Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 19s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Prevalence of Diabetes Mellitus in Newly Diagnosed Tuberculosis Patients

Bandi Ajaykumar[1], Sabolu Sudeepa Tejolatha [2], Mohammed Fazal[3], Nandigam Ashok Vardhan[4*]

[1]Assistant professor, Department of General Medicine, Singareni Institute of Medical Sciences/ Government Medical College, Ramagundam, Telangana.

[2] Assistant professor, Department of Ophthalmology, Singareni Institute of Medical Sciences/ Government medical college, Ramagundam, Telangana.

[3]Department of Human and Clinical Anatomy, College of Medicine and Health Sciences, Sultan Qaboos University, Oman.

[4]Assistant professor, Department of Biochemistry, Singareni Institute of Medical Sciences/ Government medical college, Ramagundam, Telangana.

***Corresponding Author:**

Nandigam Ashok Vardhan

Email ID: ashokbiochemists@gmail.com

Cite this paper as: Bandi Ajaykumar, Sabolu Sudeepa Tejolatha , Mohammed Fazal, Nandigam Ashok Vardhan, (2025) Prevalence of Diabetes Mellitus in Newly Diagnosed Tuberculosis Patients. *Journal of Neonatal Surgery*, 14 (19s), 521-529.

ABSTRACT

Background: Tuberculosis (TB) and diabetes mellitus (DM) are significant global health challenges, with emerging evidence suggesting a bidirectional relationship between the two conditions. The coexistence of DM in TB patients can complicate treatment outcomes, increase relapse rates, and exacerbate disease severity. This study aims to determine the prevalence of diabetes mellitus in newly diagnosed tuberculosis patients and explore associated risk factors.

Methods: A cross-sectional study was conducted among newly diagnosed TB patients at government multispecialty hospital, Sector 16, Chandigarh. Patients were screened for DM using fasting blood glucose, HbA1c, or random blood glucose tests as per WHO guidelines. Demographic data, clinical characteristics, and risk factors such as age, body mass index (BMI), family history of DM, and socioeconomic status were collected. Prevalence was calculated, and logistic regression analysis was used to identify factors associated with DM in TB patients.

Results: In our study participants of 152 newly diagnosed TB patients, 21.7% were found to have diabetes mellitus. Among these, 6.5 % were newly diagnosed with DM, while 15.1 % had a prior DM diagnosis. Factors significantly associated with DM prevalence included older age showed high significance ($p<0.001$), higher BMI ($p<0.05$), and history of smoking ($p<0.05$). And there is a significant association that was observed with gender ($p<0.35$).

Conclusion: The high prevalence of diabetes mellitus in newly diagnosed TB patients underscores the need for routine DM screening in TB management programs. Early detection and management of DM in TB patients could improve treatment outcomes and reduce complications. Further studies are warranted to assess the impact of integrated TB-DM care on long-term health outcomes.

Keywords: *Tuberculosis, Diabetes Mellitus, Prevalence, Comorbidity, Screening*

1. INTRODUCTION

The escalating global prevalence of diabetes mellitus represents a significant challenge to public health, characterized by its association with microvascular and macrovascular complications, including nephropathy, retinopathy, neuropathy, and increased cardiovascular risks (Anchit et al., 2023). The intricate interplay between diabetes mellitus and infectious diseases, particularly tuberculosis, has garnered increasing attention in recent years (Yorke et al., 2017). Diabetes mellitus, the most prevalent endocrine disorder, manifests as metabolic irregularities stemming from relative or absolute insulin deficiency and/or insulin resistance, further compounded by dyslipidemia, a condition marked by elevated levels of triglycerides and low-density lipoprotein cholesterol, coupled with decreased high-density lipoprotein cholesterol levels (Habtewold et al., 2016). The convergence of the tuberculosis and diabetes epidemics presents a formidable challenge to global health systems (Restrepo, 2007). It is clear that more robust interventions are needed, than merely describing diabetes in relation to TB (Kerama et al., 2023). Understanding the intricate relationship between diabetes mellitus and tuberculosis is crucial for implementing effective screening, prevention, and management strategies. The global prevalence of diabetes has seen a

concerning surge, doubling between 1980 and 2014, with the World Health Organization estimating that 422 million adults were living with diabetes worldwide in 2014 (Läll et al., 2016). The rising prevalence of these diseases is attributed to the adoption of western lifestyles and urbanization (Yvonne, 2013).

