Original Article

Pulmonary Tuberculosis and Associated Factors among Diabetic Patients Attending Health Care at Debre Tabor General Hospital, Northwest Ethiopia

Tesfaye Andualem[1*], Ephrem Malede[2]

Abstract

Introduction: Tuberculosis (TB) is a chronic infectious disease. It is a major cause of morbidity, and mortality in developing countries such as Ethiopia. The burden of TB on Diabetes mellitus (DM), which is one of the most common non-communicable public health problems, is one of the contributing factors for severities of DM. There is no clear scientific data on prevalence of pulmonary tuberculosis (PTB) among DM patients at Debre Tabor, Ethiopia. The aim of this study was to determine the prevalence and associated factors of smear positive PTB among DM patients who had follow up at Debre Tabor General Hospital, Northwest Ethiopia.

Methods: Hospital-based cross-sectional study was conducted from March 2019 to May 2019. Simple random sampling technique was used to recruit a total of 258 study subjects. Spot-morning-spot sputum specimens were collected and examined for acid-fast bacilli using direct microscopy by Ziehl-Nelson staining technique. SPSS software version 20 was used for data analysis. Descriptive and logistic analyses were performed. P-value ≤ 0.05 were considered as statically significant. Results were interpreted contextually.

Results: From the total study subjects, 55.8% were males, and 54.2% were females. Close to two-fifth (or 37.6%) of the study participants were between the age of 36–45 years. Most (i.e., 64.3%) of the respondents were urban dwellers. The prevalence of smear positive PTB among DM patients was 2.71%. Patients with DM for less than 5 years showed lower odds of developing PTB (AOR: 0.028; 95% CI: 0.031–0.817) compared with patients with DM for more than 10 years.

Conclusion: In the present study, the prevalence of smear-positive TB was 2.71%, prevalence lower than the national average. Duration of patients with DM was more associated with the prevalence of TB. DM patients should be screened for *Mycobacterium tuberculosis* (MTB). Pulmonary Tuberculosis and Associated Factors among Diabetic Patients Attending Health Care at Debre Tabor General Hospital, Northwest Ethiopia. [*Ethiop. J. Health Dev.* 2021; 35(2):141-145]

Keywords: Pulmonary tuberculosis, Diabetes mellitus, Prevalence, Risk factors, Debre Tabor General Hospital

Introduction

Diabetics and Tuberculosis are the major public health problems worldwide (1)**.** Although the world introduced widely adopted implementation programs to control TB, the disease has remained as a major public health problem in the globe (2, 3). TB is a chronic infectious disease caused by *Mycobacterium tuberculosis* (MTB) complex, which mainly affects lungs, and which is one of the most common risk factors for severity of DM (1, 4). According to the World Health Organization (WHO) (2019), TB globally affected an estimated 10 million people(5), and caused 1.4 million deaths(5). In Africa, approximately 2.48 million cases were reported. Ethiopia is one of the top 30 high burden countries in the world(5). In Ethiopia, WHO (2019) estimated that 112,000 cases developed TB. The estimated annual incidence rate was 157 cases per 1000 persons and the mortality rate was 125 per 100,000 people for the period 2000–2019 (5).

Similarly, the non-communicable DM is also one of the major sources of morbidity and mortality problems in the world. DM is a chronic metabolic disorder associated with high sugar content or glucose levels resulting from defects in insulin secretion (Type 1), insulin action (Type 2), or both (6). WHO reported that in 2016, there were 415 million cases and 1.2 million deaths due to DM(7). A systematic review done in 2017 showed that the prevalence of TB among DM patients in the world ranged from 0.38% to 14%; whereas, the prevalence of DM among TB patients ranged from 1.9% to 45%. (8)

According to studies (9-11), Diabetics, Human Immune Deficiency Virus (HIV/AIDS), smoking cigarette, malnutrition and extreme young age, immunosuppressive drugs, alcohol consumption, history of TB, and place of residence were among the commonly identified risk factors for development of TB mostly in low- and middle-income countries. Comorbidity of DM and TB is increasing alarmingly. Systematic reviews on the comorbidity of DM and TB showed an association between the development of TB and DM. According to studies, there was a causal relationship between DM and TB, an individual who had a history of DM was a risk factor for the development of TB (8, 11). Another systematic review indicated that individuals who had DM were more likely associated with increases the risk of failure and death in combined, relapse, and death among TB patients(12). Both TB and DM are the causes for impaired innate and acquired immunity (13).

