Original Article

Levels and Risk Factors of Diabetes Mellitus among Tuberculosis Patients Attending District Tuberculosis Centre, Vijayapur

Mallikarjun C Yadavannavar[1], Tanuja P Pattankar[2], Daneshwari P Kouttalmatt[3]

Background : The co-existence of diabetes and tuberculosis is becoming a public health problem in India, as they are the cause of morbidity, mortality and pose a burden on healthcare system.

Aims and Objectives : To assess the risk factors of diabetes mellitus and its status among Tuberculosis patients. To compare the response to treatment and drug resistance among diabetic and non-diabetic patients. And to study the prevalence of MDR-TB among Diabetic patients with Tuberculosis.

Methodology : It was a cross sectional study done in Vijayapura district during June, 2019 to July, 2019. The patients who had attended the District Tuberculosis Centre in previous 3 months of the beginning of the study were considered and data was collected from the records maintained in the center. The sample size calculated to be 300 cases. Data was collected from them.

Results : The majority of 21.7% of study participants belonged to the age group 26-35 years. The overall prevalence of diabetes was 21.6 % among TB patients. Among males the prevalence was 67.3% and among females was 32.7%. When prevalence of diabetes mellitus was compared with the age it was found that majority (30.7%) of the diabetes were in the age group of 56-65 years and it was statistically significant.

Conclusion : Diabetes is a prevalent comorbidity in both drug sensitive and drug resistant tuberculosis. Age group of more than 55 years is significantly associated with diabetes mellitus and other factors like alcohol consumption is also a associated factor.

Worldwide Tuberculosis being one among the top 10 leading cause of death[1]. 24% of TB patients & 29% deaths are due to TB in India. The factors attributed for this are HIV, Diabetes Mellitus, Smoking & Malnutrition[2]. Among 10.4 million new active TB case, one million of them have TB-DM comorbidities[3]. There is an evidence showing association between diabetes and tuberculosis referred as 'intersecting epidemic' by WHO[4]. According to International Federation of Diabetes, about 382 million adults had Diabetes in the year of 2013, among which 80% belong to low-middle income countries, with prediction of increase in global burden reaching 592 million by 2035[5]. India is stepping towards becoming the Diabetic capital, as every fifth diabetic in the World is Indian[6]. Diabetes increases the risk of active infection, progression of latent to active case and transmission of infection, besides these it has led to poor outcome

---

Editor's Comment :

■ **What's Already Known :**
　Diabetes Mellitus (DM) is a significant comorbidity among tuberculosis (TB) patients, contributing to worse treatment outcomes and complications. The association between DM and TB is well-established globally, but regional variations in prevalence and risk factors remain underexplored.

■ **What This Study Adds :**
　This study reports a 21.6% prevalence of diabetes among TB patients in Northern Karnataka, identifying key risk factors such as age, education level, alcohol consumption and family history of diabetes. It underscores the dual burden of TB and DM in the region.

■ **How It's Useful for Policy :**
　The findings advocate for integrated screening and management of both TB and diabetes. Policy should promote bidirectional screening to improve treatment outcomes and reduce complications, enhancing public health interventions in areas with high TB burden.

Department of Community Medicine, BLDE(DU) Shri B M Patil Hospital, Medical College and Research Center, Vijayapura, Karnataka 586103

¹MD (Community Medicine), Professor and Head and Corresponding Author

²MD (Community Medicine), Assistant Professor

³MBBS, Student

of treatment with increased risk of failure of treatment[4]. In addition glycemic control is being worsened by TB infection. Added to this Drug interaction is deterioting the effectiveness of both TB and Diabetes[7]. DM also increases the risk of TB by 3 times and thus rendering for slow decline of global TB incidence which may hinder the goal of achieving global milestone of 50% reduction in TB incidence and 75% reduction of deaths due to TB by 2025[8]. Hence, this bidirectional association between TB-DM

is being major concern for physicians, as DM affects the disease prognosis and treatment outcome of TB vice versa[9,10]. Bidirectional screening and integrated management will help in early diagnosis and health outcomes of both conditions, unfortunately there is inadequate evidence for this on feasibility and effectiveness of this approach[4]. The impact of these two converging epidemics has led WHO to declare Tuberculosis and Diabetes as global epidemics[11].

