

## Original Research Article

# Prevalence of diabetes mellitus among tuberculosis patients attending a directly observed treatment-short-course center in Delhi, India

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### ABSTRACT

**Background:** Diabetes (DM) can worsen the clinical course of tuberculosis (TB) and treatment outcomes in terms of increased deaths, treatment failure, and relapse rates. This study investigated the prevalence of DM in TB patients at an urban primary health centre (UPHC), Delhi and the factors associated with it.

**Methods:** A record-based study of all TB patients registered from December 2019 to November 2020 at a directly observed treatment short-course (DOTS) center of a UPHC in Delhi was conducted. Information regarding socio-demographic details and disease profile, diabetes status and random blood sugar level was collected from patients' treatment cards. Data were entered and analyzed in SPSS. Descriptive analysis was done.

**Results:** A total of 252 patients were registered at the DOTS center during one year and data for all of them were analyzed. The mean age of the study participants at the time of the study was  $31.13 \pm 15.84$  years, half of them were males (56%) and the site of the disease was predominantly pulmonary (61%). Out of 252 TB patients, 17 (7%) and 2 (1%) were diabetics and pre-diabetics respectively.

**Conclusions:** Those patients with age more than 30 years, pulmonary TB, sputum positive TB are the factors with statistically significant association with diabetes in our study.

**Keywords:** Diabetes mellitus, Tuberculosis, DOTS

### INTRODUCTION

TB is one of the top communicable causes of death worldwide. In 2019, worldwide, approximately 10 million people were afflicted from TB while 1.4 million people died from TB.<sup>1</sup> In 2018, India achieved a total notification of 21.5 lakh TB cases with the majority of the burden being the working-age group. 89% of TB cases belong to the 15-69 years age group.<sup>2</sup>

There are several medical conditions that serve as risk factors for TB and are associated with poor TB outcomes. Subsequently, TB can complicate many diseases. Most countries with high levels of tuberculosis face a large comorbidity burden from both non-communicable and communicable diseases. These include human immuno-

deficiency virus (HIV) infection, DM, malnutrition and chronic lung diseases to name a few.<sup>3</sup>

TB and DM co-morbidity is of utmost importance in countries like India where both TB and DM are a huge burden. According to International diabetes federation (IDF), the prevalence of diabetes in India is 8.9% with total cases of diabetes being 77,005,600.<sup>4</sup> TB can temporarily cause glucose intolerance which is a risk factor for developing diabetes. The likelihood of patients with TB dying or relapsing is increased if the patient has diabetes. Patients with poor immunity have an increased risk of progressing from latent to active TB due to chronic diseases like DM.<sup>5</sup> DM also increases the risk of unfavorable treatment outcomes (delayed culture conversion, death, treatment failure, recurrence) among

TB patients.<sup>6</sup> This association between diabetes and TB could further escalate the grim situation in India when non-communicable and communicable diseases are already a matter of concern. With this background, the current study was planned to estimate the prevalence of diabetes mellitus among TB patients and to find out the factors associated with it.

## METHODS

### Study setting and design

This was a record-based study conducted at a DOTS center for TB at an UPHC in Delhi, India which covers approximately 57,402 population. All TB patients undergo random blood sugar (RBS) testing with capillary blood by glucometer before starting the treatment from the DOTS clinic at the UPHC.

### Study subjects

All the TB patients who were registered in a year from December 2019 to November 2020 were included in the study. Records of all patients including pediatric patients, were taken. Information pertaining to the history of smoking and contact history was excluded from the study as it was missing from most of the patients' records.

### Study technique and data collection

Information regarding socio-demographic details, site of disease, type of patient, case definition, HIV status and diabetes status was obtained from the case records maintained at the DOTS center. Patients with RBS values between 140 mg/dl and 200 mg/dl were considered as pre-diabetics whereas those with RBS values  $\geq 200$  mg/dl and/or with a history of diabetes were categorized as diabetics.<sup>7</sup> Patients with no history of diabetes and with normal RBS were considered non-diabetics. Those issued with below poverty line ration cards (BPL) were considered in the BPL category. The income cut for those considered in the BPL category is below ₹ 1134 per capita income/month.<sup>8</sup>

### Data analysis

Data were entered in excel and were analyzed using licensed Statistical package for social sciences (SPSS) 21. Descriptive analysis was performed. Frequencies and percentages were calculated for categorical variables and mean, the standard deviation for continuous variables. All information was kept confidential and used for study purposes only. Chi-square/Fischer exact tests were applied to analyze the association between various variables with diabetic status.

A  $p < 0.05$  was considered statistically significant.

## Ethical consideration

All information was kept confidential and used for study purposes only. Permission to conduct the study was taken from respective authorities including the medical officer in charge of the UPHC.