2. BACKGROUND

The escalating prevalence of type 2 diabetes (T2D) has evolved into a substantial global and national health concern (Okemah et al., 2018). The International Diabetes Federation reported in 2021 that China, India, and Pakistan have the highest number of adults aged 20-79 years with diabetes (Patil et al., 2023). The global increase in diabetes cases has been mirrored in India, which is now considered an epicenter of the diabetes pandemic, with a substantial proportion of its population affected by the disease (Kumari & Singh, 2020). The dramatic increase in the prevalence of type 2 diabetes mellitus in low-and middle-income countries is reported by the Global Burden of Disease (Dutt et al., 2022).

2.1. Diabetes Mellitus

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, resulting from defects in insulin secretion, insulin action, or both (Pappachan, 2021). Type 2 diabetes mellitus is a heterogeneous disease characterized by deficient insulin secretion by pancreatic islet β-cells in the context of impaired insulin sensitivity (Roden & Shulman, 2019). The causes of type 2 diabetes include genetic factors, aging, obesity, and physical inactivity (Feyisa et al., 2022; Wu et al., 2014).

The global prevalence of diabetes has been on the rise, with projections estimating a continued increase in the coming years (Ong et al., 2023). The global prevalence of diabetes has been on the rise, with projections estimating a continued increase in the coming years. The number of people affected by diabetes is expected to double in the next decade because of an increase in the aging population, thereby adding to the already existing burden for healthcare providers, especially in poorly developed countries (Olokoba et al., 2012). The disease prevalence continues to increase because of the obesity pandemic (Pappachan, 2021). In 2019, approximately 9.3% of the global population was estimated to have diabetes, and projections indicate that this figure will rise to 10.2% by 2030 and 10.

2.2. Tuberculosis

Tuberculosis, caused by Mycobacterium tuberculosis, primarily affects the lungs but can also involve other organs. In 2020, approximately 9.9 million people worldwide developed tuberculosis, with an estimated 1.5 million deaths (Phelan et al., 2018). Tuberculosis is an infectious disease caused by Mycobacterium tuberculosis which commonly affects the lungs but can also affect any other organ. Tuberculosis usually spreads through the air when people with pulmonary tuberculosis cough, sneeze, or spit (Holtz, n.d.). Tuberculosis is a major public health problem worldwide, especially in developing countries.

2.3. Prevalence of Diabetes Mellitus in Tuberculosis Patients

2.3.1. Epidemiological Evidence

India bears a significant burden of tuberculosis, accounting for a substantial proportion of the global incidence (Tarachandani et al., 2023). The definitive diagnosis of pulmonary tuberculosis lies in the isolation of the tubercle bacilli from the patient's sputum, either by direct microscopy or by culture (Kumbar et al., 2021). More than 2 billion people are infected with Mycobacterium tuberculosis, of whom more than 11 million have active TB, and the number of yearly incident cases and attributable deaths is rising globally (Bailey & Grant, 2011). Both diseases are more prevalent in populations with low socioeconomic status, poor nutrition, and limited access to healthcare. In 2021, the incidence was an estimated 10.6 million cases and it contributed to 1.4 million deaths worldwide (Patel et al., 2023). The prevalence of diabetes mellitus among tuberculosis patients varies across different regions and populations, reflecting variations in diabetes prevalence and tuberculosis epidemiology. India bears a significant burden of tuberculosis, accounting for approximately one-fifth of the global incidence, with an estimated 1.96 million cases annually, while approximately 2.9 million people succumb to tuberculosis each year worldwide, with about one-fifth of these deaths occurring in India alone (Vashishtha, 2010).

2.3.2. Potential Mechanisms

Smoking habits have exhibited considerable changes between genders, particularly with an increase in smoking among young women in the past decade, potentially leading to a higher incidence of smoking-related diabetes in females in the future (Kautzky-Willer et al., 2016). Sex-specific findings implicate a higher atherothrombotic risk for women with T2DM, which potentially could have clinical consequences (Kautzky-Willer et al., 2016). The co-occurrence of diabetes and tuberculosis can have detrimental effects on treatment outcomes and disease progression (Prezzemolo et al., 2014). In the vulnerable phase of pregnancy, various environmental factors can exert a strong influence on fetal development (Kautzky-Willer et al., 2016). Psychosocial risk factors like low educational level, occupation and income, largely contribute to unhealthy lifestyle behavior and social disparities and thus are related to higher risk of obesity and T2DM particularly in women (Kautzky-Willer et al., 2016).