Apart from this the emergence of Multi Drug Resistant Tuberculosis (MDR-TB) across the world is posing a major threat, as treatment is difficult and expensive hence causing a large economic burden on the developing nations. In addition to this Diabetes is an added risk factor for the development of MDR-TB because many studies have shown increased risk of MDR-TB among Tuberculosis patients with comorbid Diabetes Mellitus, although Diabetes Mellitus is not an independent risk factor for MDR-TB[12-17].

Tuberculosis and Diabetes Mellitus co-morbidity is one of the raising public health problems. Data available regarding tuberculosis co-morbid with diabetes mellitus is very sparse in this part of Northern Karnataka, hence the study was undertaken.

AIMS AND OBJECTIVES

(1) To study the risk factors of diabetes mellitus and its status among Tuberculosis patients.

(2) To compare the response to treatment and drug resistance among diabetic and non-diabetic patients.

(3) To study the prevalence of MDR-TB among Diabetic patients with Tuberculosis.

MATERIALS AND METHODS

It is a Cross-sectional study done in 2 months from June, 2019 to July, 2019. The patients who had attended the District Tuberculosis Centre in previous 3 months of the beginning of the study were considered and data was collected from the records maintained in the centre and also by contacting the patient (after obtaining their consent) with the help of contact details available in the records for further information. With anticipated prevalence rate of diabetes among TB cases is 24%[18] at 95% confidence level and 5% absolute error, sample size calculated is 280.

Using statistical formula : $n=Z^2 p*q/d^2$, 280 sample size was obtained which was rounded to 300 cases.

Tuberculosis patients (18 years and above) who attended District Tuberculosis Centre for past 3 months are included in the study. Pregnant lactating mothers and patients with incomplete records were excluded from the study.

Data Analysis : The data obtained will be entered in a Microsoft Excel sheet and statistical analysis will be performed using statistical package for the social sciences (Version 20). Results will be presented as Mean (Median) ±SD, counts and percentages and diagrams. Categorical variables will be compared using Chi square test. Association between psychosocial changes and resiliency factors will be assessed using regression analysis, p<0.05 will be considered statistically significant. All statistical tests will perform two tailed.

RESULTS

Table 1 shows that out of 300, majority (21.7%) of them belonged to the age group 26-35 years followed by 56-65 years (21%) and 36-45 years (17%).This shows that most of population belong to the reproductive age group. In our study males were predominant (64.3%) and female constituted about (35.7%).

Majority of study participants belong to urban (51.7%) when compared to rural background (49.3%). Most of the study participants studied upto Primary

Table 1 — *Distribution of Socio-demographic Characteristics of Study Populations (N=300)*

Study variable	Number(n)	Percentage (%)
Age (years) :		
15-25	43	14.3
26-35	65	21. 7
36-45	51	17
46-55	48	16
56-65	63	21
>65	29	9.7
Sex :		
Male	193	64.3
Female	107	35.7
Place :		
Rural	145	48.3
Urban	155	51.7
Education Status :		
Illiterate	44	14.7
Primary	162	54
Secondary	73	24.3
PUC	20	6.7
Graduate	1	0.3
Marital Status :		
Married	268	89.3
Unmarried	19	6.3
Widowed	13	4.3
Type of Family :		
Nuclear	285	95
Joint	15	5
Socio-economic Status :		
Upper class	7	2.3
Upper middle class	10	3.3
Middle class	25	8.3
Lower middle class	93	31
Lower class	165	55

school (54%), followed by secondary school (24.3%), 14.7% were illiterates.

89.3% of them were married , 6.3% were unmarried and 4.3% widowed participated in study. 95% belonged to nuclear family and only 5% belonged to joint family.

In our study 55% belonged to lower class followed by lower middle class (31%) (Modified BG Prasad's classification).

In our study among 300 TB patients 65 were Diabetic (21.6 %)(Fig 1). Prevalence of diabetes in male and female is 67.3% and 32.7% respectively (Fig 2)(Table 2).

When prevalence of diabetes mellitus was compared with the age it was found that majority (30.7%) (Fig 3) of the diabetes were in the age group of 56-65 years and it was statistically significant with the p value of <0.001 (Table 3).

