

# **ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES**



Prevalence of Diabetes mellitus among active pulmonary tuberculosis patients at St. Peter specialized hospital, Addis Ababa Ethiopia.

**By: Emeshaw Damtew**

**Advisors: Dr. Ibrahim Ali**

**Dr. Daniel Meressa**

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**ADDIS ABABA UNIVERSITY**  
**SCHOOL OF GRADUATE STUDIES**

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By

Emeshaw Damtew

School of Medical Laboratory Sciences, College of Health Sciences,  
Addis Ababa University

Approved by the Examining Board

\_\_\_\_\_  
Chairman, Dep. Graduate Committee

\_\_\_\_\_  
Signature

Dr. Ibrahim Ali

\_\_\_\_\_  
Signature

Dr. Daniel Meressa

Advisors

\_\_\_\_\_  
Signature

Dr. Daniel Seifu: External examiner

\_\_\_\_\_  
Signature

Jigsa Girma: Internal examiner

\_\_\_\_\_  
Signature

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## V. Abbreviations

MTB	Mycobacterium Tuberculosis
TB	Tuberculosis
PTB	Pulmonary Tuberculosis
DM	Diabetes Mellitus
WHO	World Health Organization
IGT	Impaired Glucose Tolerance
OGTT	Oral Glucose Tolerance Test
IDF	International Diabetes Federation
FBG	Fasting Blood Glucose
IFG	Impaired Fasting Glucose
DOTS	Directly Observed Treatment Short course
NCDs	Non Communicable Diseases
HIV	Human Immunodeficiency Virus

## VI. Abstract

**Background:** *The merging epidemics of pulmonary tuberculosis (PTB) and diabetes mellitus (DM) have been raised concerns by many experts but no large scale screening and intervention have been launched yet, especially in low-income countries like Ethiopia. The thought that tuberculosis could cause diabetes seems farfetched, but is not. The peculiar relationship and frequent association of diabetes mellitus and tuberculosis has been observed for more than 2000 years, yet the reason for this correlation is, to this day, not known.*

**Objective:** *the aim of this study was to determine the prevalence of diabetes mellitus among active PTB patients at St.Peter hospital.*

**Methods/design:** *A cross-sectional Hospital based study was carried out and the study included all active pulmonary tuberculosis patients visiting St. Peter specialized hospital until the required sample size was obtained. We included 120 active PTB patients: 67 of these were male and 84 of them were urban dwellers. Analysis of fasting blod glucose was carried out using venous blood samples by enzymatic colorimetric test for glucose (GOD-PAP Method). For testing significance, the categorical data were compared using a chi-square test and expressed as proportion with a 95% confidence interval.*

**Result:** *The prevalence of DM was found to be 15.8% (95% CI:9.20-22.45), which was higher (25.4%) among male than female TB patients(3.8%).Likewise 70% of the patients were from urban and 30% of them were from rural areas. The prevalence of newly diagnosed diabetic cases was 84.2% of all patients tested positive for DM. And all of the patients diagnosed as diabetic were in the age group greater than 25 years of age. The prevalence of IFG was (26.7%) and that of HIV co-infection in the study population was (52.5%). The occurrence of DM in HIV co-infection was a little bit higher (15.9%) than HIV negative TB patients (15.8%). Of all patients with active tuberculosis, 60 (50%) were sputum smear negative. The proportion of DM was (25%) among smear positive and (6.7%) among smear negative patients.*

**Conclusion:** *The prevalence of diabetes mellitus and pre-diabetes (IFG) among active pulmonary tuberculosis cases was higher compared to the published prevalence of DM in Ethiopia. Therefore, it is important to implement a screening program of each TB patient for diabetes and Vis versa.*

**Key words:** *TB/DM, IFG, HIV co-infection*

## 1. Introduction

Diabetes mellitus is a group of metabolic diseases characterized by elevated blood glucose levels (hyperglycemia) resulting from defects in insulin secretion, insulin action or both. Insulin is a hormone manufactured by the  $\beta$ -cells of the pancreas, which is required to utilize glucose from digested food as an energy source [1]. Chronic hyperglycemia is associated with microvascular and macrovascular complications that can lead to visual impairment, blindness, kidney disease, nerve damage, amputations, heart disease, and stroke [2].

The type of diabetes is based on the presumed etiology. Type 1 diabetes occurs in childhood, it is acute, severe, complete absence of insulin secretion, and insulin dependence is permanent. Whereas type 2 occurs in pubertal age, mild-severe; often insidious, insulin secretion is variable, insulin dependence is temporary; may occur later [3]. DM is a metabolic disorder that weakens the immune system. The frequency and enhanced severity of infections in uncontrolled diabetes were well known before and after the discovery of insulin [4].

Tuberculosis (TB) is an infectious disease caused by various strains of mycobacteria, especially *Mycobacterium tuberculosis* and usually attacks the lung.

For several decades, the research community has been working for an effective preventive strategy for TB. Although the current preventive efforts against the spread of TB have lowered its incidence, the problem is far from over. Therefore, the focus of research has now shifted to the previously untargeted risk factors involved in the spread of TB. One such factor is diabetes mellitus (DM). DM impairs the immunity of patients and therefore is an independent risk factor for infections such as TB [5].

As early as in 1694, Richard Morton's *Phthisiologia*, a treatise on consumption, stated that an association between diabetes mellitus and tuberculosis was suggested even in Roman times [6].

Tuberculosis (TB) is associated with HIV, smoking, malnutrition and underlying lung disease, though presently the association between TB and diabetes mellitus (DM) is less familiar. In recent history, clinicians were accustomed to this connection: during the latter half of the nineteenth century, the diabetic patient appeared doomed to die of pulmonary tuberculosis if he/she succeeded in escaping coma [7]. Before the introduction of insulin and indeed for many years thereafter, TB was a major cause of mortality in the diabetic population. In the 21st century, at a time of unprecedented integration and interdependence of economies, environments, societies and cultures, the relationship between these two diseases is once again became significant [8].

The impact of an increasingly globalized world on disease burden goes beyond infections to non-communicable diseases (NCDs), which are rising in prevalence in middle and low income countries due to ageing populations and changing lifestyles and diets. Diabetes exemplifies this process [9]. Therefore, as a plague of the developing world meets a disease of the affluent West, knowledge of the interaction between these two diseases becomes essential for the health of all citizens of this interconnected world.

The thought that tuberculosis could cause diabetes seems farfetched, but it is not. The peculiar relationship and frequent association of diabetes mellitus and tuberculosis has been observed for more than 2000 years, yet the reason for this correlation is, to this day, not known [10]. The association between pulmonary tuberculosis and *Diabetes mellitus* has been known since antiquity. This is date back to 1000 A.D.; when Avicenna noted that ‘phthisis’, (Greek: tuberculosis), often complicated diabetes and that the presence of diabetes resulted in an increased risk of developing TB [11]. Tuberculosis is still seen as a common complication of diabetes, while diabetes is thought to be no more common among TB patients than in the population at large. To Nichol’s, this was “not logically tenable” and in his study of 178 otherwise healthy, non-diabetic military men with tuberculosis at Fitzsimmons Army Hospital, one-third had abnormal glucose screening tests [10]. Even, the comorbidity of TB-DM exceeded that of TB-HIV [12]. These two diseases constitute a combination that should be detected early and controlled quickly. But the early diagnosis of the combination is rare. The symptoms of the complicating disease are masked by the originally existing disease. The prognosis and clinical course of each of the two conditions adversely affects the other [13].

This time the linkage and the merging epidemics of pulmonary tuberculosis (PTB) and diabetes mellitus (DM) have been raised concerns by many experts [14], especially in populations with low socio-economic status and high incidence rates for both diseases. In low to middle income countries, such as in Ethiopia, where there are experiencing incredible increase in DM prevalence and the highest burden of TB in the world, both diseases are major public health problems and the link between the two diseases should be paid special concern [15, 16, & 17].