3. MATERIALS AND METHODS:

The study had been conducted among patients belonging to both sexes and with age of 18 years or more attending out-patient department and admitted at Govt. Multispecialty Hospital, Sector 16. A written informed consent was taken from both patient and their attendants prior to enrollment of study. A total of 152 TB cases of pulmonary and extrapulmonary are registered under RNTCP are included in this study after obtaining informed consent and they will be subjected to details of examination, and they will proceed for the appropriate investigations. And the participants will be further subjected to biochemical investigation with standard laboratory techniques, screened for diabetes mellitus by assessing fasting plasma glucose, postprandial plasma glucose and HbA1c.

The sample size was estimated based on the assumption that the prevalence of all types of tuberculosis is 10%. To estimate this proportion with a 95% confidence interval and a margin of error of 5%, the required sample size was 138 subjects, calculated using the formula n0=z^2*pq*/d^2. Categorical data will be presented as numbers or percentages, while continuous data assumed to be normally distributed will be reported as mean and standard deviation or median and interquartile range. Normality will be assessed using the Kolmogorov-Smirnov test. For normally distributed data, t-tests will be used for comparisons between two groups, while for skewed data, non-parametric Mann-Whitney U-tests will be employed. Categorical data comparisons will be made using Pearson's chi-square or Fisher's exact test, as appropriate. All statistical tests will be two-sided and performed at a significant level of $\alpha=0.05$. The analysis will be conducted using IBM SPSS STATISTICS. Numerical variables are often expressed as mean ± standard deviation, while categorical variables are presented as frequencies and percentages (Cherchi et al., 2020).

4. RESULTS

Table 1: Biochemical parameters for diabetic screening

Diabetes Mellitus		N	Mean	Std. Deviation	t-value	p-value
HbA1c	Yes	33	7.06	0.72	9.215	.0001**
	No	119	5.11	1.16		
Fasting plasma glucose	Yes	33	114.21	30.16	4.060	.0001**
	No	119	92.69	26.00		
Postprandial plasma glucose	Yes	33	142.94	37.33	3.367	.001**
	No	119	122.88	28.07		

Mean fasting plasma glucose114.21 ± 30.16 in diabetics and 92.69 ± 26.00 in non-diabetics and t-value is 4.060 with p-value 0.0001 i.e. significant difference in both groups. Mean postprandial plasma glucose142.94 ± 37.33 in diabetics and 122.88 ± 28.07 in non-diabetics and t-value is 3.367with p-value 0.001 i.e. significant difference in both groups. Mean HbA1c7.06 ± 0.72in diabetics and 5.11 ± 1.16 in non-diabetics and t-value is 9.215 with p-value 0.0001 i.e. significant difference in both groups.

Table 2: Age and Sex Correlation with Diabetes Mellitus

		Diabetes Mellitus						Chi-square	p-value
		Yes		No		Total			
Age	20-30	0	0.0%	26	100.0%	26	100.0%	37.977	.0001**
	30-40	1	2.9%	33	97.1%	34	100.0%		
	40-50	5	14.7%	29	85.3%	34	100.0%		
	50-60	11	39.3%	17	60.7%	28	100.0%		
	60 above	16	53.3%	14	46.7%	30	100.0%		
	Total	33	21.7%	119	78.3%	152	100.0%		

Sex	Male	27	26.7%	74	73.3%	101	100.0%	4.467	.035*
	Female	6	11.8%	45	88.2%	51	100.0%		
	Total	33	21.7%	119	78.3%	152	100.0%		

Here the p-value is less than significance level 0.05; the relation between diabetes mellitus and age was significant. The table reveals that the proportion of diabetic patients is high in the older age group, the p-value is less than significance level 0.05; the relation between diabetes mellitus and sex was significant. This suggests there is relation between diabetes mellitus and sex. The table reveals the proportion of diabetic patients is high in male sex group.

Table 3: Relationship Between Diabetic Mellitus and Smoking in Newly Diagnosed Tuberculosis Patients

		Diabetes Mellitus					
		Yes		**No**		**Total**	
Smoking	Yes	13	39.4%	25	21.0%	38	25.0%
	No	20	60.6%	94	79.0%	114	75.0%
	Total	33	100.0%	119	100.0%	152	100.0%

The data shows 39.4% of diabetics are smokers

Table 4: Prevalence of Diabetes Mellitus in Newly Diagnosed Tuberculosis Patients

	Frequency	**Percentage**
Total Patients	152	
Non-Diabetics	119	78.3%
Diabetics	33	21.7%
Newly diagnosed diabetics	10	6.5%
Preexisting diabetics	23	15.1%

The total number of tuberculosis patients without diabetes mellitus were 119 with a percentage of 78.3% and with diabetes mellitus, 33 with a percentage of 21.7%, in that 6.5% were newly diagnosed and 15.1% were already known diabetics.

