Prevalence of Diabetes Mellitus Among Tuberculosis Patients at Selected TB Centers in Mogadishu-Somalia

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Abstract: *Introduction*: Diabetes mellitus was excessive life threat to those effected which can lead to death. Due to the quickly increasing number of cases diabetes worldwide, in recent years, the association between Diabetes and tuberculosis and its consequence to public health is interesting renewed and exhaustive attention. Diabetes is estimated to tripartite the risk of active tuberculosis cases. A prospective cross sectional study *was performed to* prevalence of mellitus among tuberculosis patients at selected Tb centers in Mogadishu Somalia. *Methods*: *a* prospective cross sectional study design, from 1st July 2021 to 30th August 2021, The study site was selected TB centers including Banadir, Manhal, Sacid, and Forlilin TB centers, in Mogadishu- Somalia, a sample of 180 TB patients were selected, using systematic random sampling technique, from four main referral public TB centers in Somalia, Data Collection Procedure. The study used both primary (structured questionnaire, anthropometric measurement, and fasting blood glucose test, data statistical analyzer software called statistical package for social science (SPSS) version 24, To control possible confounders, assess factors significantly associated with diabetes and variables associated with $p < 0.05$ in the Bivariate analysis were entered into the logistic analysis model. Statistical associations were asserted based on 95% CI and two-sided 5% level of significance ($\alpha < 0.05$). *Results*: *a total of 24 out 180 patients were diabetes comorbidity with tuberculosis, prevalence of 13.3%, according* the mean age was 44.5 years with a standard deviation (SD) of 4.7. The findings clearly show that age four (≥61 years) {OR 4.036, 95% CI (1.74, 12.7), gender {OR 6.786, 95% CI (4.4, 19.16) (P-vale < 0.05) family history of diabetes (OR 9.2, 95% CI: (2.23, 37.98) $p < 0.05$ were found to have a significant association with diabetes mellitus. Conclusion: this study found that about most of the DM patients in this study were diagnosed for the first time during this study. Therefore, the concerned body should give attention to implementing diabetes screening and comprehensive chronic care at TB clinics as it might have a beneficial impact on TB control and management of diabetes mellitus.

Keywords: Prevalence, Diabetes Mellitus, Tuberculosis, Mogadishu Somalia

1. Introduction

Diabetes mellitus is defined as to a group of common metabolic disorders that have the common indication of increased blood sugar level. The ancient Egyptians identified the disease around 1500 BC, while the Greeks used the term "diabetes" to describe individuals who experienced frequent urination with sweet-tasting urine [1]. Tuberculosis (TB) is a persistent bacterial infection caused by Mycobacterium tuberculosis (MTB) and primarily targets the lungs. These microorganisms typically enter the body through inhalation. There are two main types of TB: pulmonary tuberculosis (PTB), which primarily affects the lungs and is the most common form of the disease, and extrapulmonary

tuberculosis (EPTB), where the infection affects organs other than the lungs. TB has the potential to impact any part of the body. [1]. About one-third of the world's population is infected with M. tuberculosis. Majority will develop latent TB, and only approximately 5~10% of them will develop active Tuberculosis cases with approximately 9 million individuals developing tuberculosis each year, When the integrity of the immune system is compromised, as is the case for instance in HIV infection and diabetes, the risk increases significantly [2]. Diabetes is a well-known risk factor for tuberculosis. Prior to the insulin era, Diabetes mellitus was excessive life threat to those effected which can lead to death. Due to the quickly increasing number of cases diabetes worldwide, in recent years, the association between Diabetes and tuberculosis and its consequence to public health is interesting renewed and exhaustive attention. Diabetes is estimated to tripartite the risk of active tuberculosis cases [2].

Tuberculosis is endemic in Somalia and is one of the main reasons of morbidity and mortality. Aside from safety TB in Somalia is mentioned because the best barrier to balance and monetary development. The civil battle brought on an unheard of crumble of the country wide TB Control Programme. The Programme changed into supported in its preliminary ranges with the aid of using FINDA (Finish International Development Agency). Subsequent Somalia is anticipated to have one of the maximum occurrence charges of TB withinside the world. It is anticipated that every year, round 12,000 sputum wonderful instances occur, out of which most effective are detected and acquire remedy in a supervised DOTS Programme. TB may be taken into consideration a primary public fitness hassle in Somalia, affecting the maximum efficient age companies of the community [3].