The relationship between DM and TB is bi-directional. Tuberculosis may lead to the development of new diabetes cases [18]. Studies has shown a high prevalence of diabetes, as well as impaired glucose tolerance, in patients with tuberculosis [19]. Impaired glucose tolerance is a significant risk factor for developing DM. In most of these cases, the impaired glucose tolerance reverts back to normal after successful treatment for TB; however the increased risk of developing DM persists [20]. Glucose tolerance test is a type of test

performed two hours after a meal and those results between 140 and 199mg% are considered to be impaired glucose tolerance [35 & 36].

Active tuberculosis should be a differential diagnosis in patients with enlarged pancreas. TB is a known cause of pancreatitis and tuberculous pancreatitis might reveal itself only after the development of diabetes [21]. Even though a part of the hyperglycemia associated with TB may be attributed to the severe stress associated with the infection itself, however the major factor in this process is hypofunction of the pancreas [19, 20]. On the other hand, it has been shown that testing for DM in previously undiagnosed people before the appropriate treatment for TB may lead to an over-diagnosis of DM; as TB can lead to an infection-related hyperglycemia which may mimic DM [21]. The important cause for the development of glucose intolerance in tuberculosis is active severe stress. Fever protracted inactivity and malnutrition stimulates the stress hormones epinephrine, glucagon, cortisol and growth hormone, which acting synergistically raise the blood sugar level in excess of 200 mg%. Plasma levels of IL-1 and TNF  $\alpha$  are also raised in severe illness which can stimulate the anti-insulin hormones [22].

Serum levels of adrenocortico-tropin hormone, cortisol and T<sub>3</sub> have been found to be decreased in patients with tuberculosis [23]. Clinical and sub-clinical hypoadrenalism have been described frequently in TB patients [24]. These abnormalities make the patient's ability for a stress response doubtful. The endocrine function of pancreas has also been found to be adversely affected in severe tuberculosis, and a higher incidence of chronic calcific pancreatitis occurs in patients with concomitant diabetes and tuberculosis leading to an absolute insulin deficiency state [25]. On the other hand the effect of anti-tuberculosis drug rifampicine is a powerful inducer of the hepatic microsomal enzyme system and frequently interacts with other drugs. Rifampicin induces an early phase hyperglycemia which attributed to augmented intestinal absorption [26]. TB remains a major cause of mortality in developing countries, where the prevalence of DM is increasing rapidly [27]. Therefore, this study aims to assess the prevalence of DM and other TB risk factors such as HIV, smoking, and alcoholism on patients with active pulmonary TB.

## 1.1. Statement of the problem

Formerly the global burden of diabetes mellitus was estimated by the World Health Organization in 1998 [28]. It has been projected that the prevalence of diabetes among adults worldwide will more than double, from 135 million (4%) to 300 million (5.4%), by the year 2025. The major part of this tremendous increase will occur in developing countries, wherein a 170% increase, from 84 million to 228 million was projected [29]. But currently the global burden of diabetes mellitus (DM) is expected to rise from an estimated 180 million prevalent cases to a predicted 366 million by 2030 with the greatest increase projected in the developing world [30]. 2010 IDF report showed that 285 million people live with diabetes mellitus (DM), with type 2 making up about 90% of the cases [31]. In 2013, according to International Diabetes Federation, an estimated 381 million people had diabetes [32]. Its incidence is increasing rapidly, and by 2030, this number is estimated to almost double [33]. The prevalence of diabetes in Ethiopia is estimated to be 2% nationally, evidence suggests that its prevalence could be >5% in those older than 40 years of age in some settings [34].

TB remained to be a major cause of morbidity and mortality throughout the world [35]. It still ranks as the second leading cause of death from an infectious disease worldwide, after the human immunodeficiency virus (HIV). The latest estimates show that there were 8.6 million new TB cases in 2012 and 1.3 million TB deaths (just under 1.0 million among HIV-negative people and 0.3 million HIV-associated TB deaths) [36]. WHO Global TB Report 2011 published 2012 showed Ethiopia had an estimated incidence rate of 261 cases per 100,000 population and 29 thousands deaths in 2010, with an estimated prevalence rate of 394 cases per 100,000 populations [37]. The incidence of TB was reported greatest among impaired immunity, HIV, or diabetes [38].

Despite the availability of effective therapy, PTB continues to infect an estimated one-third of the world's population, to cause disease in 8.8 million people per year, and to kill 1.6 million of those afflicted [18]. .

Ethiopia is a country with about 88 million people and ranks third in Africa and eighth in the list of 22 high burden countries severely affected by tuberculosis (TB) [39].

### **The DM-TB association**

#### **Diabetes increases incidence of TB**

Diabetes is a risk factor for developing active TB. There is strong evidence for this association, with studies examining the incidence of TB showing it to be two to five times higher in diabetic patients than in non-diabetic patients. [40, 41 & 42]. The direct interaction

between TB and DM in sub-Saharan Africa was performed in Tanzania in 1990 and found DM to be at least four times as common in patients with TB compared to the general population (in the TB population, 4% had DM compared to 0.9% in the general population) [23]. The connection between DM and TB has even been reported to be more significant than the well recognized connection between HIV/AIDS and TB. Retrospective analysis of TB control programme data in 5,049 TB patients in South Texas–Mexico border showed self-reported DM co-morbidity substantially exceeded that of HIV/AIDS [43]. A study in São Paulo reported DM as co-morbidity in 16% of TB deaths and HIV infection as co-morbidity in 11% [44].

Experts have raised concerns about the twin epidemics of DM and TB, [45] especially in low to middle income countries like Ethiopia that are experiencing the fastest increase in DM prevalence and have the highest burden of TB in the world [46]. The growing prevalence of diabetes poses a challenge for TB control as uncontrolled diabetes leads to a greater risk of developing TB. A recent study showed that countries that saw an increase in diabetes prevalence also had a significant increase in the number of people with TB [47]. Several studies have looked at the association between diabetes and tuberculosis in developed countries and found that people with diabetes are around 2.5 times more likely to develop tuberculosis [48 & 49]. These findings were also true of developing regions including Africa where the prevalence of diabetes was twice as high in people with tuberculosis than in people without tuberculosis [50]. Eight of the ten countries with the highest incidence of DM worldwide are also classified as high burden countries for TB by the World Health Organization (WHO). As a result, a growing number of patients with TB will present with DM and almost 10%–30% patients with TB may have DM [51]. Thus the link between DM and TB has occupied the center stage of discussion; and therefore, the current study has been undertaken to study the prevalence of diabetes mellitus in active pulmonary tuberculosis patients.

## 1.2. Literature review

A prospective study was conducted on occurrence of diabetes mellitus in PTB patients in India; and of 378, 280 (74.1%) males and 98(25.9 %) females proven cases of pulmonary tuberculosis, 22 of them was found to be diabetic. Among these 20(90.9 %) were males and 2(9.1%) were females. 8 patients (36.4%) were in the age group of 41-50 years, while 12 patients (54.6%) were equally distributed between the age groups of 31-40 years and 51-60 years. On this study Prevalence of Diabetes mellitus in new sputum positive cases of pulmonary tuberculosis was 5.82 %. Since the blood glucose control is the ultimate aim, this study recommended the need of oral hypoglycemic, insulin or combination therapy [15].

Another Meta analysis which was conducted in India showed that among patients with tuberculosis, 16% to 20% were of newly diagnosed cases of diabetes, which is a strikingly high prevalence of diabetes considering that of general population in India [51]. On prospective observational study conducted in the same country India, 8109 TB patients were assessed for DM and 1084 (13%) were found to have DM; of these, 682 (8%) had a previously known diagnosis of DM and 402 (5%) were newly diagnosed. The study group concluded that it is important and feasible to screen patients with TB for DM in the routine setting, resulting in earlier identification of DM in some patients and opportunities for better management of co-morbidity [52]. Another old study in India showed that among 50 established pulmonary tuberculosis cases 20 (40%) was diabetics. Thus, all the patients of diabetes mellitus and pulmonary tuberculosis should invariably be screened for the other condition [53].

