Original Article

Screening for diabetes among tuberculosis patients registered under revised national tuberculosis control program, Bhopal, India

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Abstract

Context: Tuberculosis (TB) and diabetes mellitus (DM) remain a global public health problem. India has the largest number of TB cases; in 2015, out of total global annual incidence of 9.6 million TB cases, 2.2 million were estimated from India. There are 62.4 million people with type 2 diabetes and 77 million people with prediabetes in India, and these numbers are projected to increase to 101 million by the year 2030. Diabetes and TB affect each other at many levels. Screening for diabetes in patients with TB will not only help in early case detection but also better management of both comorbidities. **Aims:** (i) To determine the prevalence of diabetes and prediabetes among diagnosed cases of TB registered under RNTCP in Bhopal district. (ii) To determine additional yield of previously unknown DM and the number needed to screen (NNS) to find out a new case of DM. (iii) To find out the factors associated with diabetes among patients diagnosed with TB registered under RNTCP in Bhopal district. **Settings and Design:** This study was a cross-sectional study conducted on registered patients with TB under RNTCP in two TB units of Bhopal district. **Materials and Methods:** Participants were contacted and interview was conducted after obtaining consent using predesigned and pretested performa during the period of 1st October 2014 to 30th March 2015 for a period of 6 months. **Statistical Analysis Used:** Continuous variable were summarized as frequency, mean, and standard deviation. All variables were analyzed using Chi-square test of significance; $P < 0.05$ was taken as statically significant. **Result:** Of the total 528 patients with TB, 296 was male and 232 were female. Of the total, 63 (11.9%) patients were diagnosed as diabetic. NNS to diagnose a new case of DM was 22.1. Significant association was found with six variables which are age, sex, body mass index, type of TB, category of TB, and smoking. **Conclusion:** This study shows feasibility and importance of screening of patients with TB in existing program settings.

Keywords: Associated factors, diabetes, number needed to screen, tuberculosis

Introduction

Tuberculosis (TB) is one of the major public health problems worldwide and it is a major cause of morbidity and mortality. India has the highest number of TB cases, In 2015, of total global annual incidence of 9.6 million TB cases, 2.2 million were estimated from India in which the prevalence of TB was 195 per lakh and incidence rate was 167 per lakh population.[1]

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The incidence of DM is also increasing worldwide. In 2015, the International Diabetes Federation estimated that about 415 million people worldwide were suffering from diabetes mellitus (DM) and this number is expected to rise to 642 million by 2040.[2]

In India, there are almost 62.4 million people with type 2 diabetes (T2DM) and 77 million people with prediabetes, and these numbers are projected to increase to 101 million by the year 2030.[3] Nationwide surveillance study of DM had

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found that the prevalence of known T2DM in urban areas was 7.3%.[4]

Available reports suggest that 95% of patients with TB and 70% of patients with DM live in the low- and middle-income countries, especially in South East Asia.[5]

Diabetes accounts for 14.8% (7.1%–23.8%) of pulmonary TB and 20.2% (8.3%–41.9%) of smear-positive TB as per a study conducted in India in 2000. Systematic review of studies conducted at multiple settings showed that screening of patients with TB for DM yielded high prevalence of diabetes ranging from 1.9% to 35%.[6-10]

Diabetes and TB affect each other at many levels, among patients with TB; diabetes may adversely affect TB treatment outcomes. Screening for diabetes in patients with TB can help in early diagnosis and management of diabetes and will lead to better TB treatment outcome.[11,12]

The World Health Organization and International Union against Tuberculosis and Lung Disease in collaboration with National Tuberculosis Control Program emphasize the routine implementation of bidirectional screening of two diseases in primary healthcare settings.[13] However, screening methods, reporting, and monitoring for the two diseases in routine health care settings have not been well determined, and operational research is needed for better information in this field.

