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Review Article

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Magnitude and Factors Associated With Tuberculosis Among Diabetic Patients At Selected Public Health Facilities in Jigjiga City, Somali Region, Eastern Ethiopia

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ABSTRACT

Background: Chronic diseases particularly diabetes mellitus have long been recognized that it substantially contributes to the burden of tuberculosis worldwide. People with diabetes have more than three times higher risk of developing active tuberculosis than people without diabetes. However, the prevalence of tuberculosis among diabetic patients in Somali region of Ethiopia is not well known as to our knowledge.

Objective: To assess the magnitude and factors associated with tuberculosis among diabetic patients at selected public health facilities in Jigjiga city, eastern Ethiopia.

Method: A facility-based cross-sectional study was carried out in selected public health facilities of Jigjiga city. Data were retrospectively retrieved from records of diabetic patients aged ≥18 years who received treatment between January 2017 and January 2021. Information was abstracted using checklists, entered into Epi-data 3.1, and exported to SPSS version 20.0 for analysis. Descriptive statistics summarized key variables, while multivariable logistic regression identified independent predictors of tuberculosis among diabetic patients. Results were reported as adjusted odds ratios with 95% confidence intervals, using a p-value < 0.05 to determine statistical significance.

Results: The prevalence of tuberculosis among diabetic patients was 21% (95% CI: 17.3%–25%). Independent predictors of TB included low body mass index (<18.5 kg/m²) (AOR = 24.6; 95% CI: 5.44–111.5), history of TB treatment (AOR = 15.3; 95% CI: 2.65–88.0), and close contact with TB patients (AOR = 9.44; 95% CI: 3.04–29.2). Among these, low BMI emerged as the strongest predictor of TB in diabetic patients.

Conclusion: One-fifth of adult diabetic patients in the study had active tuberculosis. Low body mass index, previous history of TB, and close contact with TB patients were identified as significant predictors.

Keywords: Tuberculosis, Diabetic Patient, Associated Factors, Jig jiga, Ethiopia

Abbreviations

AOR	:	Adjusted Odds Ratio
BMI	:	Body Mass Index
CI	:	Confidence Interval
DM	:	Diabetes Mellitus
Epi Data	:	Epidemiological Data Entry Software
FBS	:	Fasting Blood Sugar
HIV/AIDS	:	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IDDF	:	International Diabetes Federation
IDDM	:	Insulin Dependent Diabetes Mellitus

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NIDDM	:	Non-Insulin Dependent Diabetes Mellitus
NGOs	:	Non-Governmental Organizations
RR	:	Risk Ratio
SD	:	Standard Deviation
SPSS	:	Statistical Package for the Social Sciences
TB	:	Tuberculosis
WHO	:	World Health Organization

Introduction

Background

Tuberculosis (TB) is a major global health threat and one of the leading causes of death from infectious diseases, surpassing HIV/AIDS before the COVID-19 pandemic. The pandemic disrupted TB diagnosis and reporting, with newly reported cases declining from 7.1 million in 2019 to 5.8 million in 2020-far below the estimated 10 million global cases. High-burden countries such as India, Indonesia, and the Philippines accounted for 93% of this decline. Africa bears about one-quarter of the world's TB burden, with incidence rates more than double the global average. Ethiopia ranks eighth among the 22 high TB burden countries, with an estimated incidence of 210 per 100,000 population [1-3].

Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia due to impaired insulin secretion or action. Its prevalence is rising globally, particularly in low- and middle-income countries, with 425 million adults affected in 2017 and projections reaching 629 million by 2045. Africa currently has 15.9 million adults with DM, with the highest proportion of undiagnosed cases and an anticipated 156% increase by 2045. In Ethiopia, the adult DM prevalence is 4.36%, with 34,262 diabetes-related deaths among 20-79-year-olds in 2013 [4-7].

DM significantly increases susceptibility to TB, with diabetic individuals 2-3 times more likely to develop active TB than non-diabetics [7,8]. Coexisting DM and TB worsen outcomes, with higher mortality, relapse, and delayed sputum conversion [9-11]. Mechanisms include impaired cell-mediated immunity, pulmonary microangiopathy, renal dysfunction, vitamin deficiencies, and uncontrolled hyperglycemia [12]. Approximately 15% of global TB cases are estimated to be associated with diabetes [13].

Patterns of TB differ by DM type: insulin-dependent diabetes mellitus (IDDM) patients have a higher relative risk of active TB than non-insulin-dependent DM (NIDDM) patients [14]. Risk factors include age >35 years, low or high BMI, smoking, alcohol use, malnutrition, family history of TB, close contact with TB patients, intravenous drug use, and HIV/AIDS [15,16].

Despite the growing dual burden of TB and DM, evidence from Ethiopia, particularly the Somali region, is limited. This study aims to determine the prevalence of TB and identify associated risk factors among diabetic patients in selected public health facilities in Jigjiga city, Ethiopia.