On comparing the association between prevalence of diabetes mellitus and educational status , it was found that among diabetes most of the study
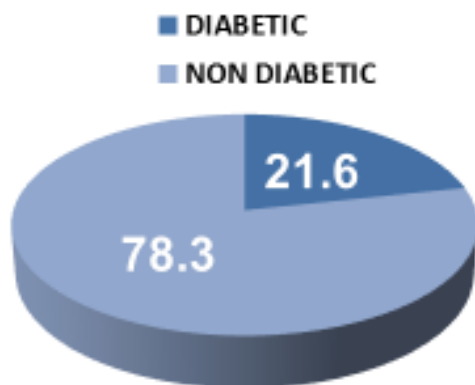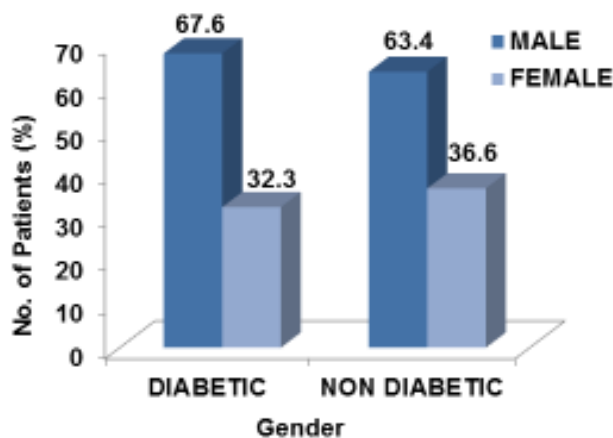

Fig 1 — Prevalence Of Diabetes Among TB Patients

Fig 2 — Distribution of Male and Female Among Diabetic and Non Diabetic TB Patients

Table 2 — *Association of Prevalence of DM and Age*					
Age	Diabetic		Non Diabetic		Chi square P value
(Years)	n	%	n	%	test
15-25	0	0	43	18.3	
26-35	2	3.1	63	26.8	χ^2=60.252 P<0.0001
36-45	8	12.3	43	18.3	HS
46-55	18	27.7	30	12.8	
56-65	20	30.7	43	18.3	
>65	17	26.1	12	5.1	
Total	65	100	234	100	
HS - Highly significant					
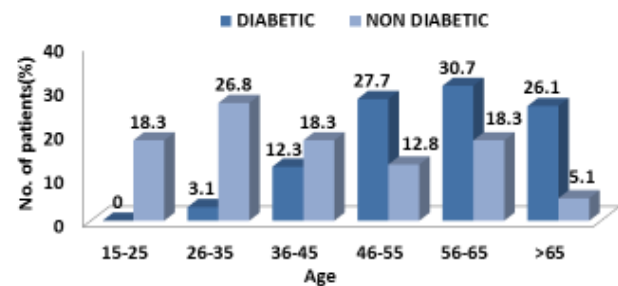
Fig 3 — Distribution of Male and Female among Diabetic and Non Diabetic TB Patients

Table 3 — *Association of Prevalace of DM and Educational Status*					
Educational	Diabetic		Non Diabetic		Chi square P value
Status	n	%	n	%	test
Illiterate	14	21.5	30	12.75	χ^2= P=
Primary	43	66.15	119	50.6	16.521 0.0024
Secondary	4	6.15	69	29.36	HS
PUC	4	6.15	16	6.8	
Graduate	0	0	1	0.4	
Total	65	100	235	100	
HS - Highly significant					

participants (66.2%)(Fig 4) studied upto primary school and it was statistically found significant (Table 4] ie, illiteracy and primary education was significantly associated (Table 4).

The prevalence of was more in non-alcoholic 70.8% (Fig 5) and this was found statistically significant (Table 5). Hence, consumption of alcohol was not risk factor in our study.

We found that prevalence of diabetes was not significant when compared with BMI (Table 6).

89.2% of Diabetes Mellitus prevalence was found

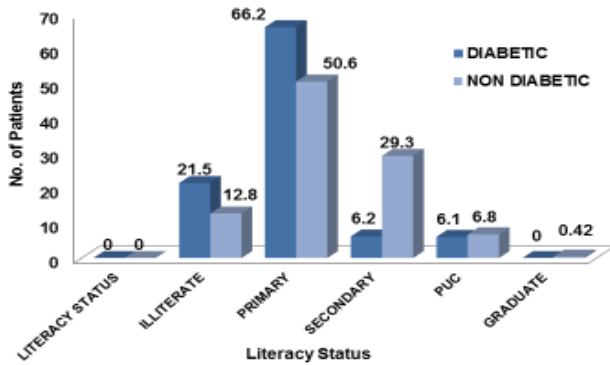| Table 4 — *Association of Prevalance of DM and Alcohol Consumption*					
Habit of	Diabetic		Non Diabetic		Chi square P value
Alcohol	n	%	n	%	test
Alcoholic	19	29.4	28	11.9	χ^2= P=
Non Alcoholic	46	70.6	207	88.1	11.55 0.0007
Total	65	100	235	100	HS
HS - Highly significant					