The prevalence of diabetes has been on a significant rise in Somalia since the 1980s. During that time, the reported prevalence in rural areas was 0.9%. A community survey conducted two decades ago found that the prevalence of diabetes was less than 2% in rural areas and over 5% in urban areas. Among the Asian population, the prevalence was even higher, exceeding 9%. Although there hasn't been a recently conducted prevalence survey, data from the International Diabetes Federation (IDF) in 2015 and the World Health Organization (WHO) in 2016 indicate that the prevalence of diabetes among adults aged 20 to 79 years was 3.5% and 4.3% respectively [3]. The escalating epidemic of diabetes mellitus (DM) in low- and middle-income countries poses a significant threat to tuberculosis (TB) control efforts and has the potential to hinder progress towards achieving the Sustainable Development Goal of ending TB by 2030 [3]. In Somalia, the estimated prevalence of diabetes in 2021 was reported to be 6.5% [4]. Given the high prevalence of both TB and diabetes in Somalia, it is likely that many patients may have comorbidities [3, 4]. However, there is a lack of comprehensive documentation regarding the problem of diabetes in TB patients in Somalia. Although a few localized studies have been conducted, these studies have indicated an increasing issue of diabetes among TB patients. Therefore, the aim of this study is to assess the prevalence of diabetes mellitus among tuberculosis patients at selected TB centers in Mogadishu, Somalia.

2. Methods

Study Design/Site: The study design of this study was a cross sectional study design to determine prevalence of mellitus among tuberculosis patients at selected TB centers in Mogadishu- Somalia, 1stJuly 2021 to 30thAugust 2021, The study site was selected TB centers including Banadir, Manhal, Sacid, and Forlilin TB centers, in Mogadishu- Somalia, a sample of 180 TB patients were selected, using systematic random sampling technique, from four main referral public TB centers in Somalia.

Eligibility Criteria: both pulmonary and extrapulmonary TB cases reported under DOTs {PTB cases confirmed with sputum smear for acid fast bacilli (AFB) and Xrays, and extra pulmonary cases confirmed with spot culture and/or histological evidence}. Those 18 years and above and physically able and willing to participate.

Collection of respondents Data: The study utilized a combination of primary and secondary data collection methods. Primary data was gathered through the use of a structured questionnaire, anthropometric measurements, and fasting blood glucose tests. Secondary data consisted of information on TB patient smear status, TB treatment category, and the type of TB. All patients diagnosed with active tuberculosis (TB) underwent screening for diabetes mellitus (DM) by assessing their medical history, previous records, and measuring fasting blood glucose (FBG) levels. The Prodigy auto code glucometer device was utilized to determine the fasting plasma glucose level. Blood sugar levels were categorized according to the cutoff points set by the American Diabetes Association. The patients were classified into three groups based on their FBG levels: normal (70-99 mg/dL), prediabetes (100-125 mg/dL), and diabetes (≥126 mg/dL). The patients' height and weight were measured using a digital weight scale, and their body mass index (BMI) was calculated. Weight status was determined using the cutoff points established by the World Health Organization. Each patient underwent at least one measurement of blood glucose (FPG). If the FPG level was equal to or greater than 126 mg/dL, a second determination was conducted one week later. Two measurements of height and weight were taken from each participant, and additional measurements were taken if the initial two did not provide the required accuracy.

Data analysis methods: The data collected in the questionnaire were organized into variable lists. These variables were assigned numeric codes and then entered into statistical analysis software called Statistical Package for the Social Sciences (SPSS) version 24. To ensure data integrity and consistency, the frequencies of each variable were examined. Binary logistic regression analysis was conducted to assess the factors associated with diabetes mellitus (DM).

The strength of association between dependent and independent variables was measured using odds ratios with a 95% confidence interval. In order to control for potential confounding factors, variables that showed a significant association with diabetes (p < 0.05) in the univariable analysis, as well as variables associated with p < 0.3, were included in the multivariable logistic analysis model. Statistical associations were determined based on a 95% confidence interval and a significance level of 5% (α < 0.05) for a two-sided test.