Objectives

General Objective

- To assess the magnitude and factors associated with tuberculosis among diabetic patients at selected public health facilities in Jigjiga city in eastern Ethiopia, 2022.

Specific Objectives

- To determine the magnitude of tuberculosis among diabetic patients at selected public health facilities in Jigjiga city, Ethiopia.
- To identify factors affecting tuberculosis among diabetic patients at selected public health facilities in Jigjiga, Ethiopia.

Study Methods and material

Study Area and Period

Jigjiga, the capital of the Somali Regional State, is located 626 km east of Addis Ababa. The city has an estimated population of 257,613 and comprises 30 Kebeles, of which 20 are urban and 10 are rural, encompassing approximately 17,001 households. The study was conducted at selected public health facilities in Jigjiga town, which includes one referral hospital, one general hospital, two primary hospitals, 14 health posts, and three health centers. Among these, Karamardha Primary Hospital and the referral hospital provide TB treatment and diabetes services for both Type I and Type II patients, including follow-up and new case management. The study period spanned from January 2017 to January 2021.

Study design

A cross-sectional study was conducted to assess the magnitude and factors associated with tuberculosis among adults diabetic patients.

Source and Study Population

The source population consisted of all diabetic patients who received treatment at public health facilities in Jigjiga between 2017 and 2021. The study population included diabetic patients aged 18 years and above who were registered for diabetes care at the selected public health facilities from January 2017 to January 2021.

Inclusion criteria and Exclusion criteria

All diabetic patients aged 18 years and above who received treatment at selected public health facilities in Jigjiga city between 2017 and 2021 were included in the study. However, gestational diabetic patients and those with incomplete or unavailable medical records were excluded.

Sample size determination

Since this study was based on medical record review, all available records of diabetic patients during the study period were considered. A total of 1,010 records were reviewed, of which 404 met the inclusion criteria. Among these, 59.4% were type II diabetic patients, 38.6% were type I, and 2% had unrecorded diabetes type (Figure 1).

Data Collection Tools and Procedures

Data collection tools were developed by reviewing existing medical records, previous studies, and relevant checklists. Four B.Sc. nurses and two midwives served as data collectors, supported by two health officers as supervisors. All data collectors received one day of training on extracting pertinent information from patient records, completing the checklist, and maintaining confidentiality. Discussions with facilitators and supervisors were held to address challenges during data collection. Data quality was further ensured throughout coding, cleaning, computer entry, and analysis.

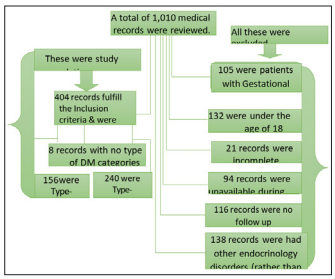

Figure 1: Diagram Shows the Diabetic Patients at Selected Public Health Facilities in Jigjiga City, Ethiopia from January 2017 to January 2021.

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Variables

Dependent Variable: Tuberculosis (Yes/No).

Independent Variables

- Socio-demographic variables such as age, sex, and place of residence.
- Past history of tuberculosis, and close contact with tuberculosis patients
- Family history of diabetes mellitus
- Type of tuberculosis (Pulmonary, extra-pulmonary, new relapse)
- Duration of diabetes mellitus
- Body mass index(BMI)
- History of smoking and alcohol consumption
- Types of anti-diabetic medication used by the patient

Data Quality Control

To ensure data quality, a checklist was developed in simple and clear language, incorporating all study variables. Data collectors received one day of training prior to collection. The checklist was pretested in another health facility on 5% of diabetic patient records, and adjustments were made accordingly. Supervisors closely monitored the data collection process, checked completeness on-site, and addressed errors immediately. The principal investigator also rechecked completeness. During data entry, data were reviewed for consistency and cleaned by running simple frequency checks. Inconsistencies were resolved by cross-checking with the original hard copy checklist. Data analysis commenced only after the cleaning process was completed.

Operational Definitions

Cases of tuberculosis: A diabetic patient diagnosed with tuberculosis by a clinician, either through clinical evaluation or bacteriological confirmation.

Data Processing and Analysis

Data were extracted from medical records, checked for completeness, coded, and cleaned before entry into EpiData version 3.1, then exported to SPSS version 20 for analysis. Descriptive statistics (frequencies, proportions, means, medians, and standard deviations) were computed. Continuous variables such as age, BMI, duration of diabetes, and fasting blood sugar were categorized for analysis. Logistic regression was used to assess factors associated with tuberculosis among diabetic patients. Variables with $p < 0.05$ in the bivariate analysis were included in the multivariable model. Associations were reported using adjusted odds ratios (AORs) with 95% confidence intervals, and statistical significance was set at $p < 0.05$. Multicollinearity was checked using the variance inflation factor, and model fitness was assessed with the Hosmer–Lemeshow test.