Fig 4 — Distribution of Educational Status among Diabetic and Non Diabetic TB Patients
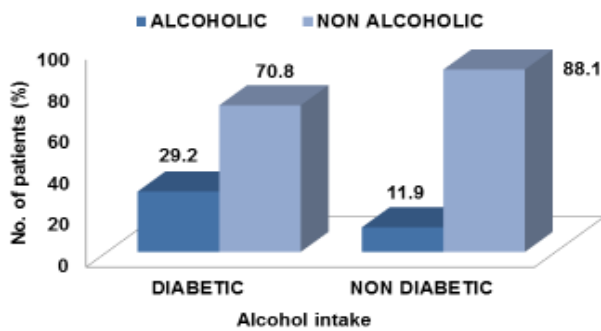
Fig 5 — Distribution of Alcohol Intake among Diabetic and Non Diabetic TB Patients

Table 5 — *Association of Prevalnce of Diabetes and Body Mass Index*					
BMI	Diabetic		Non Diabetic		Chi square	P value
	n	%	n	%	test	
Underweight	40	61.5	177	75.3	$\chi^2=$	P=
Normal	24	36.9	55	23.4	4.897	0.0864
Overweight/ Obese	1	1.59	3	1.27		NS
Total	65	100	235	100		
NS - Not significant						

among patients not having family history of DM [Figure no.07] and was statistically significant (Table 7).

We found that prevalence of DM was not significant when compared to HIV status (Fig 8).

DISCUSSION

The present study was conducted to determine the levels and risk factors of Diabetes mellitus among Tuberculosis patients registered under RNTCP in District Tuberculosis centre Vijaypura.

In our study it was found that large number of TB patients were in the age group 26-55 years (21.7%) most of them were in reproductive age group. Similar results were found in a study done by Damtew E, *et al*[11] in Addis Ababa Ethiopia where majority of patients were in age group 25-44 years of age.

In study done by Balakrishnan S, *et al*[19] in Kerala

Table 6 — *Association of Family History and Prevalence of Diabetes among TB Patients*					
Family	Diabetic		Non Diabetic		Chi square	P value
History	n	%	n	%	test	
No	58	90.2	232	98.7	$\chi^2=$	P=
Yes	7	9.8	3	1.3	14.239	0.0002
Total	65	100	235	100		HS
HS - Highly significant						

Table 7 — *Association of Prevalence of DM and HIV Status*					
HIV	Diabetic		Non Diabetic		Chi square	P value
Status	n	%	n	%	test	
Postive	4	6.15	27	11.48	$\chi^2=$	P=
Negative	61	93.85	208	88.52	1.564	0.2110
Total	65	100	235	100		NS
NS - Not significant						

most of the patients belond to the age group 45-54 years. Other studies done by Kishan, *et al* in Patiala, Punjab and Dutt N, *et al*[20] in Ahemdabad revealed 40-60 year's age group as most commonly involved. This difference in age group may be due to varied geographical condition and study design setting.

In our study 64.3% (193) subjects were male and 35.7% (107) were females similar to the study conducted by Tahir Z, *et al*[21] in Pakistan where 69.1% were males and 30.9% were females. In study done
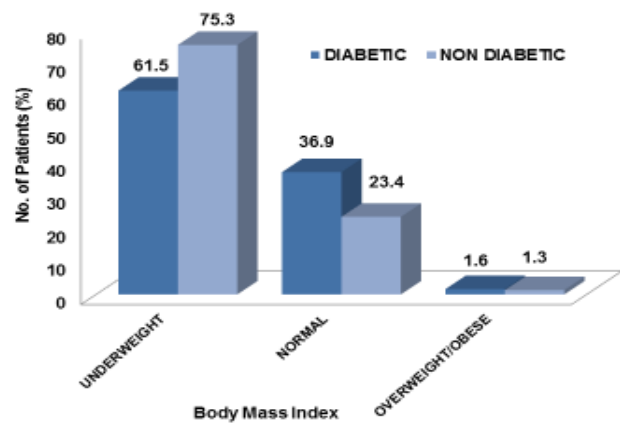