Ethical considerations were taken into account, and approval to conduct the study was obtained from the relevant authorities, which included seeking ethical approval. Institutional Research, Ethical Review Committee (IRERC) of Somaville University.

3. Results

Socio-demographic characteristics: Table 1 shows the basic demographic characteristics including sex, age, marital status, Educational level, occupation, and facility or hospital site. The most age of cases 180 TB patients who were diagnosed as 24 patients having Diabetes Mellitus the mean age was 44.5 years with a standard deviation (SD) of 4.7. The findings clearly show that majority of participants who were found diabetes in their age group majority (75.0%) were 61 years and above 70 years, and most of them (79.2%) were female, and 41.7% were widowed. according to Tb center they were present this showed that (50%) half of participants were in SACID TB center, while 20% were Frolini MDR center, and 12% were in Banadir hospital TB center.

***Table 1.** Socio-demographic characteristics of TB patients.*

| | | Diabetic status | | | |
| | | Non Diabetes | | Diabetes | |
		Count	Column N %	Count	Column N %
Age	18-25	56	35.9%	0	0.0%
	26-40	59	37.8%	0	0.0%
	41-60	41	26.3%	6	25.0%
	61-70 above	0	0.0%	18	75.0%
Gender	Male	100	64.1%	5	20.8%
	Female	56	35.9%	19	79.2%
Marital status	Single	70	44.9%	0	0.0%
	Married	86	55.1%	8	33.3%
	Divorced	0	0.0%	6	25.0%
	Widowed	0	0.0%	10	41.7%
Education level	no formal education	53	34.0%	16	66.7%
	Primary	46	29.5%	5	20.8%
	Secondary	50	32.1%	2	8.3%
	University	7	4.5%	1	4.2%
Occupation	Unemployed	80	51.3%	0	0.0%
	self-employed	72	46.2%	0	0.0%
	government/private employed	4	2.6%	19	79.2%
	Student	0	0.0%	5	20.8%
Household average monthly income	less than $50	45	28.8%	0	0.0%
	$50-$100	85	54.5%	0	0.0%
	$100-$200	26	16.7%	15	62.5%
	$200-$300	0	0.0%	9	37.5%
	$300-$400	0	0.0%	0	0.0%
	$400-$500	0	0.0%	0	0.0%
	>$500=	0	0.0%	0	0.0%
Residence	Urban	151	96.8%	18	75.0%
	Rural	5	3.2%	6	25.0%

***Table 2.** Clinical characteristics and lifestyle of TB patients by diabetes mellitus.*

| | | Diabetic status | | | |
| | | Non Diabetes | | Diabetes | |
		Count	Column N %	Count	Column N %
Family history of DM	no=	76	48.7%	22	91.7%
	yes=	80	51.3%	2	8.3%
cigarettes smoking	never smoked=	134	85.9%	0	0.0%
	stopped smoking=	22	14.1%	17	70.8%
	current smoker=	0	0.0%	7	29.2%
type of TB	pulmonary tb=	83	53.2%	21	87.5%
	extra-pulmonary tb=	73	46.8%	3	12.5%
	ptb and eptb =	0	0.0%	0	0.0%
TB treatment group	new case =	82	52.6%	11	45.8%
	relapse patient=	47	30.1%	4	16.7%

| | | Diabetic status | | | |
| | | Non Diabetes | | Diabetes | |
		Count	Column N %	Count	Column N %
Treatment regimen	treatment after faliure patient	6	3.8%	3	12.5%
	treatment after lost of follow up =	10	6.4%	6	25.0%
	drug resistance pateint=	11	7.1%	0	0.0%
	i (stline) =	56	35.9%	12	50.0%
	ii (1stline) retretment =	96	61.5%	4	16.7%
	iii (2ndline drug) =	4	2.6%	8	33.3%
BMI	Normal	80	51.3%	0	0.0%
	under weight	47	30.1%	0	0.0%
	over weight	29	18.6%	14	58.3%
	Above	0	0.0%	10	41.7%

Diabetes and clinical characteristics: Our FPG assessment showed that about 13.3% of patients attending four selected TB Centers in Mogadishu had diabetes mellitus (DM). Interestingly only 5 five of them reported to be aware of having DM and (79.2%) were not known to have diabetes. majority 91.7% haven't family history diabetic individuals reported that they had a family history of diabetes mellitus. family history of diabetes this study demonstrated that majority 91.7% haven't family history, According smoking status this showed that, 29,2% were currently smokers, and according to level physical activities before illness this demonstrated that majority of participants (62.5%) were low intensity or physically inactive.