## RESULTS

### Socio-demographic profile of study participants

A total of 252 TB patients were registered over the course of one year. The mean age of the study participants was. Less than half (43.6%,  $n=110$ ) of the study participants were above 30 years, 142 (56.4%) were males, 109 (43.3%) were gainfully employed, 163 (64.7%) were married and 150 (59.5%) were below poverty line (Table 1).

**Table 1: Epidemiological profile of tuberculosis patients visiting dots centre (n=252).**

Variables	Frequency	(%)
<b>Age group (years)</b>		
<30	142	56.4
$\geq 30$	110	43.6
<b>Sex</b>		
Male	141	56.0
Female	111	44.0
<b>Occupation</b>		
Unemployed	143	56.7
Gainfully employed	109	43.3
<b>Marital status</b>		
Married	163	64.7
Unmarried	89	35.3
<b>Socio-economic status</b>		
Bpl	150	59.5
APL	102	40.5

BPL=below poverty line; APL=above poverty line.

### Disease profile of study participants

About two-thirds of the study participants were pulmonary TB patients (61%,  $n=154$ ), 103 (40.9%) were clinically diagnosed, 203 (80.6%) were new cases, 88 (59.1%) were sputum positive and a majority of participants (96.4%) had anti-tubercular treatment (ATT) sensitive TB (Table 2).

In this study, the prevalence of diabetics and pre-diabetics was found to be 7% and 1% respectively.

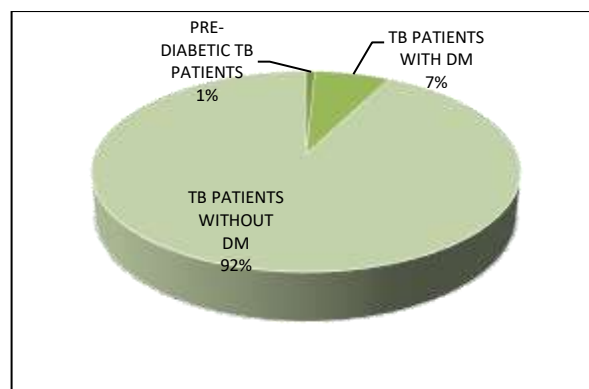
### Association of diabetes status with various variables

A significantly higher percentage of TB patients with age more than 30 years were found to have diabetes compared to those with age less than 30 years ( $p < 0.05$ ).

**Table 2: Disease profile of patients visiting dots centre (n=252).**

Variable	Frequency (%)
<b>Site of disease</b>	
Pulmonary	154 (61.0)
Extra-pulmonary	98 (39.0)
<b>Case definition</b>	
Clinically diagnosed	103 (40.9)
Microbiologically	149 (59.1)
<b>Diagnosed</b>	
<b>Type of patient</b>	
New	203 (80.6)
Retreatment	49 (19.4)
<b>HIV status</b>	
Non-reactive	250 (99.2)
Reactive	2 (0.8)
<b>Sensitivity to ATT drugs</b>	
Sensitive	243 (96.4)
Resistant	9 (3.6)

ATT=anti-tubercular drugs.



**Figure 1: Prevalence of diabetics and pre-diabetics among tb patients.**

Diabetes was more prevalent among married TB patients compared to unmarried ones and this difference was statistically significant ( $p < 0.05$ ). A significantly higher proportion of study participants having pulmonary TB were diabetic as compared to those with extra-pulmonary TB.

**Table 3: Factors associated with diabetes mellitus among TB patients.**

Variables	TB patients with diabetes	TB patients without diabetes	Total	P value
<b>Age group (years)</b>				
<30	0	142 (100.0)	142	0.000*
≥30	19 (17.3)	91 (82.7)	110	
<b>Sex</b>				
Male	12 (8.5)	129 (91.5)	141	0.676
Female	7 (6.3)	104 (93.7)	111	
<b>Occupation</b>				
Unemployed	10 (7.0)	133 (93.0)	143	0.892
Gainfully employed	9 (8.3)	100 (91.7)	109	
<b>Marital status</b>				
Married	19 (11.7)	144 (88.3)	163	0.000*#
Unmarried	0	89 (100)	89	
<b>Socio-economic status</b>				
BPL	14 (9.3)	136 (90.7)	150	0.230#
APL	5 (4.9)	97 (95.1)	102	
<b>Site of disease</b>				
Extra-pulmonary	1 (1.0)	97(99.0)	98	0.001*#
<b>Case definition</b>				
Clinically diagnosed	4 (3.9)	99 (96.1)	103	0.089#
Microbiologically diagnosed	15 (10.1)	134 (89.9)	149	
<b>Sputum</b>				
Positive	10 (16.4)	51 (83.6)	61	0.050*#
Negative	5 (5.7)	83 (94.3)	88	
<b>Type of patient</b>				
New	13 (6.4)	190 (93.6)	203	0.276
Retreatment	6 (12.2)	43 (87.8)	49	
<b>HIV status</b>				
Nonreactive	19 (7.6)	231 (92.4)	250	1.000#
Reactive	0	2 (100.0)	2	
<b>Sensitivity to ATT</b>				

Continued.

