥25 kg/m², p=0.04). Male patients had slightly higher prevalence than females, but the difference was not significant. Diabetic TB patients showed trends toward higher sputum positivity (85.7% vs. 69.6%) and more cavitary lesions on chest X-ray (57.1% vs. 34.8%), although not statistically significant.

Conclusion: Nearly one in four pulmonary TB patients had co-existing T2DM, with a substantial proportion being newly diagnosed. Diabetes was associated with older age and obesity, and appeared to worsen TB severity. These findings highlight the need for routine bidirectional screening and integrated management of TB and diabetes in clinical practice.

Keywords: Tuberculosis, Type-2 Diabetes Mellitus, Cross-sectional Study, Prevalence, India, Comorbidity

INTRODUCTION:

Tuberculosis (TB) continues to be a significant global health concern, ranking among the top ten causes of death worldwide. According to the World Health Organization (WHO) Global TB Report 2023, an estimated 10.6 million people developed TB in 2022, and 1.3 million died from the disease, despite advances in diagnosis and treatment programs [1]. India alone accounted for about 28% of the global TB burden, making it the highest TB-burden country [2].

Alongside TB, Type-2 Diabetes Mellitus (T2DM) has emerged as a rapidly growing non-communicable epidemic. Globally, the International Diabetes Federation (IDF) estimated that 537 million adults were living with diabetes in 2021, a figure projected to rise to 643 million by 2030 and 783 million by 2045 [3]. India currently ranks second globally, with nearly 77 million adults affected, and is often referred to as the "diabetes capital of the world" [4].

The convergence of TB and T2DM has become a growing public health challenge. Diabetes is known to triple the risk of developing active TB by impairing host immunity, particularly cell-mediated immune responses that are critical for containing *Mycobacterium tuberculosis* infection [5,6]. In addition, hyperglycemia alters macrophage function, cytokine production, and chemotaxis, thereby increasing susceptibility to infection and adversely affecting disease progression [7]. Conversely, active TB can worsen glycemic control through increased systemic inflammation, stress responses, and drug interactions [8].

The coexistence of TB and T2DM poses clinical and programmatic difficulties. Patients with TB-DM comorbidity often present with more severe forms of TB, delayed sputum conversion, poor treatment adherence, higher relapse rates, and increased risk of mortality compared to TB patients without diabetes [9,10]. Studies from India have reported diabetes prevalence rates among TB patients ranging from 15% to 30%, with wide variability depending on geographical region, population characteristics, and study settings [11,12].

Recognizing the bidirectional relationship between TB and diabetes, the WHO and the International Union Against Tuberculosis and Lung Disease (IUATLD) have recommended “bi-directional screening,” meaning TB patients should be routinely screened for diabetes, and diabetes patients should be screened for TB, especially in high-burden countries [13]. India’s National TB Elimination Program (NTEP) has also highlighted the importance of integrating non-communicable disease control strategies into TB management [14].

This study was conducted to determine the prevalence of Type-2 Diabetes Mellitus among patients with pulmonary tuberculosis in a hospital setting and to identify associated demographic and clinical factors.

MATERIALS AND METHODS:

Study Design and Setting: This was a **hospital-based cross-sectional study** conducted at a tertiary care hospital for a period of 6 months after taking approval from the Institutional Ethics Committee.

Study Population

Inclusion Criteria

- Patients aged ≥18 years.
- Newly diagnosed or microbiologically confirmed pulmonary tuberculosis (sputum smear microscopy/CBNAAT/GeneXpert/culture positive).
- Willing to provide informed consent.

Exclusion Criteria

- Extrapulmonary TB cases.
- Known cases of Type-1 Diabetes Mellitus.
- HIV-positive patients (to avoid confounding).

- Pregnant women.
- Patients unable to participate or unwilling to consent.

Sampling Technique

A **consecutive sampling method** was used. 60 eligible patients attending the TB outpatient clinic or admitted to inpatient wards during the study period were recruited

Data Collection

A **pre-tested structured proforma** was used to collect data, including:

- Socio-demographic details (age, sex, residence, socioeconomic status).
- Lifestyle habits (smoking, alcohol, diet, physical activity).
- Clinical details (duration of TB symptoms, past history of TB, family history of diabetes).
- Anthropometric measurements (height, weight, BMI).