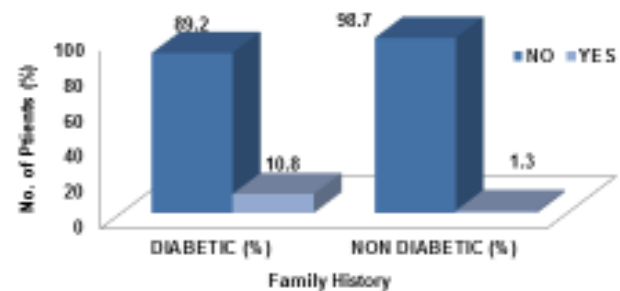Fig 6 — Distribution of BMI among Diabetic and Non Diabetic TB Patients

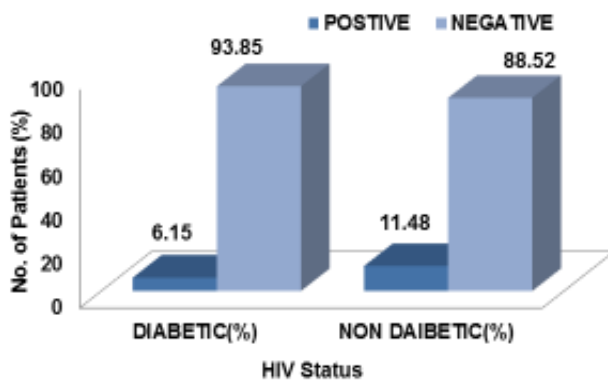Fig 7 — Distribution of Family History among Diabetic and Non Diabetic TB Patients

Fig 8 — Distribition of HIV Status among Diabetic and Non Diabetic TB Patients

by Alisjahbana B, et al[22] in Indonesia in which 52.4% of patients were males. The reason is fear and stigma associated with tuberculosis which resulted in under-notification in case of females and also the tendency to seek health care.

In our study 51.7% (155) of the patients were from urban back ground and 48.3% (145) of were from rural back ground, in other study conducted by Damtew E, et al[11] in Addis Ababa, Ethiopia in which 70% of patients belong to Urban back ground. In the study done by Vishwanathan V, et al[23] in Tamil Nadu which had majority of Tuberculosis from urban back ground. This difference is due to different study setting.

In our study more than half 54% (162) tuberculosis patients studied up to primary schooling, 24.7% (73) of them completed high school education and 14.7% (44) were illiterates, where it was observed that most of tuberculosis patients had received less schooling which was consistent with other studies.

In contrast with the study conducted by Sarkar M, et al[24] in Bangladesh 40.7% of patients were illiterates, 25.1% received primary schooling and 19.8% of them received secondary schooling.

Another study done by Tahir Z, et al[21] in Pakistan has shown 51.6% as illiterates, 34.7% as primary schooling and 10.7% as secondary schooling.

In our study 89.3% (268) were married followed by 6.3%[19] unmarried and 4.3%[13] widowed, this finding was similar with study conducted by Damtew E, et al[11] in Ethiopia 59.2% were married, 36.7% were unmarried and 1.7% widowed.

In our study, 55%(165) of participants belonged to lower class, 31 %(93) belonged to lower middle class and 8.3%(25) belonged to middle class according to modified B G Prasad's Socio-economic classification. These findings were similar to the study conducted by Agarwal A K, et al[7] in Madhya Pradesh in which 37.8% belonged to lower class and 15.7% belonged to lower middle class.

The prevalence of DM among TB patients in our study is 21.6%.

Other studies like institutional based cross sectional study done by Padmalatha P, et al[18] in Andra Pradesh showed prevalence of DM as 30.6%.

Another study conducted by Raghuraman S, et al[25] in Pondicherry (2017) reported 29% as DM prevalence.

In contrast to above findings, another study in Nigeria by Oliyanka AO, et al[26] found prevalence to be 5.7% which could be attributed to difference in demographic characteristics.

In our study 30.7% of Diabetes Mellitus prevalence was found among tuberculosis patients aged between 56-65 years which was similar to the study done by Kottarnath MD, et al[27] in Pariyaram Kerala where it was >61 years. In the study conducted by Ekeke N, et al[28] in Nigeria where 16.9% of DM prevalence was found among 56-65 years of age.