Variables	TB patients with diabetes	TB patients without diabetes	Total	P value
Sensitive	19 (7.8)	224 (92.2)	243	1.000#
Resistant	0	9 (100)	9	

A higher percentage of patients with positive sputum had diabetes as compared to those with negative sputum and the difference between them is statistically significant ( $p < 0.05$ ). No association was found between gender, occupation, socio-economic status, case definition of TB, type of TB patient, HIV status, sensitivity to ATT drugs and the diabetic status of TB patients ( $p > 0.05$ ).

## DISCUSSION

In our study, the prevalence of diabetics among TB was found to be 8%. This was similar to the other studies conducted by Nagar et al, Sembiah et al, Siddiqui et al where the prevalence of diabetics in TB patients was 11.9%, 12.4%, 15.8% respectively.<sup>9-11</sup>

The prevalence of diabetes was found to be more in males and in those who belonged to the older age group as compared to their counterparts. This may be because diabetes occurred predominantly in the older age group.<sup>12</sup> This was similar to other studies conducted in different parts of India.<sup>10,13</sup> The higher prevalence of diabetes among older TB patients could partly be explained due to progressive decline in glucose tolerance with age.<sup>14</sup>

In most parts of the world, diabetes was more prevalent in men than in women, especially in middle-aged populations. In line with this, considering almost all animal models, males were more likely to develop obesity, insulin resistance and hyperglycemia than females in response to nutritional challenges.<sup>15</sup> Furthermore the higher cases of DM among men might be an effect of risk factors of both DM and TB such as smoking, tobacco and alcohol consumption which were more common among men compared to women.

In the current study, participants who were married were more likely to have diabetes as supported by another study.<sup>11</sup> The reason could be that TB-DM patients belonged predominantly to the older age group and people tend to get married with increasing age. Lifestyle factors and dietary habits associated with marital status may also affect the risk for the development of diabetes. Other studies have found that the association of marital status with diabetes varies with the gender with unmarried men and married women being at higher risk of diabetes compared to their counterparts.<sup>16</sup>

Diabetes was reported to be more in those study participants with pulmonary TB than extra-pulmonary TB. The finding was comparable to the studies conducted by Viswanathan et al in Tamil Nadu and Das et al in Odisha.<sup>17,18</sup> This was because of the hyper-reactive cell-mediated immune response to *Mycobacterium*

*tuberculosis* (MTB) in DM patients that may be suboptimal for containing MTB growth within the lung, but effective for preventing its dissemination and reactivation elsewhere.<sup>19</sup>

The current study had demonstrated a higher association of diabetes in sputum-positive TB. Likewise, findings were reported in a study conducted by Das et al and Agarwal et al.<sup>18,20</sup> TB-DM patients were more likely to present with cavitary TB, particularly with poor glycemic control, which was in accordance with their robust cell-mediated immunity to MTB antigens. When they enlarge and undergo central caseation, they rupture and spill thousands of viable bacilli into the airways thus leading to sputum positivity.<sup>21</sup> We observed a higher proportion of TB patients with non-reactive HIV status which was similar to the findings of a study by Khanna et al and Prakash et al.<sup>13,22</sup> Siddiqui et al and Khanna et al reported new cases of TB suffering from TB with diabetes as compared to retreatment cases.<sup>11,13</sup> This was consistent with the results of our study. This could be because a large proportion of people with both TB and DM remained undiagnosed for a long time or are diagnosed too late.<sup>5</sup> Some studies have shown that the prevalence of diabetes may be overestimated in TB patients because TB causes transient hyperglycemia. Ideally, glucose screening for DM diagnosis may be more appropriate after TB treatment has taken effect.<sup>17</sup>

### Strengths and limitations

To the best of our knowledge, this study was amongst the few of them to be conducted in a UPHC in South Delhi. Furthermore, other factors apart from socio-demographic variables were taken into consideration.

This study had few limitations as it was a record-based study. Missing information cannot be ruled out. It may not be representative of the wider population. Furthermore, the incidence of the disease can't be calculated.

### Implications

In this study, the prevalence of diabetics and pre-diabetics was found to be 7% and 1% respectively. It was higher in patients more than 30 years of age, male gender, pulmonary TB and sputum positive TB.

Tuberculosis and Diabetes mellitus are both public health problems of India. Early diagnosis of pre-diabetes can help with primary prevention. The status of co-morbid conditions would guide the clinicians in deciding the appropriate treatment regimens and comprehensive

management of at-risk individuals. An early treatment, if initiated, would help in further deterioration of both conditions.

## CONCLUSION

Those patients with age more than 30 years, pulmonary TB, sputum positive TB are the factors with statistically significant association with diabetes in our study.

## Recommendations

Hence there is a need to provide counseling and behavior change communication to these special groups to manage diabetes along with TB.

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