This study was conducted to determine the overall prevalence of DM among patients with TB and to assess whether routine screening of patients with TB for DM within a program setting might yield previously undiagnosed diabetes cases offering an opportunity for earlier detection and management of the comorbidity.

Aims

- To determine the prevalence of diabetes and prediabetes among diagnosed cases of TB registered under RNTCP in Bhopal district
- To determine additional yield of previously unknown DM and the number needed to screen (NNS) to find a new case of DM
- To find out the factors associated with diabetes among patients diagnosed with TB registered under RNTCP in Bhopal district.

Materials and Methods

Study settings and design

The basic infrastructures of RNTCP Bhopal district consist of five TB treatment and supervision units, 1 per 5 lakh population. Furthermore, five TUs have 24 operational designated microscopic centers for identification and management of patients with TB. The study was conducted on registered patients with TB under RNTCP in two TB units (TUs) of Bhopal district. This study was a facility-based cross-sectional up study conducted on registered cases of TB in Bhopal equal or above the age of 18 years who gave their consent during the period of 1st October 2014 to 30th March 2015.

Study duration

The study was undertaken from 1st October 2014 to 30th March 2015 for a period of 6 months.

Study subjects and sampling

We include all patients with TB of last quarter of 2014 age 18 years and above with established diagnosis of TB registered in TUs during the study period considered as the targeted population. Further the consent was obtained, and patients with type 1 diabetes and seriously ill patients, such as TB meningitis and septicemia, and pregnant patients were excluded from the study.

Data collection method

This study was a cross-sectional study conducted on registered cases of TB in Bhopal equal or above the age of 18 years who gave their consent. TUs were selected on the basis of convenience sampling. After line listing of all registered patients with TB with the help of TB register, the day of DOTS(Directly observed treatment short-course) therapy was ascertained for all selected patients. Furthermore, participants were contacted and interview was conducted after obtaining consent using predesigned and pretested performa which consisted of sociodemographic profile including age, sex, weight, height, education, occupation economic status, history of any addiction, and assessment of TB status of patients including type of TB, category, and duration of treatment. Both fasting and random blood glucose levels of patients with TB were taken with the help of existing staff of health facility. History of diabetes, family history of diabetes, and treatment history of diabetes were recorded. The participants with already diagnosed DM on treatment were confirmed by their records.

Operational definition

Diabetes and prediabetes

According to the American Diabetes Association:

- Diabetes: fasting blood sugar level ≥126 mg/dL
- Random blood glucose level ≥200 mg/dL in patients with classical symptom of hyperglycemia
- Prediabetes: fasting blood sugar level between 100 and 125 mg/dL.

Statistical analysis used

Data were entered in Microsoft excel 2007 and analyzed using Epi Info™ language en-US version 7.2.1.0. (Atlanta,Georgia, US). Continuous variables were summarized as frequency, mean, and standard deviation. Variables were analyzed using Chi-square test of significance; $P < 0.05$ was taken as statistically significant.

Ethics approval

Ethical approval was received from Institutional Ethical Committee of Gandhi Medical College, Bhopal. Informed consent was obtained from patients before conducting the interview.

Results

A total of 528 patients with TB were interviewed using pretested questionnaire and assessed for their blood glucose level. Of the total 528 patients with TB, 296 were male (mean age 38.25 years) and 232 were female (mean age 34.7 years). Of the total 528 patients with TB, 63 (11.93%) patients were diagnosed as diabetic and 91 (15.3%) were prediabetic.