Table 5: Relationship between Diabetes Mellitus and Pulmonary, Extra Pulmonary Tuberculosis

		Diabetes Mellitus						
		Yes		**No**		**Total**		**P-value**
Pulmonary Tuberculosis	Yes	26	78.8%	69	58.0%	95	62.5%	0.029
	No	7	21.2%	50	42.0%	57	37.5%	
	Total	33	100.0%	119	100.0%	152	100.0%	
Extrapulmonary tuberculosis	Yes	7	21.2%	50	42.0%	57	37.5%	0.05
	No	26	78.8%	69	58.0%	95	62.5%	
	Total	33	100.0%	119	100.0%	152	100.0%	

Here the p-value is less than the significance level value 0.05; the relation between diabetes mellitus and pulmonary

tuberculosis was significant. That is, there is a relation between diabetes mellitus and pulmonary tuberculosis. And the p-value is less than the significance level 0.05; the relation between diabetes mellitus and sputum positive pulmonary tuberculosis was significant. That is, there is a relation between diabetes mellitus and sputum positive pulmonary tuberculosis. The table reveals that the proportion of diabetic patients is high in sputum positive pulmonary tuberculosis patients.

Table 6: Pulmonary and Extrapulmonary Tuberculosis Relationship with Diabetes Mellitus

		Diabetes mellitus					
		Yes		No		Total	
Sputum positive pulmonary tuberculosis	Yes	22	66.7%	50	42.0%	72	47.4%
	No	11	33.3%	69	58.0%	80	52.6%
Sputum negative pulmonary tuberculosis	Yes	4	12.1%	19	16.0%	23	15.1%
	No	29	87.9%	100	84.0%	129	84.9%
Lymph node	Yes	4	12.1%	15	12.6%	19	12.5%
	No	29	87.9%	104	87.4%	133	87.5%
Pleural effusion	Yes	0	0.0%	19	16.0%	19	12.5%
	No	33	100.0%	100	84.0%	133	87.5%
Genital Tract	Yes	0	0.0%	1	.8%	1	.7%
	No	33	100.0%	118	99.2%	151	99.3%
Bones&Joints	Yes	1	3.0%	2	1.7%	3	2.0%
	No	32	97.0%	117	98.3%	149	98.0%
Meningitis	Yes	2	6.1%	8	6.7%	10	6.6%
	No	31	93.9%	111	93.3%	142	93.4%
Abdominal tuberculosis	Yes	0	0.0%	5	4.2%	5	3.3%
	No	33	100.0%	114	95.8%	147	96.7%
	Total	33	100.0%	119	100.0%	152	100.0%

5. DISCUSSION

The following risk factors associated were discussed individually for the study of prevalence of Diabetes Mellitus in newly diagnosed Tuberculosis patients

Age:

In our study, the mean age of tuberculosis patients with diabetes was 58.6 ± 10.6, significantly higher than the mean age of 41.2 ± 13.23 for those without diabetes ($p<0.0001$). Similar studies reported that they mean ages of 57.69 ± 11.48, 53.8, and 47 ± 16 for tuberculosis patients with diabetes. Our findings suggest diabetes may be more common in the older age group and contribute to tuberculosis development in later life. (Chudamani, 2020)

Body Mass Index (BMI):

The present study found a mean BMI of 21.56 ± 2.85 in the study population. The mean BMI was similar between tuberculosis patients with (21.5) and without (21.58) diabetes, with a non-significant p-value of 0.878. Similar studies reported the following mean BMI values for tuberculosis patients with diabetes mellitus: Kottarath P et al.: 22.94, Alisjahbana et al.: 21.1, and the present study: 21.56

Gender:

Our study enrolled 152 tuberculosis patients, with 101 males and 51 females. Of these, 26.7% of males had diabetes, compared to 11.8% of females, a statistically significant difference (p=0.035). This result was likely influenced by the larger proportion of male patients in the study. A similar study by Balakrishnan S et al. among 552 tuberculosis patients also found a higher prevalence of diabetes mellitus among male tuberculosis patients. Another study in Nepal found that the frequency of type 2 diabetes was significantly higher in males than in females (Pokharel et al., 2012).