Plan for Dissemination and Utilization of Results

The findings of the study was disseminated to Jigjiga university school of graduate studies, school of public health department of epidemiology, relevant organizations and bodies who can make use of the study, including selected public health facilities, Somali regional health bureau and relevant NGOs. Finally I will try to publish in national and international health journals.

Result

Socio-Demographic Characteristics of Diabetic Patients

A total of 404 diabetic patients were included in the study. The mean age was 46.9 ± 15.4 years. Most participants were men (65.1%), aged above 36 years (72%), and urban residents (79.0%). (See table 1).

Table 1: Socio-Demographic Characteristics of DM Patient with and without TB at Selected Public Health Facilities in Jigjiga city 2022.

Variables	Category	Frequency	Percent (%)
Sex	Male	263	65.1
	Female	141	34.9
Age	<=35	113	28.0
	36 – 50	129	31.9
	51 – 65	107	26.5
	>=66	55	13.6
Place of residence	Rural	85	21.0
	Urban	319	79.0

Behavioral Characteristics of the Diabetic Patients

Among the 404 participants, 96 (23.8%) had a history of smoking, 29 (7.2%) reported alcohol use, and 10 (2.5%) had a history of both smoking and alcohol use (Table 2).

Table 2: Behavioral Characteristics of the Diabetic Patients at Selected Public Health Facilities in Jigjiga City, 2022.

	Category	Frequency	Percent (%)
History of smoking	No	299	74.0
	Yes	96	23.8
	Not recorded	9	2.2

History of alcohol use	No	365	90.3
	Yes	29	7.2
	Not recorded	10	2.5
History of smoking and alcohol use	No	381	94.3
	Yes	10	2.5
	Not recorded	13	3.2

Clinical Characteristics Associated with TB Outcomes

Among the participants, 183 (45.3%) had a family history of diabetes mellitus. The majority, 240 (59.4%), had non-insulin-dependent diabetes mellitus. Regarding disease duration, 182 (45%) had diabetes for less than five years, while 183 (45.3%) had it for 6–10 years. Most participants, 252 (62.4%), had a normal body mass index, and 231 (57.2%) were receiving oral hypoglycemic agents only (Table 3).

Table 3: Clinical Characteristics of the Diabetic Patients at Selected Public Health Facilities in Jigjiga city, 2022.

Variables	Category	Frequency	Percent (%)
Family history of DM	No	216	53.5
	Yes	183	45.3
	Not recorded	5	1.2
Type of DM	type one	156	38.6
	Type two	240	59.4
	Not recorded 8	8	2.0
DM Medication	OHA only	231	57.2
	Insulin only	163	40.3
	Not recorded	10	2.5
BMI	<18.5	109	27.0
	18.5 - 24.9	252	62.4
	>25.0	43	10.6
Duration of DM	≤ 5	182	45.0
	6 – 10	183	45.3
	>10	39	9.7
Renal failure	No	380	94.1
	Yes	18	4.5
	Not recorded	6	1.5
Cancer	No	378	93.6
	Yes	21	5.2
	Not recorded	5	1.2
Chemotherapy	No	14	3.5
	Yes	9	2.2
	Not recorded	3	.7
Sero-status for HIV	Positive	22	5.4
	Negative	379	93.8
	Not known	3	.7
History of TB treatment	No	358	88.6
	Yes	33	8.2
	Not recorded	13	3.2
Close contact with TB patient	No	269	66.6
	Yes	125	30.9
	Not recorded	10	2.5

Magnitude of Tuberculosis Among Diabetic Patients

Out of 404 diabetic patients 21% (95%CI; 17.3%-25%) of patients developed tuberculosis, among these pulmonary TB accounts for 14.9%, extra-pulmonary TB for 5.0%, and the remaining 1.2% were disseminated TB cases (see Figure 2).

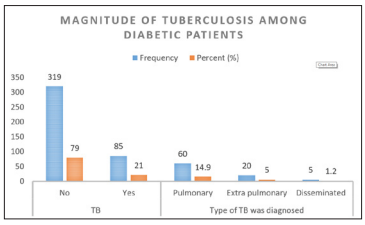

Figure 2: The magnitude of TB Among Diabetic Patients at Selected Public Health Facilities in jigjiga city, 2022.

Factors Associated with TB Among DM Patients

The relationship between tuberculosis and independent variables was first assessed using bivariate logistic regression. Factors with $p < 0.05$—BMI, family history of diabetes, history of TB treatment, type of diabetes, and close contact with TB patients—were considered for multivariable analysis. In the multivariable model, BMI, history of TB treatment, type of diabetes, and close contact with TB patients remained statistically significant ($p < 0.05$).