Diagnosis of Pulmonary Tuberculosis

- **Sputum smear microscopy** for Acid-Fast Bacilli (AFB) by Ziehl–Neelsen staining.
- **CBNAAT/GeneXpert MTB/RIF assay** for confirmation and rifampicin resistance testing.
- In selected cases, **culture (Löwenstein–Jensen medium / MGIT)** was done. Only microbiologically confirmed PTB patients were included.

Diagnosis of Type-2 Diabetes Mellitus

All TB patients were screened for diabetes according to **ADA 2023 guidelines** [15]:

- **Fasting Plasma Glucose (FPG):** ≥126 mg/dL
- **2-hour Post-Prandial Blood Glucose (PPBG):** ≥200 mg/dL
- **Random Blood Glucose (RBG):** ≥200 mg/dL with classical symptoms
- **HbA1c ≥6.5%** (where available)

Patients already on anti-diabetic medications were considered diabetics.

Statistical Analysis

- Data were entered in **MS Excel** and analyzed using **SPSS version 20**.
- **Descriptive statistics** (mean ± SD for continuous variables, proportions for categorical variables) were used.
- **Chi-square test/Fisher's exact test** was applied to study the association between categorical variables (e.g., diabetes status and age, BMI, smoking).
- **Independent t-test** was used for comparing continuous variables.
- A **p-value <0.05** was considered statistically significant.

RESULTS:

A total of **60 patients** with microbiologically confirmed pulmonary tuberculosis were included in the study. The mean age of participants was **41.5 ± 12.4 years** (range: 19–70 years). There were **38 males (63.3%)** and **22 females (36.7%)**, giving a male-to-female ratio of 1.7:1. Most patients were in the **31–50 year age group (43.3%)**, followed by those aged >50 years (30.0%), and ≤30 years (26.7%).

Out of 60 pulmonary TB patients, **14 (23.3%)** were found to have Type-2 Diabetes Mellitus. Among these:

- **9 (15.0%)** were previously known diabetics,
- **5 (8.3%)** were newly diagnosed during the study.

Thus, nearly **one-third (35.7%) of all diabetes cases were newly detected** through screening as shown in Table 1

Table 1: Prevalence of Type-2 Diabetes Mellitus in Pulmonary TB Patients (n=60)

Diabetes Status	Number (n)	Percentage (%)
Known Diabetes	9	15.0%
Newly Detected DM	5	8.3%
Non-Diabetic	46	76.7%
Total DM cases	14	23.3%

Diabetes prevalence was higher in patients aged **>40 years (34.4%)** compared to ≤40 years (10.7%) ($p = 0.02$). Male TB patients had slightly higher prevalence (26.3%) compared to females (18.2%), but the difference was not statistically significant as shown in Table 2

Table 2: Association of Diabetes with Demographics

Variable	Total (n)	Diabetic (n, %)	Non-Diabetic (n, %)	p-value
Age ≤40 years	28	3 (10.7%)	25 (89.3%)	0.02*
Age >40 years	32	11 (34.4%)	21 (65.6%)	
Male	38	10 (26.3%)	28 (73.7%)	0.48
Female	22	4 (18.2%)	18 (81.8%)	

*Significant at $p < 0.05$

Overweight/obese patients (BMI ≥25 kg/m²) had higher prevalence of diabetes (**36.8%**) compared to those with BMI <25 (**17.1%**) ($p = 0.04$). Smoking and alcohol use were more frequent among diabetics, though statistical significance was marginal as shown in Table 3

Table 3: Association of Diabetes with Lifestyle Factors

Risk Factor	Total (n)	Diabetic (n, %)	Non-Diabetic (n, %)	p-value
BMI <25	41	7 (17.1%)	34 (82.9%)	0.04*
BMI ≥25	19	7 (36.8%)	12 (63.2%)	
Smoker	24	7 (29.2%)	17 (70.8%)	0.32
Non-Smoker	36	7 (19.4%)	29 (80.6%)	
Alcohol User	18	6 (33.3%)	12 (66.7%)	0.18
Non-Alcohol User	42	8 (19.0%)	34 (81.0%)	