Smoking:

The study found that 25% of tuberculosis patients were smokers, and among those with both tuberculosis and diabetes, 39.4% were smokers. The higher proportion of smokers among tuberculosis patients with diabetes suggests that smoking may be a risk factor that exacerbates the relationship between tuberculosis and diabetes. Smokers with tuberculosis may be more likely to also develop diabetes, potentially due to the negative impact of smoking on glucose metabolism and insulin resistance. Addressing smoking cessation could be an important intervention to mitigate the burden of both tuberculosis and diabetes. Statistics play a crucial role in biomedical research, particularly in understanding complex diseases like diabetes and tuberculosis, as well as the interplay between them (Yorke et al., 2017).

Pulmonary Tuberculosis:

In our study, 95 subjects had pulmonary tuberculosis, and 26 of them had diabetes, which was statistically significant (p=0.029). This suggests diabetes mellitus is associated with pulmonary tuberculosis. Among the diabetic patients, 66.7% had sputum-positive pulmonary tuberculosis, while 12.1% had sputum-negative tuberculosis. The relationship between sputum positivity and diabetes was significant (p=0.012). Our findings align with studies by Raghuraman S et al. and Mansuri S et al., which also found a significant association between diabetes and sputum positivity. In our study, 9 out of 23 cases of sputum-negative tuberculosis were positive by GeneXpert, and the remaining cases were treated based on clinical or radiological criteria. (Chopra et al., 2020; Datta et al., 2020)

Extrapulmonary Tuberculosis:

Our study found that 21.2% of subjects with extrapulmonary tuberculosis had diabetes, but this relationship was not statistically significant (p=0.637). Previous research by AN Siddiqui et al. reported a higher prevalence of diabetes among pulmonary tuberculosis patients compared to those with extrapulmonary tuberculosis. The global burden of tuberculosis is substantial, with India carrying a significant portion of cases (Tarachandani et al., 2023).

Diabetes Mellitus:

The present study found that 21.7% of tuberculosis patients had diabetes, with the majority (15.1%) being previously known diabetics and the remaining (6.5%) newly diagnosed. Previous studies reported a wider range of diabetes prevalence among tuberculosis patients, ranging from 15.29% to 29%. The variations in diabetes prevalence may be due to differences in study populations, diagnostic criteria, and geographical locations. (Kubiak et al., 2019)

Fasting Plasma Glucose:

Our study found the mean fasting plasma glucose level in tuberculosis patients with diabetes was 114.21 ± 30.16 mg/dL, which was significantly higher compared to 92.69 ± 26.00 mg/dL in those without diabetes (p=0.0001). Similarly, the Manjareeka et al. study reported a mean fasting plasma glucose of 132.4 mg/dL in tuberculosis patients with diabetes, significantly greater than the 108.5 mg/dL observed in those without diabetes (p=0.007). These findings demonstrate a significant association between elevated fasting plasma glucose and the presence of diabetes among individuals with tuberculosis. (Laxmi et al., 2019; Naghipour et al., 2021)

Postprandial Plasma Glucose:

In our study, the average postprandial plasma glucose in patients with diabetes is 142.94 ± 37.33 mg/dl as compared to 122.88 ± 28.07mg/dl in patients without diabetes. This was a significant relationship with a p value of 0.001.(Kumari & Singh, 2020)

HbA1c:

The study found that tuberculosis patients with diabetes had significantly higher mean HbA1c levels compared to those without diabetes. Previous studies have also reported a high prevalence of diabetes among tuberculosis patients, with many having poor glycemic control. In the present study, the prevalence of diabetes among tuberculosis patients was 21.7%, much higher than the general population. Older age, male sex, smoking, elevated fasting plasma glucose, and sputum positivity were identified as significant risk factors for diabetes in tuberculosis patients. All diabetic cases in this study were found to have type 2 diabetes mellitus. The increasing global incidence of diabetes mellitus, with projections estimating 643 million cases by 2030 and 783 million by 2045, highlights the importance of proper diabetes management, especially in the context of tuberculosis co-infection (Kerama et al., 2023; Laxmi et al., 2019).

