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Prevalence of Tuberculosis Infection Among Individuals with Diabetes Mellitus at Pasir Mulya Primary Health Center, Bogor City

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Abstract. *Diabetes mellitus is a chronic metabolic disorder marked by elevated blood glucose levels and a weakened immune system, which increases vulnerability to infections such as tuberculosis. In Indonesia, the prevalence of both conditions continues to rise; however, the relationship between them remains inconsistent. This study aims to examine the association between demographic factors—specifically gender and age—and the incidence of tuberculosis among patients with diabetes mellitus. A quantitative cross-sectional study was conducted involving 30 diabetes mellitus patients registered at the Pasir Mulya Health Center, Bogor City, from September 2024 to March 2025. Tuberculosis diagnosis was performed using the GeneXpert method, while statistical analysis employed the Chi-Square test and Fisher's Exact Test. The majority of respondents were male (66.7%) and under 60 years of age (63.3%). Statistical analysis revealed no significant association between gender ($p = 0.101$) or age ($p = 0.702$) and the incidence of tuberculosis in this population. Although a higher proportion of TB was observed in male and younger patients, the differences were not statistically significant. These findings highlight the need for sustained preventive measures and targeted health promotion, particularly among high-risk groups.*

Keywords: *Tuberculosis prevalence, diabetes mellitus patients, comorbidity TB-DM, primary health care, Bogor City epidemiology*

1. Introduction

Diabetes mellitus is a prolonged metabolic conditions characterized by abnormal elevations in blood glucose levels. This disorder typically emerges due to either a deficiency in insulin production by the pancreas or reduced cellular responsiveness to insulin activity (Sehgal et al., 2025). Current global estimates suggest that approximately 537 million individuals aged 20 to 79 are affected by diabetes. Indonesia is between the top five countries in terms of prevalence, with an estimated 19.5 million diagnosed cases and over 236,000 diabetes-related deaths (WHO, 2023; Indonesia, 2023; Safinatin Najiyah et al., 2024).

Individuals living with diabetes are prone to experiencing serious health complications, including cardiovascular disease, renal failure, limb amputation, visual impairment, and nerve damage (Hartono, 2020; Singh et al., 2025). Persistently high glucose levels can accelerate plaque accumulation within blood vessels, a condition known as atherosclerosis, which interferes with oxygenated blood delivery to essential organs such as the eyes, kidneys, and lower extremities. This blockage increases the likelihood of cardiovascular events and can result in fatal outcomes (Zahid et al., 2025).

Tuberculosis (TB) is a communicable disease initiated by *Mycobacterium tuberculosis*, a pathogen that predominantly infects the lungs but may also affect other parts of the body, including bones, lymph nodes, skin, kidneys, and the central nervous system. The

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transmission primarily occurs through aerosol droplets expelled by infected individuals during coughing or sneezing (Guo et al., 2022; Noubiap et al., 2019). Among patients with diabetes, immune defenses such as neutrophils, macrophages, and NK cells are often impaired. Macrophages, in particular, serve as hosts for *Mycobacterium tuberculosis* replication, further increasing vulnerability to TB infection in diabetic individuals (Abbas et al., 2022; Alves et al., 2025).

Globally, TB was the second-leading cause of death after COVID-19 in 2022. Indonesia recorded the second-highest number of TB cases worldwide, following India (Goig et al., 2025). The reported cases of TB have shown a sharp increase over the past three years, rising from 443,235 in 2021 to 724,309 in 2022 and escalating further to 821,200 in 2023 (WHO, 2024).

A studies conducted by Chen et al. (2021) and colleagues indicated that around 15% of individuals with diabetes mellitus are also diagnosed with tuberculosis, primarily due to weakened immune defenses. In response, the World Health Organization (WHO) has implemented bidirectional screening programs in several countries to detect the coexistence of both diseases (WHO, 2023). These screenings found that the prevalence of diabetes among TB patients averaged 21%, with ranges from 11% in Bangladesh to 24% in Sri Lanka (Gautam et al., 2021; Mahato et al., 2025) Local data from the Bogor City Health Office also revealed a simultaneous rise in diabetes and tuberculosis cases, underscoring the need for further investigation into the interplay between these two conditions.

2. Methods

The sample used was 30 people with diabetes mellitus, the examination was carried out quantitatively from September 2024 to March 2025 at the Pasir Mulya Health Center, Bogor City. The tools and materials used are pots of phlegm, cetridge, droplet pipettes, phlegm, tissue The tool used is GeneXpert uses an automated system in integrating the process of specimen purification, nucleic acid amplification, and target sequence detection.