PTB is a life-threating chronic and communicable disease among DM patients. Studies found that TB treatment for DM patients reduced the burden of their comorbidity and mortality. (14). However, there is no

[1]Department of Medical Laboratory Science, College of Health Sciences, Debre Tabor University, Email: tesfayeandu@gmail.com, P.O.Box 272, Ethiopia.

[2]Unit of Microbiology, Debre Tabor General Hospital, Debre Tabor, E-mail: ephremmalede21@gmail.com, Ethiopia

study on prevalence of PTB among DM patients in Debre Tabor, Ethiopia. Therefore, the study aimed to determine the prevalence and associated factors of smear positive PTB among DM patients in Debre Tabor General Hospital, Northwest Ethiopia.

Methods

Study design, period, and area:

Hospital-based cross-sectional study was conducted from March to May 2019 to assess the prevalence and associated factors of PTB among DM patients in Debre Tabor General Hospital, Ethiopia. Debre Tabor is the administrative centre of South Gondar Administration Zone of Amhara regional state. It is located around 97km from East of the regional town Bahir Dar, and about 665km to the Northwest of Addis Ababa. It has a latitude and longitude of 11.85 and 38.01667, and an altitude of 2692m above sea level. The population of the town is estimated at 55, 157, of whom 27,430 are males and 27,727 are females.

Sampling technique

The study participants were selected using a single proportion formula ($n= n_0/ (1+n_0/N)$). p= the proportion of PTB among DM, assuming consistency of value taken from a study done at Dessie referral hospital Ethiopia, which is 6.2%(10), and margin of error taken as 5%. n_0=249. Since the source population (DM who visited DTGH) was 2,189 (< 10,000), reduction formula was used $n= n_0/ (1+n_0/N)$. n=224. The final sample size was 258 after adding 15% non-response rate. All DM patients that were attending treatment at Debre Tabor General Hospital during the study period were the source of population. DM patients selected by using simple random sampling technique method among those who visited Debre Tabor General Hospital in the study period were the study population. Detection of MTB was performed by Ziehl-Nelson staining technique with the aid of physical examinations and chest x-ray. (15).

DM patients who were on follow-up at Debre Tabor General Hospital and who fulfilled the eligibility criteria were included in the study, and DM patients who were severely ill, those who were not willing to participate, who had hearing and mental problems, and those who could not provide appropriate information were excluded.

Operational definition:

Body Mass Index (BMI): It is derived from the body mass divided by the square of height of body.

Duration of DM: refers to the time length a patient lived the condition, such that when patients lived with DM for less than 5 years, it was consider as shorter duration; when they lived with the disease for 5–10 years, it was taken as medium duration; and when they lived with DM for more than 10 years, it was considered longer duration.

Pulmonary tuberculosis (P TB): Refers to TB involving the lung parenchyma that is diagnosed clinically and confirmed by bacteriological examination.

Data collection and laboratory methods

The socio-demographic characteristics of the study participants were collected using organised questionnaires by direct interview of the patient. The questionnaire consisted of open-ended and closed-ended questions. The questionnaires were prepared in English and translated into Amharic (local language) to make the questions understandable by the participants. Appropriate amounts of spot- morning-spot sputum samples were collected from DM patients who were suspected for PTB, using clear, dry, leak-proof sample container. Patients were instructed to collect a concentrated sample to increase the chance of a positive result. Microscopic diagnosis of sputum was performed based on the National TB Diagnosis Guidelines. All laboratory investigations were done in adherence to accepted standard procedures. The collected sputum samples were smeared and stained with the Ziehl-Neelsen staining method. To look for acid fast bacilli (AFB), the stained smears were examined by a light microscope under the oil immersion 100 objective lenses , and result interpretations were done according to Ethiopian National TB Guidelines(15). Fasting blood glucose level was measured according to manufacturer's manual, and BCG vaccination statuses were measured by observing and asking the study participants.