In our study majority (67.6%) of prevalence among males similar to the study by Agarwal AK, et al[7] in Madhya Pradesh (77%) and in another study conducted by Vishwanathan V, et al[23]. The higher prevalence of DM among males might be due to risk factors such as smoking tobacco and consumption of alcohol, which affects both TB and DM.

In our study prevalence of DM was high among who had less education (66.1% primary school and 21.5% illiterates) which is similar to the study done by Kornfeld H, et al[29] in South India where 51.4% of diabetic patients were illiterates. This is due to lack of awareness about diasease among less educated patients.

Our study has shown significant association between prevalence of DM and Alcohol consumption which is similar to the study conducted by Mkhontfo MM, et al[30] in the state of Florida.

Conclusion

The present study showed that, the prevalence of DM among TB patients registered under RNTCP in District Tuberculosis Centre Vijayapura, was 21.6%. The DM TB were more between 56-65 years of age majority of them studied upto primary school and belonged to lower socio-economic status. Most of them were underweight due to DM TB co-morbidity. Various factors like age, educational status, addictive habits , family history of DM have influenced the prevalence.

REFERENCES

1 WHO — Global tuberculosis report 2018.

2 PandeT, Huddart S, Xavier W, Kulavalli S, Chen T, Pai M, *et al* — Prevalence of diabetes mellitus amongst hospitalized tuberculosis patients at an Indian tertiary care center : a descriptive analysis. *PLoS ONE* 2018; **13(7) :** e0200838

3 Shewade HD, Jeyashree K, Mahajan P, Shah AN, Kirubakaran R, Rao R, *et al* — Effect of glycemic control and type of diabetes treatment on unsuccessful TB treatment outcomes among people with TB-Diabetes: A systematic review. *PLoS ONE* 2017; **12(10):** e0186697.

4 Segafredo G, Kapur A, Robbiati C, Joseph N, de Sousa JR, Putoto G, *et al* — Integrating TB and non-communicable diseases services: Pilot experience of screening for diabetes and hypertension in patients with Tuberculosis in Luanda, Angola. *PLoS ONE* 2019; **14(7):** e0218052.

5 IDF. IDF Diabetes ATLAS 2013 [cited 2018 Apr 27]. 6th:[Available from: www.idf.org/diabetesatlas.

6 Mahishale V, Avuthu S, Patil B, Lolly M, Eti A, Khan S — Effect of Poor Glycemic Control in Newly Diagnosed Patients with Smear- Positive Pulmonary Tuberculosis and Type-2 Diabetes Mellitus. *Iran J Med Sci* 2017; **42(2):** 144-51.

7 Agarwal AK, Gupta G, Marskole P, Agarwal A — A Study of the Patients Suffering from Tuberculosis and Tuberculosis-diabetes Comorbidity in Revised National Tuberculosis Control Program Centers of Northern Madhya Pradesh, India. *Indian J Endocrinol Metab* 2017; **21(4):** 570-6. doi:10.4103/ijem.IJEM_89_17.

8 Mave V, Nimkar S, Prasad H — Tuberculosis screening among persons with diabetes mellitus in Pune, India. *BMC Infect Dis* 2017; **17(1):** 388. Published 2017 2. doi:10.1186/s12879-017-2483-9.

9 Siddiqui AN, Khayyam KU, Sharma M — Effect of Diabetes Mellitus on Tuberculosis Treatment Outcome and Adverse Reactions in Patients Receiving Directly Observed Treatment Strategy in India: A Prospective Study. *Biomed Res Int* 2016; 2016:7273935. doi:10.1155/2016/7273935.

10 Nagar V, Gour D, Pal DK, Singh AR, Joshi A, Dave L — A study on prevalence of diabetes and associated risk factors among diagnosed tuberculosis patients registered under Revised National Tuberculosis Control Programme in Bhopal District. *J Family Med Prim Care* 2018; **7(1):** 130-6. doi:10.4103/jfmpc.jfmpc_289_17

11 Damtew E , Ali I, Meressa D — Prevalence of Diabetes mellitus among Active Pulmonary Tuberculosis Patients at St. Peter Specialized Hospital , Addis Ababa , Ethiopia. *World J Med Sci* 2014; **11(3):** 389-396.

12 Workneh MH , Bjune GA, Yimer SA — Prevalence of associated factors of diabetes mellitus among Tuberculosis patients in South Eastern Amhara region , Ethiopia : A Cross Sectional Study. *PLoS ONE* 2016; **11(1):** 1-15.