Risk factors related to Diabetes Mellitus among Tuberculosis Patients. We have piloted a binary regression analysis to spot the factors related with DM among patients on TB treatment. Within the univariable analysis; age, education, occupation, and case history of polygenic disorder had a major statistical association (p< 0.05) with DM. A multivariable direct logistic regression analysis was performed to find out factors considerably related to DM. independent variables that showed significant association at p< 0.05 were entered into the ultimate model (multivariable logistic analysis). The model contained 9 independent variables (sex, age, marital status, occupation, family history, BMI, TB treatment category, and sort of TB). As indicated in Table 3, solely age and case history of polygenic disorder created a singular statistically significant contribution to the model. The age of the patients was a robust predictor of diabetes mellitus, recording odds magnitude relation of four (≥61 years) {OR 4.036, 95% CI (1.74, 12.7). On Pearson correlation coefficient, a major correlation was found between age and DM (r=0.644, p=< 0.05).

Table 3. Factors associated with diabetes mellitus among patients tuberculosis on treatment TB centers in Mogadishu Somalia.

| | | Non Diabetes | Diabetes | | |
		N %	N %	AOR (95% CI)	P-Value
Age	18-25	56 (35.9%)	0 (0.0%)		
	26-40	59	0 (0.0%)		
	41-60	41 (37.8%)	6 (25.0%)	4 (1.74, 12.7)	0.000
	61-70 above	0 (0.0%)	18 (75.0%)	8 (3.2, 22.8)	
Sex	Male	100 (64.1%)	5 (20.8%)		
	Female	56 (35.9%)	19 (79.2%)	6 (4.4, 19.16)	0.000
Family history of DM	no=	76 (48.7%)	22 (91.7%)		
	yes=	80 (51.3%)	2 (8.3%)	9 (2.3, 13.96)	0.000
Type of TB	pulmonary tb=	83 (53.2%)	21 (87.5%)	5 (1.5, 16.5)	0.001
	extra-pulmonary tb=	73 (46.8%)	3 (12.5%)		
	ptb and eptb =	0 (0.0%)	0 (0.0%)		
Treatment regimen	i (stline) =	56 (35.9%)	12 (50.0%)	5 (1.5, 16.5)	0.001
	ii (1stline) retretment =	96 (61.5%)	4 (16.7%)		
	iii (2ndline drug) =	4 (2.6%)	8 (33.3%)	3.90 (1.14, 12.7)	0.000
BMI	Normal	80 (51.3%)	0 (0.0%)		
	under weight	47 (30.1%)	0 (0.0%)		
	over weight	29	14 (58.3%)	6.286 (4.4, 19.16)	0.000
	Obese	0 (18.6%)	10 (41.7%)		

In gender status this study found that most of diabetic patient comorbidity with TB 19 (79.2%) were Female and being female {OR 6.786,95% CI (4.4, 19.16) were associated with an increased risk for diabetes (P-vale < 0.05) significant difference from female and male. TB patients who have a family history of diabetes is (OR 9.2, 95% CI: (2.23, 37.98) significant association at p< 0.05 diabetic compared with people who had no family history. Pearson correlation of BMI and prevalence of diabetes mellitus was found to be moderately positive and statistically significant (r=.626 p <.001). Hence, H1 was supported. This shows that an increase in BMI would lead to a higher chance to develop Diabetes mellitus.