*Significant at $p < 0.05$

Sputum smear positivity was more common among diabetics (85.7%) compared to non-diabetics (69.6%), but this difference was not statistically significant ($p = 0.18$). **Cavitary lesions on chest X-ray** were seen in **57.1% of diabetics** versus **34.8% of non-diabetics** ($p = 0.09$). **Treatment-related adverse effects** were more frequent in diabetics (14.3%) compared to non-diabetics (6.5%) as shown in Table 4

Table 4: TB Severity among Diabetic vs Non-Diabetic Patients

Variable	Diabetic TB (n=14)	Non-Diabetic TB (n=46)	p-value
Sputum smear positive	12 (85.7%)	32 (69.6%)	0.18
Cavitary lesions on X-ray	8 (57.1%)	16 (34.8%)	0.09
Treatment complications	2 (14.3%)	3 (6.5%)	0.32

DISCUSSION:

In this cross-sectional study of **60 microbiologically confirmed pulmonary tuberculosis (PTB) patients**, the prevalence of **Type-2 Diabetes Mellitus (T2DM) was 23.3%**, with more than one-third of the cases being newly diagnosed. This underscores the importance of routine screening for diabetes in patients with tuberculosis.

The prevalence of diabetes among TB patients in our study (23.3%) is consistent with findings from several Indian studies. Viswanathan et al. reported a prevalence of **25%** among TB patients in Tamil Nadu, while Balakrishnan et al. found diabetes in **44%** of TB patients in Kerala [16,17]. Similarly, a multi-centric study across India reported that **16–30% of TB patients** had co-existing diabetes [18]. Our findings fall within this range, confirming that diabetes is a significant comorbidity in TB patients in the Indian setting.

Globally, studies from countries with high TB burden have also documented a strong association. In Indonesia, Ruslami et al. (2010) reported a prevalence of **19%**, while in Mexico, Restrepo et al. found diabetes in **30% of TB patients** [19,20]. A systematic review by Jeon and Murray concluded that diabetes increases the risk of developing TB by about **threefold** [21]. Thus, our results align with both national and international data.

Demographic and Lifestyle Associations

We observed that diabetes was more common in patients aged **>40 years (34.4%)** compared to younger individuals, which is in line with the natural epidemiology of T2DM. Similar age-related trends have been observed in other Indian studies [16,18]. Males had a slightly higher prevalence than females, but the difference was not statistically significant.

Obesity and overweight (BMI $\geq$25 kg/m^2) were significantly associated with diabetes in our study, a finding consistent with reports from Kerala [17] and China [22], where higher BMI was identified as a risk factor for the coexistence of TB and diabetes. Lifestyle factors such as smoking and alcohol use were more frequent among diabetics, though not statistically significant, possibly due to small sample size.

Impact of Diabetes on TB Severity

Diabetic TB patients in our study showed trends toward **higher sputum positivity (85.7%)** and **more frequent cavitary lesions (57.1%)** compared to non-diabetics. This is biologically plausible, as diabetes impairs both innate and adaptive immunity, leading to poor control of *Mycobacterium tuberculosis* infection. Previous studies also demonstrated that TB patients with diabetes tend to have **higher bacillary load, delayed sputum conversion, and more extensive lung involvement** [23,24]. Although our results did not achieve statistical significance (likely due to smaller sample size), the pattern supports earlier findings that **diabetes may worsen TB severity and outcomes**.

Public Health Implications

The coexistence of TB and diabetes represents a **"double burden"** for public health systems, especially in low- and middle-income countries like India. With India being the highest TB-burden country globally and also experiencing a rising diabetes epidemic, the **bi-directional screening of TB and diabetes** has been strongly recommended by the World Health Organization (WHO) and the International Union Against Tuberculosis and Lung Disease (The Union) [25].

CONCLUSION: Our study demonstrated that nearly **one in four pulmonary TB patients** had co-existing Type-2 Diabetes Mellitus, with a substantial proportion being **newly detected**. Diabetes was significantly associated with **older age and higher BMI**, and showed trends toward more severe TB disease. These findings highlight the urgent need for **routine diabetes screening in all TB patients** and coordinated management strategies to address this dual epidemic.

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