6. CONCLUSION

Tuberculosis remains a major global health concern, and its co-occurrence with diabetes mellitus exhibits a bidirectional relationship, amplifying the magnitude of each condition. This study aimed to determine the prevalence of diabetes mellitus among individuals newly diagnosed with tuberculosis. The study enrolled 152 patients, with 33 identified as diabetic and 119 as non-diabetic. The findings revealed that the diabetic group exhibited a higher prevalence of advanced age, male gender, pulmonary tuberculosis, and sputum positivity. The study reported a 21.7% prevalence of diabetes among newly diagnosed tuberculosis patients, underscoring the significance of the bidirectional association between diabetes and tuberculosis. This association emphasizes the importance of future screening efforts to develop early and appropriate preventive and therapeutic strategies for these patients. The study highlights the need for comprehensive management approaches that address both tuberculosis and diabetes simultaneously, to improve patient outcomes and public health overall.

REFERENCES

[1] Anchit, Bhushan, A., & Srinivasa, B. (2023). Effect of Metformin Monotherapy and Combination Therapy with Glimepiride on Lipid Profile in Drug Naive Type-2 Diabetes Patients: A Prospective Observational Study. Journal of Pharmaceutical Care. https://doi.org/10.18502/jpc.v11i1.12633

[2] Bailey, S., & Grant, P. (2011). 'The tubercular diabetic': the impact of diabetes mellitus on tuberculosis and its threat to global tuberculosis control. Clinical Medicine, 11(4), 344. https://doi.org/10.7861/clinmedicine.11-4-344

[3] Chopra, V., Virk, B. S., Chopra, S., Bansal, M., & Chungath, J. T. (2020). Application of CBNAAT (Xpert MTB/RIF assay) in new smear negative pulmonary tuberculosis patients. Monaldi Archives for Chest Disease, 90(1). https://doi.org/10.4081/monaldi.2020.1146

[4] Chudamani, P. (2020). Comparative study of pulmonary tuberculosis in diabetics and non-diabetics. International Journal of Advanced Research in Medicine, 2(2), 282. https://doi.org/10.22271/27069567.2020.v2.i2d.243

[5] Datta, B., Ford, D., Goyal, P., Prakash, A., Tripathy, J. P., Gnanashanmugam, D., Mishra, S. K., Aggarwal, A., Kotalwar, S., Mittal, S., Mangla, A., Jaiswal, A., & Trehan, N. (2020). Mobile digital x-ray and portable cartridge based nucleic acid amplification test machines for point-of-care diagnosis of TB in rural India. Transactions of the Royal Society of Tropical Medicine and Hygiene, 115(8), 937. https://doi.org/10.1093/trstmh/traa152

[6] Dutt, C., Salles, J. E. N., Joshi, S., Nair, T., Chowdhury, S., Mithal, A., Mohan, V., Kasliwal, R. R., Sharma, S., Tijssen, J., & Tandon, N. (2022). Risk Factors Analysis and Management of Cardiometabolic-Based Chronic Disease in Low- and Middle-Income Countries [Review of Risk Factors Analysis and Management of Cardiometabolic-Based Chronic Disease in Low- and Middle-Income Countries]. Diabetes Metabolic Syndrome and Obesity, 451. Dove Medical Press. https://doi.org/10.2147/dmso.s333787

[7] Feyisa, B. R., Mosisa, G., Biru, B., Debelo, S., & Dufera, M. (2022). Community-Based Findings of Magnitude of Type 2 Diabetes Mellitus among Adults in Selected Towns of Western Ethiopia. Dubai Diabetes and Endocrinology Journal, 28(2), 56. https://doi.org/10.1159/000522563

[8] Habtewold, T. D., Tsega, W. D., & Wale, B. Y. (2016). Diabetes Mellitus in Outpatients in Debre Berhan Referral Hospital, Ethiopia. Journal of Diabetes Research, 2016, 1. https://doi.org/10.1155/2016/3571368

[9] Holtz, T. H. (n.d.). Tuberculosis: epidemiology. Retrieved April 16, 2025, from https://www.sciencedirect.com/science/article/pii/B9780123739605002240

[10] Kautzky-Willer, A., Harreiter, J., & Pacini, G. (2016). Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus [Review of Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus]. Endocrine Reviews, 37(3), 278. Oxford University Press. https://doi.org/10.1210/er.2015-1137

[11] Kerama, C., Horné, D., Ong'ang'o, J. R., & Anzala, O. (2023). Rethinking the syndemic of tuberculosis and dysglycaemia: a Kenyan perspective on dysglycaemia as a neglected risk factor for tuberculosis [Review of Rethinking the syndemic of tuberculosis and dysglycaemia: a Kenyan perspective on dysglycaemia as a neglected risk factor for tuberculosis]. Bulletin of the National Research Centre/Bulletin of the National Research Center, 47(1). Springer Science+Business Media. https://doi.org/10.1186/s42269-023-01029-6