Diabetic patients with a BMI <18.5 kg/m² were 25 times more likely to have TB compared to those with BMI >25 kg/m² (AOR = 24.6; 95% CI: 5.44–111.5). Patients with a history of TB treatment had 13.1 times higher odds of developing TB than those without such history (AOR = 13.1; 95% CI: 2.75–62.45). Type II diabetic patients were significantly less likely to develop TB compared to type I patients (AOR = 0.015; 95% CI: 0.002–0.087). Additionally, patients with close contact to TB cases had 12.4 times higher odds of developing TB compared to those without such contact (AOR = 12.4; 95% CI: 4.44–34.7) (table 4).

Table 4: Bivariate and Multivariable Analysis for the Risk Factors of TB Among Diabetic Patients at Selected Public Health Facilities in Jigjiga City, 2022.

Variables	DM patient with TB		COR (95% CI)	AOR (95% CI)	P-value
	No	Yes			
BMI					
<18.5	41	68	8.53(3.47 – 20.9)	24.6(5.44-111.5)	**0.000**
18.5 - 24.9	242	10	0.213 (0.076–0.594)	0.71(0.76-0.168)	
>25.0	36	7	1	1	
Family history of DM					
No	179	37	1	1	

Yes	135	48	1.72(1.06–2.79)	0.95(0.35-2.54)	**0.920**
History of TB treatment					
No	295	63	1	1	
Yes	12	21	8.19(3.83–17.5)	13.1(2.75-62.4)	**0.001**
Type of DM					
Type one	73	83	1	1	
Type two	238	2	0.007(0.002 – 0.031)	0.015(0.002 - 0.087)	**0.000**
Close contact with TB patient					
No	251	18	1	1	
Yes	58	67	16.1(8.89 – 29.1)	12.4(4.44-34.7)	**0.000**

Discussion

Diabetes mellitus (DM) increases susceptibility to active tuberculosis (TB), yet evidence from Ethiopia, especially the Somali region, is scarce. This study found a 21% prevalence of TB among diabetic patients (95% CI: 17.3%–25%), far higher than the 0.2% prevalence in the general population [17], but comparable to reports from China (3.7%) and India (2.6%) [15]. Differences with South Africa (10.6%) and Dessie, Ethiopia (6.2%) likely reflect diagnostic methods and population selection.

Older age was associated with increased TB risk, with most cases among patients aged 36–50 years, consistent with prior studies [18,19]. Type II DM was protective (AOR = 0.02, 95% CI: 0.004–0.114), likely due to later disease onset and fewer immunological complications [20-22]. Low BMI (<18.5 kg/m²) strongly predicted TB (AOR = 24.6; 95% CI: 5.44–111.5), confirming previous findings linking malnutrition to TB susceptibility [23-25]. Additionally, prior TB treatment (AOR = 13.1; 95% CI: 2.75–62.45) and close contact with TB cases (AOR = 12.4; 95% CI: 4.44–34.7) were significant predictors, highlighting high-risk patient groups.

Strengths and Limitations

Data collection by trained professionals and well-maintained records ensured accuracy and completeness. As the first study of its kind in this setting, it provides valuable baseline evidence for interventions. However, the cross-sectional design limits causal inference, preventing determination of temporal relationships between risk factors and TB development [26,27].

Conclusion

The magnitude of TB among DM in this study was 21%. The finding of this study also identifies, BMI less 18.5kg/m2, History of TB treatment, close contact with TB patient and type of DM was predictors of TB [28,29].

Recommendations

Routine TB screening for diabetic patients should be implemented in all health facilities, with clear national guidelines provided by the Ministry of Health. Health workers should screen patients at diagnosis and ensure regular follow-up, prioritizing early detection and care for high-risk individuals. Patients should be informed about TB symptoms and encouraged to seek timely care. Further large-scale and qualitative studies are needed to explore additional risk factors and improve TB prevention among diabetic populations.

Author contributions

AAM1*2 conceptualized, designed, and drafted the manuscript. AAM1*2, AAM1, MAA3 and FBI4 performed article searching, data extraction, and quality assessment. AAM1 and AAM1*2 conducted data analysis and wrote the manuscript. MAA3 and FBI4 reviewed the final manuscript. All authors read, reviewed, and approved the final manuscript.

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Availability of data and materials

All relevant data are available from the First author upon request.

Ethical approval and consent to participate

Ethical clearance was obtained from Jigjiga University of, College of medicine and health sciences. Then, written permission was obtained from Somali regional health bureau, Jigjiga city administration and also heads of the selected public hospitals and health centers were communicated through formal letter from city administration in addition to personal communication by the investigator and Answers to any questions was completely confidential.The information collected from the medical record was used only for the research purpose and was kept confidential.

Competing interests

The authors have declared that they do not have any competing interests

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