Similarly a cross-sectional study conducted in 5 different hospitals of India revealed that of 800 TB patients 25.3% of them had DM; and another 24.5% had prediabetes. Out of 25.3%, 9% were newly detected and 16% were already diagnosed with diabetes. Moreover, the study revealed that men with TB are more likely to have diabetes than women [54]. Another recent prospective observational study from India revealed that among 307 TB patients 19.54% were known cases of diabetes, and 15.96% were newly diagnosed cases of diabetes. The key finding of the study was that nearly half of the TB patients had either diabetes or prediabetic status [55]. A questioner based study from the same country India, Kerala was conducted. And among 552 TB patients screened, 243(44%) had DM – 128(23%) had previously known DM and 115(21%) were newly diagnosed - with higher prevalence among males and those aged 50years. The authors agreed that nearly half of TB patients in Kerala have DM, and approximately half of these patients were newly-diagnosed during the survey period [56].

An article review in Pakistan stated that high prevalence of diabetes, as well as impaired glucose tolerance, in patients with tuberculosis. The prevalence of impaired glucose tolerance test in patients with TB was ranging from 2 to 41% [21].

An article review conducted in Saudi Arabia indicated that both diseases may impact adversely on each other with a resultant poor glycemic control of DM and poor response to anti-TB treatment. Half of the diabetic patients were unaware about DM at the time of the national survey in Saudis; One-third of non-diabetic men with TB had abnormal glucose screening tests and active TB may worsen blood sugar control with increase risk to develop sepsis in diabetic patients [51].

A retrospective cohort study conducted in United States Maryland showed that of 297 confirmed TB patients 42 (14%) were diabetic [57]. Another research performed in United States of America revealed of 178 tuberculous patients 5% had diabetes and a further 22% had an abnormal screening test [58]. Similarly a systematic review conducted at Harvard University USA on Bi-directional screening for tuberculosis and diabetes revealed that Screening for TB in persons with DM demonstrated that TB prevalence in the population was high, ranging from 1.7% to 36%, and Screening patients with TB for DM also yielded high prevalence of DM ranging from 1.9% to 35%. They have been concluded that active screening leads to the detection of more TB and DM with varying yield [59]. A retrospective study in USA South Texas–Mexico border examined 5049 known TB patients for DM. Of these patients they found 27.8% self-reported diabetes by Texans and 17.8% of Mexican. Patients with TB and diabetes were older; thus they suggested that the impact of type 2 diabetes on TB is underappreciated, and in the light of its epidemic status in many countries, it should be actively considered by TB control programmes, particularly in older patients [60]. A probabilistic, multistage, stratified, cluster household survey conducted by the Mexican Secretariat of Health showed that among 581 patients with MTB, 29.6% of them had diabetes. This survey suggested that there should be a need of continuous screening of TB patients for DM. [61]. Another prospective study conducted in Mexico for 15 years revealed that the prevalence of DM among 1262 patients with pulmonary TB was 29.63% (n=374). Patients with DM and pulmonary TB had more severe clinical manifestations, delayed sputum conversion, higher probability of treatment failure, and recurrence. The authors of the study finally concluded that given the growing epidemic of DM worldwide, it is necessary to add DM prevention and control strategies to TB control programmes and vice versa and to evaluate their effectiveness [61].

A prospective observational study conducted in China to assess the burden of both TB and DM indicated that there were 541 TB patients who fulfilled the inclusion criteria; of these 3.3% of patients had a known diagnosis of DM and 3.2% of those tested had a new diagnosis of DM. In this paper it has been suggested that Screening for DM in TB clinics should lead to better and earlier detection of DM, earlier and better treatment of DM (which might have gone unrecognized) and improved clinical outcomes on anti-TB treatment. There was a similar study conducted in Guangzhou, China and there was 1589 patients with TB of whom 189 (12%) had DM [62 & 63].

There has been a cross-sectional study in Japan. Of 644 TB patients 116 were diabetic; and from the same study population those with MDR-TB and having DM were 6.0% [64].

Two recent studies conducted in Africa showed increased prevalence of glucose intolerance. In the Tanzanian study of 506 patients admitted with sputum positive pulmonary tuberculosis, 9 of whom were known diabetics. 11 patients giving a crude diabetes prevalence rate of 4%; and impaired glucose tolerance (IGT) was present in 82 patients (16.2%). Whereas the Nigerian study, done on 54 patients with active pulmonary tuberculosis found that 3 patients had OGTT values in the diabetic range and 20 had IGT [30]. Another similar study in Tanzania found that among 34 TB patients with DM, 73% of DM was newly diagnosed. Also in study from Indonesia in 2007 showed, among 94 TB patients with DM, 61% of DM was newly diagnosed [65].

Another cross-sectional study in Uganda generated a prevalence of DM as 8.5% among 260 confirmed TB patients. Of this Only 5 (1.9%) patients with TB had a known diagnosis of diabetes mellitus at enrolment. Majority of the study participants (90.9%) with TB-DM co-infection had type 2 diabetes mellitus. As a result the authors reached on conclusion that DM is common among hospitalized tuberculosis patients in Uganda [66].

A prospective study done in Gondar University Ethiopia showed that the prevalence of DM was 8.5% among 199 (117 male, 82 females) patients with pulmonary TB and all of them were in age group 25-44 years. The prevalence of DM among the male was 11.1 % and among the female 4.9%. Likewise, 10.2% of the participants were from urban areas, and 6.6% from rural settings. Newly diagnosed DM account for nearly 53% of all patients tested positive for DM. The prevalence of IFG among these patients was 29.6% which was slightly higher in subjects from rural residence (34.1%) compared with those from urban areas (25.9%). The prevalence of IFG among women was 31.7% and 28.2 among men. The authors of this study concluded that it is imperative to have active case detection of DM in patients with TB and active case detection of TB in patients with DM [67].

## **2. Objective of the study**

### **2.1. General objective**

- To assess the prevalence of diabetes mellitus among active pulmonary tuberculosis patients at st. peter specialized hospital Addis Ababa, Ethiopia.

### **2.2. Specific objectives**

- To determine the prevalence of diabetes mellitus among the study population.
- To determine the risk factors of diabetes mellitus in the study population.
- To determine the prevalence of diabetes mellitus among TB patients co-infected with HIV.
- To perform fasting blood glucose from active TB patients.

### **3. Material and methods**

#### **3.1. Study design and area**

A cross-sectional study was conducted at St. Peter specialized hospital which serves as a referral TB hospital in Addis Ababa Ethiopia. The hospital has DOTS (Directly Observed Treatment, Short course) follow up clinic and wards. The hospital provides various services especially in tuberculosis diagnosis and treatment and has a vision to become Center of Excellence for diagnosis and treatment of TB in East Africa. In this study, TB confirmed patients who visited St. Peter specialized hospital during the study period were included.

#### **3.2. Study period**

A cross-sectional study was employed to determine the prevalence of DM among active PTB patients from March 15, 2014 to May 10, 2014.

#### **3.3. Study Subjects**

This cross-sectional hospital-based study was conducted among patients with active pulmonary TB admitted in the wards and from DOTS follow up clinic of age 15 years and above. All eligible subjects with active TB cases during the study period were included until the required sample size (120) was obtained.

##### **3.3.1. Inclusion criteria**

- TB Patients who avail themselves during data collection.
- Who gave informed consent was included.

##### **3.3.2. Exclusion criteria**

- Patients who were unconscious and unable to communicate
- Patients with the age of 14 & below were excluded from the study.