[12] Kerama, C., Horné, D., Ong'ang'o, J. R., & Anzala, O. (2023). Rethinking the syndemic of tuberculosis and dysglycaemia: a Kenyan perspective on dysglycaemia as a neglected risk factor for tuberculosis [Review of Rethinking the syndemic of tuberculosis and dysglycaemia: a Kenyan perspective on dysglycaemia as a neglected risk factor for tuberculosis]. Bulletin of the National Research Centre/Bulletin of the National

Research Center, 47(1). Springer Science+Business Media. https://doi.org/10.1186/s42269-023-01029-6

[13] Kubiak, R. W., Sarkar, S., Horsburgh, C. R., Roy, G., Kratz, M., Reshma, A., Knudsen, S., Salgame, P., Ellner, J. J., Drain, P. K., & Hochberg, N. S. (2019). Interaction of nutritional status and diabetes on active and latent tuberculosis: a cross-sectional analysis. BMC Infectious Diseases, 19(1). https://doi.org/10.1186/s12879-019-4244-4

[14] Kumari, M., & Singh, R. kumar. (2020). Evaluation of safety and efficacy of glimepiride and sitagliptin in combination with metformin in patients with type 2 diabetes mellitus: Analytical study.

[15] Kumari, M., & Singh, R. kumar. (2020). Evaluation of safety and efficacy of glimepiride and sitagliptin in combination with metformin in patients with type 2 diabetes mellitus: Analytical study.

[16] Kumbar, A. S., Faseed, M., & D.S, H. (2021). Pattern of chest radiographic abnormalities and co-morbidities in newly detected sputum positive pulmonary tuberculosis cases. Indian Journal of Immunology and Respiratory Medicine, 6(1), 10. https://doi.org/10.18231/j.ijirm.2021.003

[17] Läll, K., Mägi, R., Morris, A. P., Metspalu, A., & Fischer, K. (2016). Personalized risk prediction for type 2 diabetes: the potential of genetic risk scores. Genetics in Medicine, 19(3), 322. https://doi.org/10.1038/gim.2016.103

[18] Laxmi, S. B., Kandikonda, S. H., Vemuri, J. L. N., & Rao, R. L. L. (2019). A study on prevalence of diabetes mellitus among adult tuberculosis patients in tertiary health care centre, Hyderabad. International Journal of Community Medicine and Public Health, 6(3), 1225. https://doi.org/10.18203/2394-6040.ijcmph20190616

[19] Naghipour, A., Khatirnamani, Z., Kalteh, E. A., & Taramian, S. (2021). Prevalence of Tuberculosis in Diabetic Patients Living in Rural Areas of Northern Iran in 2016. Journal of Guilan University of Medical Sciences, 29(4), 114. https://doi.org/10.32598/jgums.29.4.1

[20] Okemah, J., Peng, J., & Quiñones, M. J. (2018). Addressing Clinical Inertia in Type 2 Diabetes Mellitus: A Review [Review of Addressing Clinical Inertia in Type 2 Diabetes Mellitus: A Review]. Advances in Therapy, 35(11), 1735. Adis, Springer Healthcare. https://doi.org/10.1007/s12325-018-0819-5

[21] Olokoba, A. B., Obateru, O. A., & Olokoba, L. B. (2012). Type 2 Diabetes Mellitus: A Review of Current Trends [Review of Type 2 Diabetes Mellitus: A Review of Current Trends]. Oman Medical Journal, 27(4), 269. Oman Medical Specialty Board. https://doi.org/10.5001/omj.2012.68

[22] Ong, K. L., Stafford, L. K., McLaughlin, S. A., Boyko, E. J., Stein, D. J., Smith, A., Dalton, B., Duprey, J., Cruz, J. A., Hagins, H., Lindstedt, P. A., Aali, A., Abate, Y. H., Abate, M. D., Abbasian, M., Abbasi-Kangevari, Z., Abbasi-Kangevari, M., ElHafeez, S. A., Abd-Rabu, R., … Azadnajafabad, S. (2023). Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet, 402(10397), 203. https://doi.org/10.1016/s0140-6736(23)01301-6

[23] Pappachan, J. M. (2021). Efficacy and Cardiovascular Safety of Antidiabetic Medications. In Current Drug Safety (Vol. 16, Issue 2, p. 115). Bentham Science Publishers. https://doi.org/10.2174/1574886316666210112153429

[24] Patel, B. K., Gochhait, D., Dhandapani, K., Jamir, T. S., Edura, P., Parepalli, D., & Siddaraju, N. (2023). Bacillary Positive Tuberculous Body Fluid Smears: A Perspective on How Fast to Use Acid Fast. Cureus. https://doi.org/10.7759/cureus.38447

[25] Patil, S., Nishat, S. A., & Dharapur, P. (2023). Comparing the effect of Sitagliptin versus Glimepiride on lipid profile and BMI in known case of Type 2 Diabetes Mellitus.