13 Dobler CC, Flack JR , Marks GB — Risk of Tuberculosis among people with Diabetes Mellitus : An Australian nationwide cohort study. *BMJ Open* 2012; **2:** 1-5.

14 Umaaknth M, Rishikesavan S — Prevalence of diabetes mellitus among tuberculosis patient in Batticaloa district, Sri Lanka. *Int J med Res* 2017; **2(2):** 21-3.,

15 Zheng C Hu M, Goa F — Diabetes and pulmonary tuberculosis: a global overviewwith special focus on the situation in asian countries with high TBDM burden, *Global Health Action* 2017; **10(1):** 1-11.

16 Tahir NB, Uddin QT, Munir SS Waheed A, Waheed S, Daud HM — Prevalence of Diabetes Mellitus in tuberculosis patients at DOTS regional centre KMU-IMS teaching Hospital Kohat. *Eur Acad Res* 2014; **2(7):** 9948-59.

17 Chaudhary LA , Essa EB, Solaiman Sa , Al-Sindi K — Prevalence of diabetes type -2 and pulmonary tuberculosis among Filipino and treatment outcomes: A surveillance study in the eastern Saudi Arabia. *Int J Myobact* 2012; 106-9.

18 Padmalatha P, Hema K — Study on prevalence of Diabetes Mellitus in Tuberculosis patients attending a tertiary care hospital in Guntur , Andhra Pradesh. *IJBAMR* 2014; **4(1):** 494-8.

19 Balakrishnan S, Vijayan S, Nair S, Subramoniapillai J, Mrithyunjaya S — High Diabetes Prevalence among Tuberculosis cases in Kerala, India. *PLoS ONE* 2012; **7(10):** 1-7.

20 Kishan J, Garg K — Tuberculosis And Diabetes Mellitus: A Case Series of 100 patients. *Saarc J Tuber Lung Dis* HIV/AIDS 2010; **7(2):** 34-8.

21 Tahir Z, Ahmed M, Akhtar AM, Yaqub T, Mushtaq MH, Javed H — Diabetes mellitus among tuberculosis patients: a cross sectional study from Pakistan. *Afri Health Sci* 2016; **16(3):** 671-6.

22 Alisjahbana B — Diabetes mellitus is strongly associated with tuberculosis in Indonesia. *Int J Tuberc Lung Dis* 2006; **10(6):** 696-700.

23 Vishwanathan V , Kumpatla S, Aravindalochanan V, Rajan R, Chinnaswamy C, Srinivasan R, *et al* — Prevalence of Diabetes and Pre-Diabetes and Associated Risk Factors among Tuberculosis Patients in India. *PLoS ONE* 2012; **7(7):** 1-9.

24 Sarkar M, Barua M, Guerra F, Saha A , Aftab A, Latif AHMM, *et al* — Double Trouble: Prevalence and Factors Associated with Tuberculosis and Diabetes Comorbidity in Bangladesh. *PLoS ONE* 2016; **11(10):** 1-15.

25 Raghuraman S, Vasudevan KP, Govindarajan S, Chinnakali P, Panigrahi KC — Prevalence of diabetes mellitus among tuberculosis patients in Urban Puducherry. *North Am J Med Sci* 2014; **6:** 30-4.

26 Olayinka AO, Anthonia O, Yetunde K — Prevalence of diabetes in persons with tuberculosis in a tertiary health centre in Lagos, Nigeria. *Indian J Endocr Metab* 2013; **17:** 486-9.

27 Kottarnath MD, Mavila R, Achuthan V, Nair S — Prevalence of diabetes mellitus in tuberculosis patients – A hospital based study. *Int J Res Med Sci* 2015; **3(10):** 2810-4.

28 Ekeke N — Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria : a multi-centre implementation study under programme settings. *Sci Rep* 2017; **7:** 1-8.

29 Kornfeld H — High Prevalence and Heterogeneity of Diabetes in Patients with TB in South India. *Chest* 2016; **149(6):** 1501-8.

30 Mkhontfo, Mandzisi Mbongeni — An Examination of The Distribution of Diabetes Mellitus Among TB Patients with Pulmonary Tuberculosis and Drug Resistance Tuberculosis In The State of Florida, USA. (2016) [cited on Sep 20 2017]. Graduate Theses and Dissertations. Available from:http://scholarcommons.usf.edu/edu/etd/6325