##### **3.3.3. Sampling**

The sample size (120) for the study was determined by taking the prevalence of DM among TB patients from previous study. All consecutive subjects with active pulmonary TB who volunteered to participate and signed a written consent were enrolled. The sample size was estimated using the formula for calculating sample size for cross-sectional study as described below.

$$N = \frac{Z_{\alpha/2}^2 P (100-P)}{d^2}$$

The diagnosis of pulmonary TB was made according to the national guideline using sputum smear microscopy for acid fast bacilli (AFB), clinical presentation, and imaging features.

### **3.3.4. Screening for DM and HIV**

All patients diagnosed as having active pulmonary TB were screened for DM through history, previous medical records, and measurement of fasting blood glucose (FBG) concentrations.

DM was diagnosed if the FBG concentration was  $\geq 126$  mg/dL at 2 different time points; FBG concentrations of 110–125 mg/dl were considered to indicate impaired fasting glucose (IFG), in accordance with the International Diabetes Federation (IDF) criteria [35, 36]. Blood was collected from each subject for fasting blood glucose testing. HIV testing was carried out for all patients with TB according to the hospital routine for provider initiated HIV testing and counseling practice. Prevalence estimations of diabetes were made for all study subjects, and similar prevalence was determined based on HIV status, residence (for urban and rural), age, past history of diabetes, smear status, and sex among TB-DM cases directly from our study data.

## **3.4. Study variables**

### **3.4.1. Dependent variables**

- Proportion of DM patients

### **3.4.2. Independent variable**

- Sociodemographic variables: age, geographical area, occupation, educational status, marital status and sex
- Risk factors like TB, past history of diabetes, drinking alcohol, smoking etc.

## **3.5. Measurement and data collection**

### **3.5.1. Data collection tools**

#### **Administration of standard questioner**

Hospital based cross-sectional study was conducted among smear positive and negative TB patients. Participant's Socio demographic variables and risk factors of DM was carefully collected using pre-tested standard questionnaire to obtain relevant information. The questionnaire was translated to the local language (Amharic) and the data was collected by trained nurses. No personal identifier was included; each individual given a unique code numbers on the questionnaire and laboratory specimens. The data for the study was derived from laboratory results and questionnaires.

### **3.5.2. Specimen collection and Laboratory investigation**

After obtaining informed consent, 5 ml of fasting venous blood was drawn under aseptic conditions from peripheral vein by experienced nurses. The tubes were labeled with unique

identification number and processed at the time of collection. All laboratory investigations were done adhering to accepted standard procedures.

Samples from confirmed TB patients at two different points were collected, allowed to clot, centrifuged at 3000 RPM for 5 minutes at room temperature; the serum was separated, and tested immediately to look for the blood glucose level. The glucose level was determined after enzymatic oxidation in the presence of glucose oxidase by enzymatic colorimetric test for glucose (GOD-PAP Method) and the interpretation of the results by this method is indicated in the annex part under laboratory test procedure. Results with abnormal blood glucose ( $\geq 126$ mg/dl) and those between 110 & 125 were communicated with the hospital clinicians for further evaluation and treatment.

### **3.5.3. Quality control and quality assurance**

The questionnaires was prepared both in English and Amharic, intensive training has been given for data collectors, and Pre- testing of 5% of each questionnaire type was done in the study population. The clarity, understandability and flow of each question and the time to fill the questionnaire were assessed. Daily all the collected data were checked for completeness by the principal investigator.

The performance of the test kits was evaluated using controls and standards obtained from the manufacturers. The laboratory has its own standard operating procedure for quality control and quality assurance of the equipments regularly.

### **3.6. Statistical analysis**

Data was entered into Microsoft Excel sheets and exported the software STATA Version 11 and SPSS version 20.0 for analysis. The data was summarized and organized using graphs, tables and texts. The chi square was used to see the association. Odds ratios (OR) and their 95% confidence intervals (CI) were estimated using bivariate and multivariate logistic regression analysis to identify possible explanatory variables on occurrence of DM. The result at p-value  $\leq 0.05$  was considered as statistically significant.

### **3.7. Ethical considerations**

Before starting the study, ethical clearance was obtained from the ethical review committee of Addis Ababa University College of health Sciences, Department of Medical Laboratory Sciences and St. Peter specialized hospital. Information about the study was given to all TB. Patients and assured about the confidentiality, protection and anonymity of data and are only for research purposes. Written informed consent was obtained from voluntary study participants.

Information obtained at any course of the study was kept confidential. Those participants with blood glucose level  $\geq 126$  mg/dl were referred to physicians for proper management, further investigations and follow-up.

## 4. Results

### **Socio-demographic characteristics of TB patients screened for DM**

Of the total 120 active pulmonary TB cases, 67 (55.8%) were male, and 53(44.2) were female. In terms of residence place, 84 (70.0%) of them were urban dwellers and the rest 36 (30.0%) were from rural settings. The mean age ( $\pm$ SD) of the study group was 37.3 ( $\pm$ 13.3) ranging from 15 to 86 years. The majority of the participants 74(61.7%) were between the age of 25 to 44 followed by 45 to 64 25(20%),  $\leq$ 24 14(11.7%),  $\geq$ 65 7(5.8%). More than half of the respondents 71 (59.2%) were married, whereas 3 (2.5%) were divorced, and 2 (1.7%) of them were widowed. In terms of literacy, 65 (54.2%) of the respondents had no formal education and just completed primary school; and the rest (45.8%) either completed high school or higher education. Regarding occupational status, 86 (71.7%) respondents were self employed, 24 (20%) were government/ private employed, 7 (5.8%) were student, and 3 (2.5%) were unemployed (Table-1).

**Table 1: Socio-demographic characteristics of study participants at St. Peter hospital, 2014 (N=120).**

Characteristics	No (%)
<b>Age</b>	
≤24	14 (11.7)
25-44	74 (61.7)
45-64	25 (20.8)
≥65	7 (5.8)
<b>Sex</b>	
<b>Male</b>	67 (55.8)
<b>Female</b>	53( 44.2)
<b>Residence</b>	
<b>Urban</b>	84 (70.0)
<b>Rural</b>	36 (30.0)
<b>Education</b>	
<b>No formal education</b>	37 (30.8)
<b>Grade 1-6</b>	28 (23.3)
<b>Grade 7-12</b>	43 (35.8)
<b>Diploma &amp; above</b>	12 (10)
<b>Total</b>	
<b>Marital status</b>	
<b>Single</b>	44 (36.7)
<b>Married</b>	71 (59.2)
<b>Widowed</b>	2 (1.7)
<b>Divorced</b>	3 (2.5)
<b>Occupation</b>	
<b>Self employed</b>	86 (71.7)
<b>Gov. / pvt. Employed</b>	24 (20)
<b>Student</b>	7 (5.8)
<b>Unemployed</b>	3 (2.5)

### Risk factors associated with TB patients screened for DM

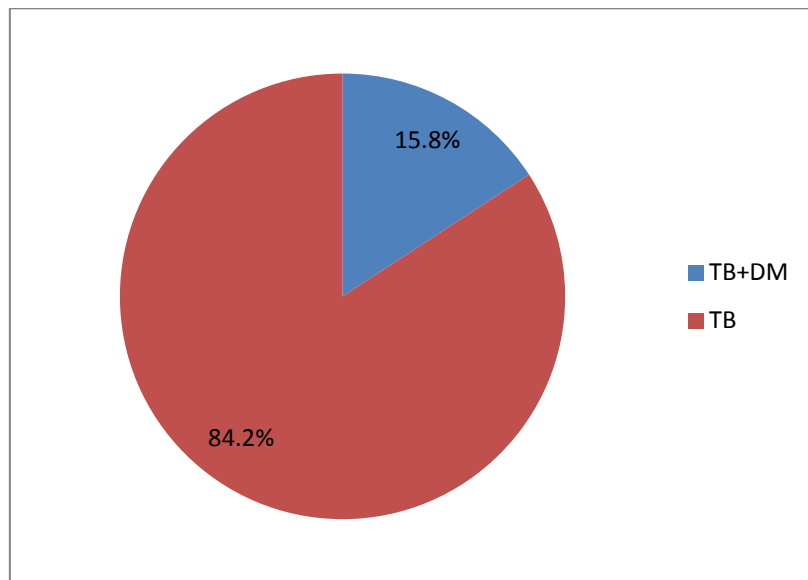
The prevalence of previously known DM and that of having family history of DM among TB patients was 2.5% and all of them were male. Among TB patients having family history of DM 66.7% were diabetic while (33.3%) were non- diabetic (Table-2). From this finding we can see that those with family history of diabetes were more prone to become diabetic; because there is a transfer of genetic makeup from generation to generation.