3. Results and Discussion

From the research that has been carried out on 30 samples from September 2024 to March 2025, the number of diabetes mellitus patients based on the lowest sex is obtained in table 1, as follows:

Table 1. Gender Characteristics of Diabetic Mellitus Patients

Gender	Quantity (n)	Presentase (%)
Male	20	66.7
Female	10	33.3
Sum	30	100

Table 1 shows the sex distribution in 30 samples of diabetes mellitus patients studied from September 2024 to March 2025. Of the total sample, the majority were men with a total of 20 people (66.7%), while women amounted to 10 people (33.3%). This data indicates that in the sample population of this study, diabetes mellitus patients are more prevalent in men than in women.

Table 2. Age Characteristics of Diabetes Mellitus Patients

Age	Quantity (n)	Presentase (%)
< 60 years old	19	63.3
> 60 years old	11	36.7
Sum	30	100

Table 2 shows that most of the diabetes mellitus patients in this study were in the age group under 60 years old, namely 19 people (63.3%), while the remaining 11 people (36.7%) were over 60 years old. Although diabetes mellitus is known as a degenerative disease whose prevalence increases with age, these results suggest that productive age groups are also beginning to show vulnerability to the disease. This can be caused by lifestyle changes, high-calorie diets, lack of physical activity, and work stress that trigger metabolic disorders at a young age.

Table 3. Sex Relationship with Tuberculosis Incidence In Patients with Diabetes Mellitus

		TCM Results		Total
		Positive	Negative	
Gender	Male	9	11	20
	Female	1	9	10
Total		10	20	30

From Table 3, it was found that among 20 male diabetes mellitus patients, 9 tested positive for tuberculosis and the remaining 11 were negative. Meanwhile, among the 10 female diabetes mellitus patients, only 1 tested positive for tuberculosis and the remaining 9 were negative. A study conducted at Haji General Hospital Medan found that 64.2% were male and 35.8% were female among the tuberculosis-diabetes mellitus group (Batubara & Lukito, 2024).

Table 4. Chi *Square* Test Sex Relationship With IncidenceTuberculosis in Diabetic Mellitus

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3,675[a]	1	,055		
Continuity Correction[b]	2,269	1	,132		
Likelihood Ratio	4,164	1	,041		
Fisher's Exact Test				,101	,062
Linear-by-Linear Association	3,553	1	,059		
N of Valid Cases	30				

a. One cell (25.0%) has an expected count of less than 5. The minimum expected count is 3.33.
b. Calculated only for a 2×2 contingency table.

To assess the potential association between sex and the incidence of tuberculosis among patients with diabetes mellitus, a chi-square test was performed, with the findings summarized in Table 4. The Pearson Chi-Square test yielded an Asymptotic Significance (2-sided) value of 0.055, which is marginally above the conventional alpha level of 0.05,

indicating that the result is not statistically significant. Additionally, it is important to highlight that one of the cells in the contingency table (25.0%) had an expected frequency lower than 5, specifically 3.33, which could reduce the validity and robustness of the chi-square test outcome. Given this limitation, the Fisher's Exact Test was also applied to provide a more accurate measure of significance for small sample sizes. The resulting Exact Significance (2-sided) value was 0.101, further confirming that the observed association between sex and tuberculosis incidence is not statistically significant ($p > 0.05$).

Although the descriptive data indicate a higher proportion of tuberculosis cases among male participants, this difference lacks sufficient statistical evidence to support a generalizable conclusion. Therefore, the findings suggest that in this sample, sex does not significantly influence the incidence of tuberculosis among people with diabetes mellitus.

Table 5. Relationship of Age to the Incidence of Tuberculosis in Diabetic Mellitus Patients

		TCM Results		Total
		Positif	Negatif	
Age	**< 60**	7	12	19
	> 60	3	8	11
Total		10	20	30

Table 5 presents the distribution of tuberculosis incidence across age groups among patients with diabetes mellitus. Among the 19 patients aged below 60 years, 7 individuals (36.8%) tested positive for tuberculosis, while 12 individuals (63.2%) tested negative. In comparison, among the 11 patients aged 60 years and above, 3 individuals (27.3%) were TB-positive, and 8 individuals (72.7%) were TB-negative. Descriptively, the younger age group (<60 years) showed a slightly higher proportion of TB cases compared to the older group (>60 years).

Table 6. *Chi Square* Test Relationship with Tuberculosis Incidence in Diabetic Mellitus

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,287a	1	,592		
Continuity Correction[b]	,018	1	,893		
Likelihood Ratio	,292	1	,589		
Fisher's Exact Test				,702	,452
Linear-by-Linear Association	,278	1	,598		
N of Valid Cases	30				

a. One cell (25.0%) had an expected count of less than 5, with the minimum expected count being 3.67.
b. Calculated only for a 2×2 contingency table.