Data management and quality control

Close The data collection process was supervised to ensure good quality of data. Data were collected, processed, and analysed according to the Guidelines(15).

Data analysis and interpretation

We checked the completeness of the data. It was entered and analysed by using the Statistical Package for Social Sciences (SPSS) Version 20 statistical software. Descriptive variables were presented in frequency and percentages. Chi square and logistic regressions were used for testing the associations of risk factors and significance. We considered confidence interval at 95% and p-value $\leq$ 0.05 as statically significant.

Ethical considerations

Ethical approval was obtained from the Ethics Review Committee of the College of Health Sciences, Debre Tabor University (Ref. No.: CHS/224/2011) and permission was obtained from Debre Tabor General Hospital (DTH). Verbal consent was obtained from each study participant, and the confidentiality of the study participants was maintained.

Results

Socio-demographic characteristics of study participants: Two hundred fifty-eight known DM patients participated in the present study. Of the study participants, 55.8% were males, and 54.2% were females. Study participants' age ranged 16–71 years old with mean age of 44.26, and standard deviation (SD) = 12.75). Among the study participants, 37.6% were between the age groups of 36–45. Most of the participants (91.5%) were Orthodox, 7.0% were Muslim, and 1.16% were Protestant. The majority

(64.3%) of the respondents were urban dwellers, and 37.7% were rural dwellers. About two-thirds of the study participants (66.3%) were married, 26.7% were single, 5.0% were divorced, 1.9% were widowed respectively (Table1.)

Table 1. **Socio-demographic characteristics of diabetic patients in Debre Tabor General Hospital, Northwest Ethiopia, 2019**

		Pulmonary TB status		
		Smear Positive	Non-smear positive	
Variables	Total (%)	Total (%)	Total (%)	p -value
Sex				
Male	144(55.8%)	5(3.5)	139(96.5)	
Female	114(44.2%)	2(1.7)	112(98.3)	
Total	258	7(2.71)	251(97.3)	0.48
Age				
≤35	68(26.4%)	0	68(100)	
36-45	97(37.6)	2(2.1)	95(97.9)	
46-55	45(17.4%)	3(6.7)	42(93.3)	
≥55	48(18.6%)	2(4.2)	46(95.8)	0.104
Religion				
Orthodox	236(91.5%)	6(2.5)	230(97.5)	
Muslim	18(7.0%)	1(5.6)	17(94.4)	
Protestant	4(1.6%)	0	4(100)	0.715
Residence				
Urban	166(64.3%)	4(2.4)	162(97.6)	
Rural	92(35.7%)	3(3.3)	89(96.7)	0.687
Marital status				
Single	69(26.7%)	2(0.8%)	67(26%)	
Married	171(66.3%)	5(2.9)	166(97.1)	
Divorced	13(5.0%)	0	13(100)	
Widowed	5(1.9%)	0	5(100)	0.795
Educational status				
unable to read and write	88(34.1%)	1(1.1)	87(98.9)	
primary school	69(26.7%)	2(2.9)	67(97.1)	
secondary school	34(13.2%)	2(5.9)	32(94.1)	
college and above	67(26.0%)	2(3)	65(97)	0.56
Occupational status				
Government employed	82(31.8%)	3(3.7)	79(96.3)	
private employed	14(5.4%)	0	14(100)	0.46
Farmer	55(21.3%)	1(1.8)	54(98.2)	
Merchant	41(15.9)	2(4.9)	39(95.1)	
Daily labour	20(7.8%)	1(5)	19(95)	
Other	46(17.8%)	0	46(100)	

Prevalence of Pulmonary tuberculosis among DM patients: With the aid of physical examinations and chest x-ray, MTB was detected by Ziehl-Nelson staining technique. Out of 258 DM patients suspected for PTB, 2.71% were smear positive. Of the smear positive cases, 1.94% were males, and 0.78% were females (Table1).

Anthropometric and clinical characteristics of the study participants: Of the 258 study participants,

14.1% had smoking habit, 36.8% had alcohol drinking habits. Majority of the study participants (85.7%) had no contact history of TB whereas 14.3% had a history of TB. Close to 30% had a blood glucose level of between 169 - 220 mg/dl. Among the study participants, 66.3% had body mass index (BMI) between 18.5–24.99, about 26.7 had ≥25, and 7.0% had < 18.5.