The overall prevalence of DM among patients with TB disaggregated by age, sex, education status, socioeconomic status, body mass index (BMI), smoking status, type of TB, and treatment category is shown in Table 1. Male patients with TB (14.8%) were found to be significantly more associated with diabetes as compared to female patients (8.1%). Diabetes among patients with TB was reported to be higher among patients with age more than 50 years (24.2%) as compared to patients with age less than 50 years (7.4%), and the difference was statistically significant ($P < 0.0001$). In this study, the prevalence of diabetes among TB was more among upper socioeconomic status patients (11.6%) as compared to middle (10%) and lower (6.3%) socioeconomic status patients though the difference was not significant ($P = 0.44$). Prevalence of diabetes among illiterate patients with TB was more (7.1%) than literate patients

Table 1: Diabetes among tuberculosis patients according to their different variables, Bhopal, Indian, 2014-15

Variables	TB with DM	TB without DM	Total	*P*
Age				
≥50 years	34 (24.2)	106 (75.7)	140	0.0001
<50 years	29 (7.4)	359 (92.5)	388	
Sex				
Male	44 (14.8)	252 (85.1)	296	0.02
Female	19 (8.1)	213 (91.8)	232	
BMI				
≥25	29 (19.0)	123 (80.9)	152	0.002
<25	34 (9.04)	342 (90.9)	376	
Smoking				
Yes	28 (16.3)	143 (83.6)	171	0.04
No	35 (9.8)	322 (90.1)	357	
Education status				
Literate	57 (12.6)	395 (87.3)	452	0.32
Illiterate	6 (7.8)	70 (92.1)	76	
Socioeconomic status				
Upper	12 (11.6)	91 (88.3)	103	0.44
Middle	48 (10)	330 (69.3)	478	
Lower	3 (6.3)	44 (93.6)	47	
Alcohol				
Yes	13 (12.6)	90 (87.3)	103	0.94
No	50 (11.7)	375 (88.2)	425	
Treatment category of TB				
II	22 (18.3)	98 (81.6)	120	0.02
I	41 (10.04)	367 (89.9)	408	
Type of TB				
Pulmonary	58 (14.4)	343 (85.5)	401	0.002
Extra pulmonary	5 (3.9)	122 (96)	127	

Table 2: Additional yields of new cases of DM and NNS to diagnose a new case of DM among TB patients in Bhopal, India 2014-15

Variables	Total TB Patients (n1)	Newly diagnosed DM patients(n2)	Previously Diagnosed DM patients (n3)	Additional yield= n2/(n2 + n3) × 100	NNS= n1-n3/n2
Age					
>50 years	140	14	20	41.1	8.5
<50 years	388	08	21	27.5	45.8
Sex					
Male	296	14	30	31.8	19
Female	232	08	11	42.1	27.6
BMI					
>25	152	12	17	41.3	11.2
<25	376	10	24	29.4	35.2
Smoking					
Yes	171	10	18	35.7	15.3
No	357	12	23	34.2	27.8
Treatment category of TB					
II	120	09	13	40.9	11.8
I	408	13	28	31.7	29.2
Type of TB					
Pulmonary	401	21	37	36.2	17.3
Extra pulmonary	127	01	04	20	123
Total	528	22	41	34.9%	22.1

with TB (12.6%) though the difference was not statistically significant ($P = 0.78$). Patients with TB having BMI more than 25 were found to be having significantly more prevalence of diabetes (19%) as compared to patients with BMI less than 25 (9.04%). The prevalence of diabetes in smoker patients with TB is high (16.3%) as compared to nonsmokers (9.8%) and the difference was statistically significant ($P < 0.001$). In alcoholic patients with TB the prevalence of diabetes is high (12.6%) as compared to nonalcoholic patients (11.7%), but the difference was not significant ($P = 0.94$). Of 63 patients with DM, 44 (8.3%) had history of previous diagnosis of DM and 19 (3.59%) were newly diagnosed.

Of the total patients with TB, pulmonary patients with TB (14.4%) had more prevalence of diabetes as compared to extrapulmonary TB (3.9%) and the difference was statistically significant ($P = 0.002$). In this study, 18.3% type II treatment category patients with TB had diabetes as compared to 10.04% of type I treatment category patients with TB and the difference was found to be statistically significant ($P < 0.02$).

Of the 528 patients with TB, 63 (11.3%) were found to have DM, of whom 44 (4.1%) were newly diagnosed cases. The additional yield and NNS for different variable are shown in Table 2.