[26] Phelan, J. J., Basdeo, S. A., Tazoll, S. C., McGivern, S., Saborido, J. R., & Keane, J. (2018). Modulating Iron for Metabolic Support of TB Host Defense [Review of Modulating Iron for Metabolic Support of TB Host Defense]. Frontiers in Immunology, 9. Frontiers Media. https://doi.org/10.3389/fimmu.2018.02296

[27] Pokharel, D. R., Gautam, N., Archana, J., Nagamma, T., Kumar, R., & Sapkota, R. M. (2012). Frequency of Type 2 Diabetes mellitus and Impaired Glycemia in a Teaching Hospital of South-Western Nepal. Asian Journal of Medical Sciences, 2(3), 202. https://doi.org/10.3126/ajms.v2i3.5485

[28] Prezzemolo, T., Guggino, G., Manna, M. P. L., Liberto, D. D., Dieli, F., & Caccamo, N. (2014). Functional Signatures of Human CD4 and CD8 T Cell Responses to Mycobacterium tuberculosis [Review of Functional Signatures of Human CD4 and CD8 T Cell Responses to Mycobacterium tuberculosis]. Frontiers in Immunology, 5. Frontiers Media. https://doi.org/10.3389/fimmu.2014.00180

[29] Restrepo, B. I. (2007, July 25). Convergence of the Tuberculosis and Diabetes Epidemics: Renewal of Old Acquaintances. In Clinical Infectious Diseases (Vol. 45, Issue 4, p. 436). Oxford University Press. https://doi.org/10.1086/519939

[30] Roden, M., & Shulman, G. I. (2019). The integrative biology of type 2 diabetes [Review of The integrative biology of type 2 diabetes]. Nature, 576(7785), 51. Nature Portfolio. https://doi.org/10.1038/s41586-019-1797-8

[31] Tarachandani, D., Singhal, K., Goyal, A., Joshi, A., & Joshi, R. (2023). Quantum of Stress Hyperglycemia at the Time of Initial Diagnosis of Tuberculosis. Cureus. https://doi.org/10.7759/cureus.36382

[32] Tarachandani, D., Singhal, K., Goyal, A., Joshi, A., & Joshi, R. (2023). Quantum of Stress Hyperglycemia at the Time of Initial Diagnosis of Tuberculosis. Cureus. https://doi.org/10.7759/cureus.36382

[33] Vashishtha, V. M. (2010). Current status of tuberculosis and acute respiratory infections in India: Much more needs to be done! Indian Pediatrics, 47(1), 88. https://doi.org/10.1007/s13312-010-0005-6

[34] Wu, Y., Ding, Y., Tanaka, Y., & Zhang, W. (2014). Risk Factors Contributing to Type 2 Diabetes and Recent Advances in the Treatment and Prevention [Review of Risk Factors Contributing to Type 2 Diabetes and Recent Advances in the Treatment and Prevention]. International Journal of Medical Sciences, 11(11), 1185. Ivyspring International Publisher. https://doi.org/10.7150/ijms.10001

[35] Yorke, E., Atiase, Y., Akpalu, J., Sarfo-Kantanka, O., Boima, V., & Dey, I. D. (2017). The Bidirectional Relationship between Tuberculosis and Diabetes [Review of The Bidirectional Relationship between Tuberculosis and Diabetes]. Tuberculosis Research and Treatment, 2017, 1. Hindawi Publishing Corporation. https://doi.org/10.1155/2017/1702578

[36] Yorke, E., Atiase, Y., Akpalu, J., Sarfo-Kantanka, O., Boima, V., & Dey, I. D. (2017). The Bidirectional Relationship between Tuberculosis and Diabetes [Review of The Bidirectional Relationship between Tuberculosis and Diabetes]. Tuberculosis Research and Treatment, 2017, 1. Hindawi Publishing Corporation. https://doi.org/10.1155/2017/1702578

[37] Yvonne, O. (2013). Diabetes Mellitus in Developing Countries and Case Series. In InTech eBooks. https://doi.org/10.5772/50658