Risk factors associated with pulmonary tuberculosis: Bivariate and multivariable logistic regression was used to identify the possible risk factors. The multivariable analysis showed that duration of DM was found to be statically associated with PTB infection in DM patients at a 95% confidence interval. Participants that had short duration had less PTB infection than those who had long-duration (AOR: 0.16; 95%; CI: 0.031– 0.817) (Table 2).

Table 2. **Factors Associated with Pulmonary TB among DM patients in Debre Tabor General Hospital, Northwest Ethiopia, 2019 (n=258)**

Variables	PTB infections		COR (95% CI)	AOR (95% CI)	p-value
	Positive	Negative			
Age					
≤35	0	68	1.028(0.969-1.090)	1.0697(0.939-1.099)	0.697
36-45	2	95	2.065(0.28-15.13)	3.25(0.30-35.09)	3.3
46-55	3	42	0.61(0.09-3,82)	0.55(0.06-4.84)	0.59
≥55	2	46	1.00	1.00	
Blood glucose level					
≤168	1	70	0.545(0.258-1.151)	0.496(0.160-1.536)	0.224
169-220	1	76	5.07(0.51-50.18)	3.32(0.26-42.27)	0.35
221-288	2	60	2.00(0.32-12.47)	2.56(0.27-24.22)	0.41
>288	3	45	1.00	1.00	
Duration of DM					
<5	1	114	.250(0.080-.786)	0.160(0.031-.817)	0.028
5_10	3	113	4.71(0.89-24.76)	6.15(0.79-47.52)	0.08
>10	3	24	1.00	1.00	
Contact history of TB					
Yes	3	34	0.209(0045-.974)	1.61(0.146-17.744)	0.699
No	4	217	1.00	1.00	
BCG vaccine					
Yes	1	9	.223(0.024-2.053)	0.168(0.003-9.219)	0.383
No	6	142	1.00	1.00	

Discussion

The present study confirmed that TB is a substantial problem among DM patients. The study had shown that the prevalence of PTB in DM was 2.71% at 95% CI. The prevalence was lower than the prevalence observed in a systematic review of TB and DM comorbidity in 2018 in the globe 4.1% (8), Africa 5.6% (8), and Ethiopia 6.2% (8). It was comparable with studies done in South Africa (3.0 %,) (16), and Debre Markos, Ethiopia (3.7%) (17); but it was lower than studies done in India (5%) (18), Iran (6%) (19), Hawassa (5.3 %.) (20), and Dessie (6.2%)(21). These variations may be due to differences in the diagnostic methods they used, sample size, and population.

In the present study, the frequency of positive PTB cases was higher in males (3.4%) than in females (1.75%) from the total sample, and 71.4% of the PTB DM patients were males. However, the association of sex with active PTB was not statistically significant in the present study. The finding in this study was consistent with a study done in Pakistan (22), Dessie, Ethiopia (21). This could be due to women might have been less likely to follow up public health clinics; however, they may be presented with cough.

Studies conducted in Dessie (10) identified age and residence as risk factors for the development of PTB where rural residents were more likely to be affected than urban dwellers. In the present study, however, age and place of residence were not risk variables for PTB. This difference might be due to geographical location variations.

In most studies (23, 24), smoking and contact history of the patients had been associated with PTB. In contrast with these studies, the present study showed smoking cigarette and contact history of TB hadn't been associated with the risk of developing PTB. Similarly, a study done in Dessie showed smoking was not associated with PTB(21). This may be due to the difference of awareness towards TB transmissions. The duration of DM had been statistically associated with the risk of developing PTB. The present study strengthens those patients who had DM for more than ten years had a higher proportion of PTB than those who had shorter durations. This finding was supported by study done in Dessie Ethiopia (21).

Conclusion

The prevalence of smear-positive TB among DM patients was low compared with results of other studies. The comorbidity of both diseases is a risk for increased global spreading and complications of TB and diabetics control programs. The burden of TB among DM patients was more likely associated with duration of DM. Appropriate strategies for prevention and targeted diagnosis are needed to control TB in the study area and to minimise the complications of DM.

Competing interest

The authors declare that there is no competing interest.

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