**Table: 2. Distribution of Health related characteristics of study subjects by sex at St. Peter hospital, 2014 (N=120)**

Characteristics	Total no (%)	Male n (%)	Female n (%)
<b>HIV/AIDS status</b>			
<b>HIV positive</b>	63 (52.5)	31(49.2)	32(50.8)
<b>HIV negative</b>	57 (47.5)	36 (63.2)	21 (36.8)
<b>FBG level</b>			
<b>70-109</b>	67 (55.83)	35 (50.7)	34 (49.3)
<b>110-125</b>	32 (26.7)	14 (43.7)	18 (56.3)
<b>≥126</b>	19 (15.8)	17 (89.5)	2 (10.5)
<b>Smoking</b>			
<b>Yes</b>	18 (15)	16 (88.9)	2 (11.1)
<b>No</b>	102 (85)	51 (50)	51 (50)
<b>Drinking alcohol</b>			
<b>Yes</b>	58 (48.3)	45 (77.6)	13 (22.4)
<b>No</b>	62 (51.7)	22 (35.5)	40 (64.5)
<b>Sputum smear test for AFB</b>			
<b>Positive</b>	60 (50.0)	39(65.0)	21 (35.0)
<b>Negative</b>	60 (50.0)	28 (46.7)	32 (53.3)
<b>History of diabetes</b>			
<b>Yes</b>	3 (2.5)	3 (1.0)	0 (0)
<b>No</b>	117 (97.5)	64 (54.7)	53 (45.3)
<b>Former diabetes status</b>			
<b>Diabetic</b>	3 (2.5)	3 (1.0)	0 (0)
<b>Not diabetic</b>	117 (97.5)	64 (54.7)	53 (45.3)
<b>Habit of physical exercise</b>			
<b>Yes</b>	65 (54.2)	39 (61.5)	26 (38.5)
<b>No</b>	55 (45.8)	28 (50.9)	28 (49.1)

### Prevalence of DM & other characteristics among TB patients

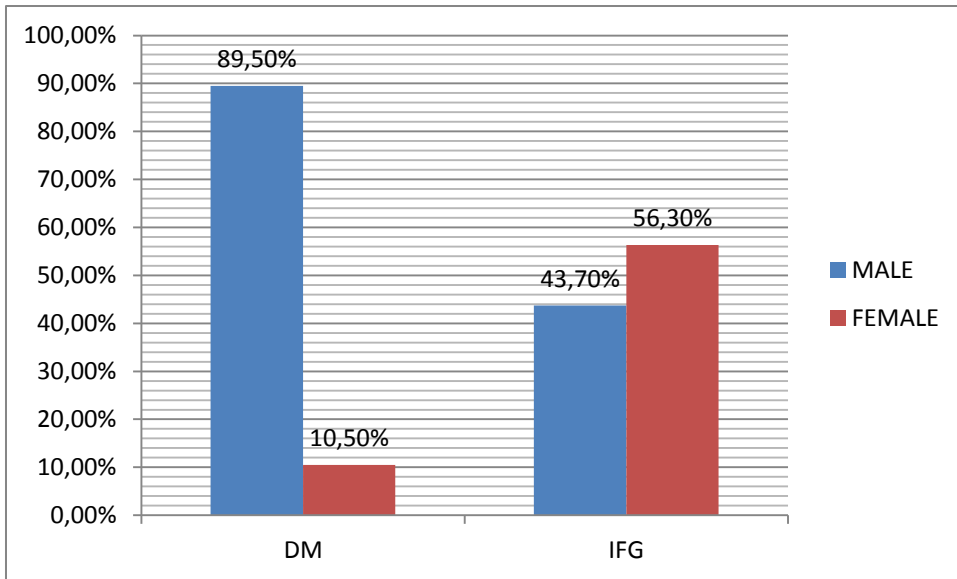
The prevalence of DM was 15.8% [95%CI: 9.20-22.45] among patients with pulmonary TB cases. (fig-1) and all of them were in age group greater than 25years. (Table-1). Newly diagnosed DM account for 84.2% of all patients tested positive for DM.



**Fig 1: Prevalence of DM among the study subjects.**

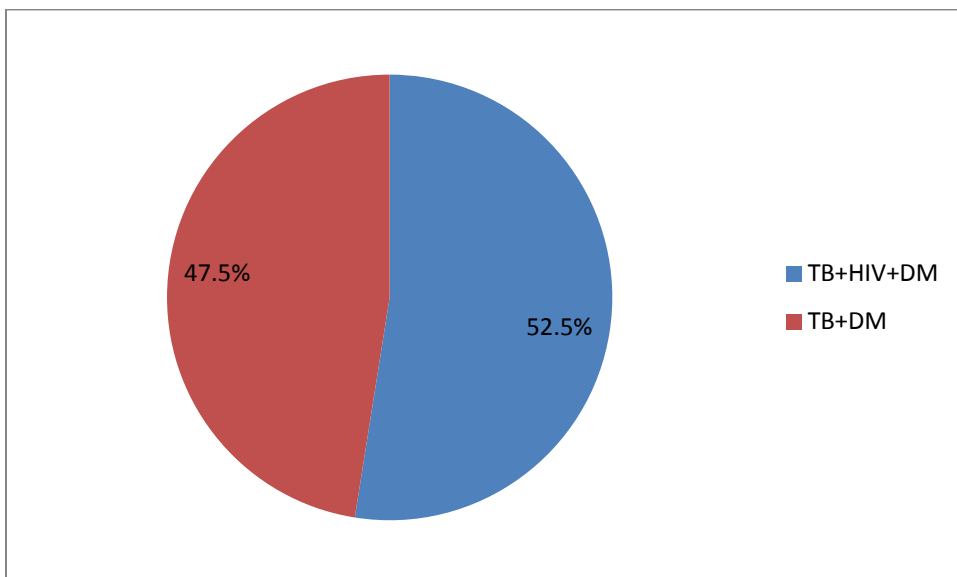
The prevalence of DM among the male was 89.5% and among the female was 10.5 %. (Fig-2). Likewise, 70% of the participants were from urban areas, and 30% from rural settings. DM was higher in urban residents (21.4%) than rural residents (2.8%). Newly diagnosed DM account for 84.2% of all patients tested positive for DM. (Table 3). Of the study subjects, 60 (50.0%) were sputum smear negative for AFB at baseline, and DM was higher in smear positive subjects (25.0%) than smear negative (6.7%) (Table- 4).

The prevalence of IFG among patients with active pulmonary TB was 32 (26.7%); which was higher in subjects from urban residence (68.8%) compared with those from rural areas (31.3%). The Prevalence of IFG was (56.3%) among women and (43.7%) among men. (Table- 2).



**Fig 2: Prevalence of DM and IFG by sex**

HIV co-infection rate among the study population of active pulmonary TB cases was (52.5%). The proportion was (50.8%) in women and (49.2%) in men (table-2). HIV co-infection was higher (74.6%) in subjects from urban areas than in those from rural settings (25.4%). The occurrence of DM in HIV co-infected study subjects was higher (15.9%) than HIV-negative TB patients (15.8%) (Table-4). The proportion of cigarette smokers was (15%) and that of alcohol consumers was (48.3%) (Table-2).