The additional yield of DM cases on screening was 34.9%. The NNS to detect one new case of DM was 22. Among patients age 50 years or less, the NNS was 45.8, and among those age (>50) years the NNS was 8.5 [Table 2]. The NNS to diagnose one male patient with DM was 19 compared to 27.6 for females. The additional yield of screening among pulmonary patients with TB for DM was 36.2% and 20% for extrapulmonary patients with TB. However, the NNS to diagnose one DM case among pulmonary patients with TB was 17.3 compared to 123 among extrapulmonary patients with TB. NNS among BMI >25 was 11.2 and among patients having BMI <25 was 35.2. Among smoker patients with TB, NNS was 15.3, and in nonsmoker patients with TB it was 27.8. Among the category I patients with TB, the NNS was 29.2 compared to 11.8 among previously treated TB cases.

Discussion

In this study, we found a high prevalence of DM among patients with TB (11.9%) treated in Bhopal. It was higher among those with age >50 years, male gender, smokers, patients having high BMI range (>25), type II treatment category, and those with pulmonary TB as compared to age <50 years, female gander, nonsmokers, BMI range <25, type I treatment category, and extrapulmonary TB.

In this study, the prevalence of diabetes among patients with TB was 11.9% and that of prediabetes was 15.3%. Similar results were reported in earlier studies by Singla *et al.*,[14] Raghuraman *et al.*,[15] Khanna *et al.*,[16] Kumar,[17] Balakrishnan *et al.*,[8] and Zhang *et al.*,[18] with 25%, 29%, 14.5%, 13%, and 44% 9.5%, prevalence of diabetes among patients with TB. This study found a significantly higher prevalence of DM in older patients with TB (age >50 years). Similar findings have been reported by earlier studies.[19-22] This study also reported higher association of DM and PTB, which is also reported in many studies including those by Zhang *et al.*[18] and Guptan and Shah.[21] This study has reported significantly higher prevalence of DM among male gender, which is supported by that reported in a study conducted in south India.[23]

The result of this study shows that diabetes among alcoholic patients with TB is more as compares to nonalcoholic patients, and the difference was not significant. Similar result seen earlier studies[24,25] shows that alcohol consumption was found to be a risk factor for diabetes in patients with TB.

This study shows that diabetes was more common among patients with TB with BMI more 25 (19.0%) as compared to those with BMI <25 (9.04%) and the difference was statistically significant ($P = 0.001$). Similar result was seen earlier by Raghuraman et al.[15] In this study, we found that diabetes among TB was significantly more among type II category patients with TB as compared to type I treatment category TB. The finding of this study was supported by earlier studies.[25,26]

In this study, we found that smoker patients with TB have significantly more diabetes (16.3%) as compared to nonsmoker patients with TB (9.8%) ($P = 0.0001$). Similar result was found in earlier studies.[9,27]

The NNS to detect a new case of DM among patients with TB was 22. This number varies among studies from south India and this may be due to higher prevalence of DM. We found that NNS needed to detect one case of DM among patients with TB decreases as age increases.[8,28]

Conclusion

This study shows the importance of early screening of patients with TB which will enable us to manage these patients in the early phase. Diagnosis of prediabetes at early phase is necessary so that primary prevention methods may be initiated timely. As there is higher burden of both TB and DM in our country, we need better information and monitoring system to guide us in managing this comorbidity in our existing health services.

The strength of this study is that we implement this screening program in routine program settings. We also emphasis on the NNS to diagnose a new case of DM with respect to different variables so we can focus on the lower value of NNS for screening on large scale. There were a few limitations such as previous documentation of blood sugar not cross checked. The mean time for sugar testing and disease duration was not the same for each patient with TB.

The study has several policy implications as the results of current study emphasize that National Tuberculosis Control Program in collaboration with NCD program should have special provision for screening of DM among patients with TB.

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Conflicts of interest

There are no conflicts of interest.

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