4. Discussion

This observe found out that 13.3% of tuberculosis patients had diabetes mellitus. This finding is in step with research achieved Ethiopia (13.5%) [5], It became decrease than research achieved with the aid of using [6]. In Southern Mexico in TB sufferers & observed 29.63% diabetes incidence amongst 1262 sufferers. [7]. observed the relative ratio of DM & TB about 3.11. They additionally observed random outcomes of cohort research which confirmed that DM become related to an elevated threat of TB. [8] Executed a look at wherein out of 827 TB sufferers, 209 (25.3%) had diabetes [7]. Executed a look at which leads to screening for TB in folks with DM, confirmed that TB incidence on this populace is high, and starting from 1.7% to 36%. According to Baker et al. the worldwide burden of DM is raising; the superiority is envisioned to attain 438 million with the aid of using 2030 in TB sufferers. Our look at indicates the superiority of DM in TB sufferers is 13.3%. This end result indicates a few similarity with the preceding research. But as our pattern wide variety is simplest 180, it's miles difficult to return back to a specific end of incidence of DM in TB sufferers. We are assuming that, maximum of the humans of Somalia are blind to their fitness repute and self-mentioned prognosis is likewise very poor. Our look at observed that (79.2%) of diabetes comorbidity with Tb sufferers had been now no longer regarded to have diabetes, So many humans but don't understand whether or not they've diabetes or now no longer. The huge variety of incidence of DM in different research is probably because of the difference in socio-demographic traits of supply populations with inside the localities studied and screening strategies utilized in DM prognosis. Type II diabetes mellitus and different lifestyle-associated persistent illnesses are extra typical in antique age. In our look at findings, maximum of the DM-high quality people had been extra than or identical to sixty one years of age. When age is elevated, the superiority of DM additionally increases, which become steady with the research achieved in Kenya and Kerala, India [9, 10]. Increasing age is connected to immune suppression and is one of the threat elements for each TB and DM [8]. Diabetes is a sickness which has sturdy clustering in families, and owns circle of relative's records of DM is a threat element for DM [5]. The end result of our look at confirmed this reality; the superiority of DM become better amongst sufferers who've a own circle of relatives records of DM. This finding is supported with the aid of using the shreds of proof from different research carried out in Ethiopia and different growing countries [10]. This reality would possibly advocate the space and necessity of revising the present display and control approach, male or female of diabetes mellitus. [11] Executed a look at and confirmed that incidence of diabetes become notably better in female in comparison to male 15.6% vs 12.0% women. In our look at, 64.1% had been Female having DM & TB and 35.9%% had been Male having DM & TB. Studies have shown that females are more susceptible to developing diabetes due to various factors such as hormonal influences, differences in body fat distribution, and genetic predisposition [12]. The odds ratio (OR) of 6.786 with a 95% confidence interval (CI) of (4.4, 19.16) further supports the significant association between being female and an increased risk of diabetes among TB patients. This end result is much like preceding end result. So it is able to be stated that Female sufferers are at risk of DM & TB incidence.

This finding is consistent with previous studies that have demonstrated a genetic component in the development of diabetes. Individuals with a family history of diabetes are more likely to inherit genetic susceptibility to the disease, leading to a higher risk of developing diabetes themselves [12, 13]. The OR of 9.2 with a 95% CI of (2.23, 37.98) further reinforces the strong association between a family history of diabetes and the risk of developing diabetes among TB patients. This finding corroborates previous research that has consistently identified obesity and higher BMI as significant risk factors for diabetes [14, 15]. The positive correlation indicates that an increase in BMI is associated with an elevated likelihood of developing diabetes among TB patients. This highlights the importance of weight management and healthy lifestyle interventions in reducing the risk of diabetes in this population.

5. Conclusion

In conclusion, this study provides significant insights into the prevalence and risk factors associated with DM among TB patients. These findings contribute to our understanding of the complex interplay between TB and DM and highlight the importance of addressing DM within TB care programs. By identifying at-risk individuals and implementing appropriate preventive measures, healthcare providers can mitigate the impact of DM on TB patients and improve their overall health outcomes.

What Is Already Know on This Topic

1) Prevalence of diabetes mellitus is very in low resource areas.
2) Tuberculosis comorbidity with diabetes mellitus.

What This Study Adds

1) Prevalence of diabetes mellitus in our study area.
2) Pulmonary Tuberculosis, and relapse cases were more prone to develop diabetes mellitus in our study findings.
3) Women whose old age is high prevalent diabetes mellitus.
Include at least 2 points of what your study adds.

Authors' Contributions

MGS and ASH developed the study concept. AIM and MGS collected and collated the data and carried out the statistical analysis. MGS, IGI, and YGS did the literature search and prepared and contributed to the primary

Conflicts Interests

The authors declare no competing interest.

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