**Fig-3. Prevalence of HIV co-infection rate among the study population**

### Socio demographic characteristics in relation to diabetes mellitus

Bivariate logistic regression was used to identify possible explanatory (independent) variables. As a result, sex (P=0.001) and place of residence (P = 0.010) were significantly associated with the occurrence of DM. On the other hand, age (P=0.232), educational status (P = 0.432), occupational status (P = 0.432), and marital status (P = 0.613), were not significantly associated with the development of DM (Table-3)

**Table: 3. Seroprevalence of diabetes mellitus in relation to socio demographic characteristics and HIV among active tuberculosis study subjects at St. Peter hospital, 2014 (N=120).**

Variables/Characteristics	No (%)	Diabetic cases no (%)	Chi square test value	P-value
<b>Age</b>				
≤24	14 (11.6)	0 (0)	4.2903	0.232
25-44	74 (61.7)	14 (18.9)		
45-64	25 (20.8)	3 (12.0)		
≥65	7 (5.8)	2(28.6)		
<b>Sex</b>				
Male	67 (55.8)	17(25.4)	10.3597	<b>0.001*</b>
Female	53 (44.2)	2 (3.8)		
<b>Education</b>				
No formal educated	37 (30.8)	3 (8.1)	2.7475	0.432
Grade 1-6	28 (23.3)	5 (17.9)		
Grade 7-12	43 (35.8)	8 (18.6)		
Diploma and above	12 (10)	3 (25.0)		
<b>Marital status</b>				
Single	44 (36.7)	9 (20.5)	1.8086	0.613
Married	71 (59.2)	10 (14.1)		
Widowed	2 (1.7)	0 (0.0)		
Divorced	3 (2.5)	0 (0.0)		
<b>Residence</b>				
Urban	84 (70.0)	18 (21.4)	6.5778	<b>0.010*</b>
Rural	36 (30.0)	1 (2.8)		
<b>Occupation</b>				
Self employed	86 (71.7)	12 (13.9)	5.3109	0.150
Gov. / pvt. Employed	24 (20)	7 (29.2)		
Student	7 (5.8)	0 (0.0)		
Unemployed	3 (2.5)	0 (0.0)		

### Risk factors associated with diabetes mellitus

Bivariate logistic regression of possible risk factors of DM showed that smear positive (P=0.006) and past history of DM (P=0.015) were significantly associated with the occurrence of DM. The rest, HIV sero-status (P=0.990), smoking (P=0.132), drinking alcohol (P=0.159), and habit of physical exercise (0.391) were not significantly associated with the occurrence of DM. (Table-4)

**Table: 4. Seroprevalence of diabetes mellitus in relation to related risk Factors of the study subjects, St. Peter specialized hospital Addis Ababa, 2014.(N=120)**

Characteristics	No (%)	Diabetic cases no (%)	Chi square test value	p-value
<b>HIV/AIDS status</b>				
HIV positive	63 (52.5)	10 (15.9)	0.0002	0.990
HIV negative	57 (47.5)	9 (15.8)		
<b>Smoking</b>				
Yes	18 (15)	5 (27.8)	2.2671	0.132
No	102 (85)	14 (13.7)		
<b>Drinking alcohol</b>				
Yes	58 (48.3)	12 (20.7)	1.9866	0.159
No	62 (51.7)	7 (11.3)		
<b>Sputum smear test for AFB</b>				
Positive	60 (50.0)	15 (25.0)	7.5664	<b>0.006*</b>
Negative	60 (50.0)	4 (6.7)		
<b>History of diabetes</b>				
Yes	3 (2.5)	2 (66.7)	5.9662	<b>0.015*</b>
No	117 (97.5)	17 (14.5)		
<b>Habit of physical exercise</b>				
Yes	65 (54.2)	12 (18.5)	0.7351	0.391
No	55 (45.8)	7 (12.7)		

\* P-value ≤ 0.05

Seemingly significant values ( $P \leq 0.05$ ) on socio-demographic characteristics and associated risk factors were taken to multivariate logistic regression. As a result only sex ( $P=0.032$ ) and smear status ( $P=0.029$ ) were significantly associated with the occurrence of DM.

On the other hand, past history of diabetes ( $P=0.057$ ) and place of residence ( $P=0.061$ ) were not significantly associated with the occurrence of DM. Men were about six times (AOR = 5.6; 95% CI = 1.16-27.03) more likely to develop DM than women. Patients with smear positive were also five times (AOR=4.5; 95% CI=1.16-17.51) more likely to develop DM than smear negative patients. (Table-5)

**Table: 5. Multivariate analysis on seemingly significant predictors of DM in bivariate analysis, St. Peter specialized hospital Addis Ababa, 2014 (120).**

Characteristics	Crude odds ratio (95% confidence interval)	P-value	Adjusted odds ratio (95% confidence interval)	P-value
<b>Sex</b>				
Female	1	0.005	1	<b>0.032*</b>
Male	8.67 (1.90-39.49)		5.61(1.16-27.03)	
<b>History of diabetes</b>				
No	1	0.049	1	0.057
Yes	11.76 (1.0-137.00)		24.59(.91-665.57)	
<b>Sputum smear test for AFB</b>				
Negative	1	0.010	1	<b>0.029*</b>
Positive	4.66(1.44-15.04)		4.52(1.16-17.51)	
<b>Residence</b>				
Rural	1	0.031	1	0.061
Urban	9.54(1.22-74.51)		8.74(.9-84.23)	

\*  $P\text{-value} \leq 0.05$

## 5. Discussion

In this hospital based cross-sectional study the prevalence of DM was higher among patients with active PTB; it is six times higher than the estimated prevalence of DM in Ethiopia (2-3%) [67]. Our finding is in line with reports of almost similar prevalence from Maryland, USA (14%), India, Bangalore (15.9%), and Mexico (17.8%) [44, 55, & 57]. And also reports of high prevalence from Pakistan (19.8%), India, Kerala (21%), Texas (27.8%), and southern Mexico (29.6%) [44, 56, & 60]. Additionally there are reports of lower prevalence than our finding from Nigeria (1.9%), China (3.2%), India (5-5.8%), Tanzania (7.81%) and Uganda (8.5%) [15, 55, 66, 69, & 74]. The wide range of prevalence of DM in different studies might be due to the difference in socio-demographic characteristics of source populations in the localities studied.

The higher prevalence of DM among patients with TB was associated with male study subjects, urban dwellers, smear positive and HIV co-infected ones. The high prevalence of DM in smear positives was also comparable with studies in Texas (24.2%) and low prevalence (5.82%) from India [15 & 40]. And also high prevalence of DM in the males was very close to the findings in India (90.9%) very low report from Ethiopia (11.1%) [54, 65, & 68]. The increased prevalence among male study subjects might be due to risk factors like drinking alcohol and smoking which are more widely practiced among men than women and are assumed to cause different metabolic disorders including DM [70]. On the other hand, the prevalence of DM in urban areas was also comparable to that of other studies [46, 56]. The observed rise in the prevalence of DM in urban areas can be explained by rapid urbanization, overcrowded living conditions and the high HIV co-infection rate in the study areas [69].

This study also demonstrated the proportion of new cases of DM (84.2%) by screening for DM in patients with pulmonary TB. A similar study conducted in Tanzania, Gondar, Ethiopia and India showed high prevalence (61%-73%), (53%), and (9%-20%) of undiagnosed DM among new pulmonary TB cases respectively [54, 56, 65]. This high proportion of undiagnosed cases may indicate less awareness of DM by the public and lack of access to health care services for the diagnosis of DM [56, 67, & 70]. Therefore, the finding of this research call for the implementation of active case finding of DM in patients diagnosed for TB and also for the integrating of TB and DM care programs. The overall proportion of IFG among TB cases was higher. The reason for this finding is not clear and could be a random occurring but in line with some of lower studies from Pakistan (2%) and USA (22%) [58 &

71] and higher reports done in Gondar, Ethiopia (29.6%) Tanzania (37.6%) and Pakistan (41%) [21, 65, & 72].

The prevalence of DM in patients with HIV co-infected active PTB cases was high. In line with this research, other studies indicated that the prevalence of TB cases to become diabetic was 4 times higher among HIV co-infected patients when compared with HIV negative TB patients [67 & 73]. The increased prevalence of DM in HIV patients can contribute to the increased prevalence of active PTB.

Our study also demonstrated that among study participants having family history of DM 66.7% were diabetic. This observation may tell us there is a transfer of genetic makeup from family to their offspring. On the other hand we found 15% of smokers; of which male accounts for 88.9%. And this study demonstrated 48.3% of drunker; among these 77.6% were male. The prevalence of habit of physical exercise was 54.2% and higher (61.5%) among male.

This study also demonstrated high number (71.7%) of self employed study participants followed by government/private employed participants (20%). The increased number of self employed study individuals is not clear and could be a random occurring.

High prevalence of DM was found amongst younger TB patients (25-44 years of age) and smear positive cases. In agreement with this finding, a study conducted in Mexican-American and Europeans revealed higher prevalence among younger people with incidence of TB background [56, 74, & 75]. Usually incidence of DM increases with age; but from our finding we have seen how much TB increases the chance of developing DM even at early ages. So this increased prevalence of TB-DM in the younger people will negatively affect TB control program and will become another burden to health service systems.

## **6. Strength of the study**

This cross-sectional hospital based study plays a great role to the growing body of evidence on the importance of TB-DM association.

To our knowledge, this study is among the very few studies that revealed the relationship between TB and DM in Ethiopia .Our finding showed that the prevalence of DM among active TB patients is very high.

### **6.1. Limitations**

All the patients in our study group were MDR suspected but because of time limitation we did not confirm whether they are MDR patients or not

## **7. Conclusions and Recommendations and policy implications**

### **7.1. Conclusion**

The prevalence of diabetes mellitus and pre-diabetes (IFG) among active pulmonary tuberculosis cases was higher compared to the published prevalence of DM in Ethiopia. Moreover, the proportion of DM among HIV co-infected TB cases was very high.

High prevalence of DM was found amongst younger TB patients (25-44 years of age); the increased prevalence of TB-DM in the younger people will negatively affect TB control program and will become another burden to health service systems.

### **7.2. Recommendations and policy implications**

Given the absence of international guidelines on the joint management and control of TB and DM, national programmes need to establish a coordinated response to these two diseases at both the organizational and clinical levels.

Given the growing epidemic of DM worldwide, it is necessary to add DM prevention and control strategies to TB control programmes and vice versa and to evaluate their effectiveness Therefore, the outcome of this study suggests the need for screening each TB patient for diabetes and vis versa

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## List of annexes

### *Annexe-1*

#### **Consent form (English version)**

My name is Emeshaw Damtew and I am MSc student in Medical Laboratory science at Addis Ababa University. I am doing a research entitled “Prevalence of Diabetes mellitus among active pulmonary tuberculosis patients in Ethiopia”.

The objective of the study is to assess the prevalence of diabetes mellitus among active pulmonary tuberculosis patients. If you are agree to participate in the study, about 5 ml of blood will be collected from you or you will allow us to use the sample that you will give for your medical examination and you will be interviewed. During collection of blood, you may feel some discomfort, but this does not produce serious pain. All the data obtained will be kept strictly confidential by using only code numbers and locking the data, only study personnel will have access to the files. Anonymous testing will be undertaken, that is sample will be coded and positive result will not be identified by names. There will be no costs to you as a result of taking part in this study and you are not asked to pay for the laboratory examination. I will give you the result and if your result is clinically significant, I will refer you to the physician for further diagnosis and treatment. Your participation is purely voluntary, and you cannot participate or you can withdraw any time after you get involved in the study or you can also jump (decline) to answer some of the questions if you feel uncomfortable. Participating and not participating has no influence on the service you seek to get.

**Participant’s response:** I am free to decline to be in this study, or to withdraw from it at any point and also to jump a question that feels me discomfort. He promised to give the result without cost .My decision as to whether or not to participate in this study will have no influence on my present or future medical service. My signature below indicates that I agree to participate in this study.

Signature of Person Obtaining Consent

date of signature

---

Subject’s signature

date of signature

---

**Consent form (Amharic version)**

**የመረጃ መሰብሰቢያ መጠይቅ ፎርም (ቅፅ)**

**አዲስ አበባ ዩኒቨርሲቲ የላቦራቶሪ ት/ቤት**

**በጥናቱ ለሚሳተፉ ግለሰቦች የፈቃድ መጠየቂያና መቀበያ ፎርም።**

እምሻዉ ዳምጠዉ እባላለሁ።

በአዲስ አበባ ዩኒቨርሲቲ የህክምና ፋኩልቲ የላቦራቶሪ ሳይንስ የማስተርስ ዲግሪ ተማሪ ነኝ። ባሁኑ ሰዓት የስክሮ በሽታን የቲቢ በሽታኛ በሆኑ ሰዎች መካከል ያለውን ስርጭትና አመለካከት ሠዎች የሚወስዱትን የመከላከያ መንገድ ለበሽታው የሚያጋልጣቸውን እና ተሞክሮ ለማወቅ ጥናት እያካሄድኩ ነው።

**የጥናቱ ዓላማ**

በቲቢ በሽታኞች መካከል ያለውን የስክሮ በሽታ ስርጭት ለማወቅ ጥናት እያካሄድኩ ነው። እርስዎ በጥናቱ ለመሳተፍ ፍቃደኛ ከሆኑ በኋላ በመጠይቁ ይተባበሩናል። 5ሚ.ሊት ደም ይሰጡናል ወይም ለሌላ ምርመራ የሰጡትን ደም እንድንጠቀም ይፈቅዱልናል፤ ደም በሚሰጡበት ሰዓት የተወሰነ የህመም ስሜት ይኖራል። ዳሩ ግን ምንም ዓይነት የከፋ ጉዳት አይደርስብዎትም። የሰጡት ማንኛውም መረጃ ሁሉ ሚስጥራዊነቱ የተጠበቀ ነው። በስም አይገለፅም በጥናቱ የሚሳተፍ ምንም ዓይነት ክፍያ አይከፈልም ምንም ዓይነት የሚያገኙት ገንዘብ አይኖርም። ነገር ግን የስክሮ በሽታ በደምዎ ካለ ወይም የምርመራ ውጤቱ ህክምና የሚያስፈልገው ከሆነ ተጨማሪ ምርመራ እና ህክምና እንዲያገኙ ከባለሙያ ጋር አገናኝታለሁ። በጥናቱ የሚሳተፉት ፈቃደኛ ከሆኑ ብቻ ነው። ስለዚህ መሳተፍ ከጀመሩ በኋላ ማቋረጥ ወይም መመለስ የማይፈልጉት ጥያቄ ካለ ይለፈኝ ማለት ሙሉ መብትዎ ነው። በጥናቱ መሳተፍ ወይም አለመሳተፍ በሚያገኙት አገልግሎት ላይ ምንም ዓይነት ጥቅምም ሆነ ጉዳት አይኖረውም።

**የተሳታፊውን ፈቃድ መግለጫ**

መሳተፍ ፣ አለመሳተፍ፣ ከጀመሩ በኋላ ማቋረጥ ወይም መመለስ የማይፈልገው ጥያቄ ካለ ይለፈኝ ማለት እንደሚቻል፣ በጥናቱ መሳተፍ አለመሳተፍ በማገኘው አገልግሎት ላይ ምንም ዓይነት

ጥቅምም ሆነ ጉዳት እንደሌለው እና በውጤቱ መሰረት ሀኪም ጋር እንደሚያገናኙኝ በመሳተፊም ምንም አይነት ክፍያ እንደማይሰጠኝ እና እኔም እንደማልከፍል ተገልጿልኛል።

የጥናቱ አላማ ግልፅ ስለሆነልኝ ለመሳተፍ ተስማምቻለሁ። ፊርማዬንም እንደሚከተለው አስቀምጫለሁ፡

የጥናቱ ተሳታፊ ፊርማ \_\_\_\_\_ ቀን \_\_\_\_\_

ፍቃደኛነትን የጠየቀ ሰው ፊርማ \_\_\_\_\_ ቀን \_\_\_\_\_

**Annex-2**

**Survey questionnaire (English version)**

Questionnaire for “Prevalence of diabetes mellitus among active tuberculosis patients at St. peter specialized hospital Addis Ababa, Ethiopia, 2014

Interviewer Name \_\_\_\_\_ Date of interview \_\_\_\_\_

Questionnaire Number \_\_\_\_\_

Interviewer Code \_\_\_\_\_

Name of Health Centre \_\_\_\_\_

**A. Socio-demographic information**

- 1) Age (in years) \_\_\_\_\_
- 2) Sex
  - a) Male
  - b) Female
- 3) Residence
  - a) Urban
  - b) Rural
- 4) Marital status (Circle)
  - a) Single
  - b) Married

- c) Widowed
- d) Divorced
- 5) Education Level (Circle)
  - a) No formal education at all
  - b) 1-6
  - c) 7-12
  - d) Diploma and above
- 6) What is your occupational status? (Circle)
  - a) Self employed
  - b) Government/pvt. employed
  - c) student
  - d) Not employed

**B. Risk Factors of diabetes**

1. Do you have any history of diabetes?

- a. Yes
- b. No

2. Do you drink alcohol? (Circle)

- a. Yes
- b. No

3. HIV sero-status

- a) Positive
- b) Negative

4. Do you smoke cigarettes?

- a) Yes
- b) No

5. Former diabetes status

- a) Diabetic
- b) Not diabetic

6. Do you have experience of physical exercise?

- a) Yes
- b) No

**Serology (Laboratory findings) (Tick)**

Diabetes Mellitus (DM)

- a. Positive \_\_\_\_\_
- b. Negative \_\_\_\_\_

TB

- a. Smear positive \_\_\_\_\_
- b. Smear negative \_\_\_\_\_

**Survey questionnaire (Amharic version)**

**የመረጃ መሰብሰቢያ መጠይቅ ፎርም (ቅፅ)**

**አዲስ አበባ ዩኒቨርሲቲ የላቦራቶሪ ት/ቤት**

**በጥናቱ ተሳታፊ በሆኑ ግለሰቦች የሚሞላ ፎርም**

**ሀ. የግለሰቡ አካላዊ ማህበራዊ እና ኢኮኖሚያዊ ዝርዝር**

- 1. ዕድሜ \_\_\_\_\_
- 2. የጋብቻ ሁኔታ ሀ) ያላገባ
  - ለ) ያገባ
  - ሐ) የትዳር ጓደኛ የሞተበት
  - መ) የተፋቱ
- 3. የትምህርት ሁኔታ ሀ) ያልተማረ
  - ለ) የመጀመሪያ ደረጃ ት/ት ያጠናቀቀ
  - ሐ) ሁለተኛ ደረጃ ት/ት ያጠናቀቀ
  - መ) የኮሌጅ ተማሪ
- 4. ስራ ሀ) የግል ወይም የመንግስት ተቀጣሪ ለ) ተማሪ ሐ) የራስ ሥራ መ) ሥራ አጥ

**ለ) ለስክር በሽታ ሊያጋልጡ የሚችሉ ሁኔታዎች**

1. በዘርዎ የስክር በሽታ አለ?

ሀ) አዎ

ለ) የለም

2. መጠጥ ይጠጣሉ?

ሀ) አዎ

ለ) አልጠጣም

3. የኤች አይ ቪ ኤድስ የምርመራ ወጤት

ሀ) ፖዘቲቭ

ለ) ኔጋቲቭ

4. ሲጋራ ያጨሳሉ?

ሀ) አዎ

ለ) አላጨሰም

5. ከዚህ በፊት ስክር ነበረብዎት?

ሀ) አዎ

ለ) የለብኝም

6. የአካል ብቃት እንቅስቃሴ ያደርጋሉ?

ሀ) አዎ

ለ) አላደርግም

**የላቦራቶሪ የስክር ህመም ምርመራ ወጤት**

ሀ) ስክር በሽታ

ለ) ከስክር ነፃ

**የሳንባ በሽታ የአክታ ምርመራ ወጤት**

ሀ) የሳንባ በሽታ

ለ) ነፃ

### **Annex-3**

#### **Laboratory test Procedure**

##### **Test procedure:**

1. Pipette 50 microlitter sample and standard to two different test tubes
2. Pipette 500 microlitter deproteinizer and distilled water to sample test tube and standard test tube respectively.
3. Mix carefully, centrifuge sample at high speed for 5-10min.
4. Pipette 50microlitter diluted STD and sample to each tube.
5. Pipette 50microlitter distilled water to reagent blank (RB).
6. Pipette 1000microlitter to all (sample, STD, and RB).
7. Mix, incubate for 10min. at 20-25<sup>o</sup>c or 5min. at 37<sup>o</sup>c.
8. Measure the absorbance of the STD and the sample against the RB.

##### **Linearity**

Linearity up to a glucose concentration of 700mg/dl or 38.85mmol/l

**Normal range:** serum or plasma (fasting) 75-110mg.dl, 4.2-6.1mmol/l.

##### **Principle of the test:**

The glucose is determined after enzymatic oxidation in the presence of glucose oxidase. The formed hydrogen peroxide reacts under catalysis of peroxidase with phenol and 4-aminophenazone to a red-violet quinoneimine dye as indicator.

Reaction principle:  $\text{Glucose} + \text{O}_2 + \text{H}_2\text{O} \longrightarrow \text{gluconic acid} + \text{H}_2\text{O}$

$2\text{H}_2\text{O} + 4\text{-aminophenazone} + \text{phenol} \longrightarrow \text{quinoneimine} + 4\text{-H}_2\text{O}$

**Reagent and materials needed:** sample, test reagent, micropipette, yellow and blue tips, and gloves.

**Storage and stability:** The reagents are stable up to the given expiry date when stored at 2-8<sup>o</sup>c . When opened contamination must be avoided. Reagent is stable for two weeks at 15-25<sup>o</sup>c .

**Specimen:** serum, plasma/whole blood. The glucose is stable for 24hr.at 2-8<sup>o</sup>c if serum or plasma is prepared within 30min. after collection.

**Assay:** wave length- 500nm, Hg 546nm

Optical path-1cm

Temperature-20-25<sup>°c</sup> or 37<sup>°c</sup>

Measurement-against reagent blank. Only one reagent blank per series is required.

**Normal value / Interpretation of the results:**

Whole blood (fasting): 70-100mg/dl or 3.9-5.6 mmol/l

Serum, plasma (fasting): 75-110 mg/dl or 4.2-6.1 mmol/l

## ***Annex 4: Declaration***

I the undersigned, declare that this is my original work and has not been presented for a degree in this or any other university and all sources of materials used for this thesis have been acknowledged.

Name: Emeshaw Damtew

Signature \_\_\_\_\_

Place \_\_\_\_\_

Date of submission \_\_\_\_\_

This thesis has been submitted with my approval as University advisor.

Name \_\_\_\_\_

Signature \_\_\_\_\_

Place \_\_\_\_\_

Date of submission \_\_\_\_\_

Name \_\_\_\_\_

Signature \_\_\_\_\_

Place \_\_\_\_\_

Date of submission \_\_\_\_\_