To determine whether age is associated with the incidence of tuberculosis among individuals with diabetes mellitus, a chi-square test was performed, and the outcomes are displayed in Table 6. The Pearson Chi-Square test produced an Asymptotic Significance (2-sided) value of 0.592, which exceeds the commonly accepted significance level of 0.05, suggesting no meaningful statistical association. Similarly, the Fisher's Exact Test returned an

Exact Significance (2-sided) value of 0.702, reinforcing the conclusion that the observed variation is not statistically significant.

It is worth mentioning that one cell in the cross-tabulation (25.0%) had an expected frequency of less than 5 (specifically, 3.67), which may limit the validity of the chi-square result. In situations where expected cell counts are low, Fisher's Exact Test is generally regarded as a more appropriate statistical method. The findings from both tests consistently indicate that age does not have a significant effect on tuberculosis incidence in the diabetes mellitus patient sample analyzed in this study. Thus, although there appeared to be a slightly higher proportion of TB cases in the younger age group (<60 years) compared to the older group (≥60 years), the difference is not statistically significant, and therefore, cannot be generalized to the broader diabetic population (Jiang et al., 2024; Sehgal et al., 2025).

This study involved 30 patients with diabetes mellitus registered at the Pasir Mulya Health Center, Bogor City, between September 2024 and March 2025. Initial analysis focused on respondent demographics, including gender and age, as these are key determinants of susceptibility to infectious diseases such as tuberculosis (TB).

Of the 30 participants, 20 were male (66.7%) and 10 were female (33.3%). These findings indicate a higher prevalence of diabetes mellitus among males in this population. This aligns with research by Adlanta et al. (2022) which reported that comorbidity between TB and diabetes is more frequently observed in men. Possible contributing factors include riskier lifestyles such as smoking, alcohol consumption, poor dietary habits, and physical inactivity. Moreover, differences in hormonal profiles and immune responses between sexes may influence susceptibility to both diabetes and TB (Batubara & Lukito, 2024; WHO, 2024).

In terms of age distribution, the majority of patients (19 individuals or 63.3%) were under 60 years old, while 11 patients (36.7%) were 60 years or older. These findings reflect a global epidemiological shift in which diabetes mellitus is increasingly affecting younger, working-age individuals due to widespread adoption of unhealthy lifestyles (Prathiksha et al., 2025; Rickman et al., 2025). Supporting this, Pahlawati & Nugroho (2019) found that younger adults often lack awareness of diabetes risks, making them more prone to complications that may go undetected.

The study also explored the association between demographic factors and TB incidence among diabetic patients. An analysis of the relationship between gender and TB status showed that 9 out of 20 male patients (45%) tested positive for TB, while only 1 out of 10 female patients (10%) did. Despite this apparent difference, the Pearson chi-square test yielded a significance value of 0.055, marginally above the 0.05 threshold. Given that 25% of the cells had expected counts below 5 (minimum expected count: 3.33), a Fisher's Exact Test was conducted, resulting in a p-value of 0.101. Thus, no statistically significant association was found between gender and TB incidence in diabetic patients. These findings are consistent with those of Anisah et al. (2021) and Widiati & Majdi (2021), who also reported that gender was not significantly associated with TB, including drug-resistant and pulmonary forms.

A separate analysis examined the relationship between age and TB incidence. Among patients under 60 years, 7 out of 19 (36.8%) tested positive for TB. Among patients aged 60 years and above, 3 out of 11 (27.3%) were TB positive. Although TB incidence appeared higher in the younger group, the chi-square test produced a significance value of 0.592, and the Fisher's Exact Test showed a p-value of 0.702—both well above the conventional alpha level of 0.05. Hence, no statistically significant relationship was found between age and TB

incidence in this cohort. These results support findings by Widiati & Majdi (2021), who also reported no significant age-related association with pulmonary TB. However, this contrasts with findings from Sunarmi & Kurniawaty (2022), who observed a significant correlation between TB incidence and age in elderly populations.

While this study did not find statistically significant associations between age or sex and TB among diabetes mellitus patients, descriptive patterns still suggest the need for continued monitoring, especially in younger, male populations with lifestyle-related risk factors.

Conclusions

The findings of this study indicate that among diabetes mellitus patients diagnosed with pulmonary tuberculosis, the majority were male (9 out of 10, or 90%), and most belonged to the non-geriatric age group (under 60 years), accounting for 70% of cases. Despite these descriptive trends, statistical analysis confirmed that no significant association exists between sex or age and the incidence of tuberculosis in individuals with diabetes mellitus. These results are consistent with previous studies showing inconsistencies in the relationship between diabetes and tuberculosis. For example, while one hospital-based study identified a significant link between the two conditions, another reported no such association. This variation suggests that the relationship may be influenced by contextual, environmental, or population-specific factors.

In light of these findings, it is recommended that health authorities and relevant stakeholders intensify preventive strategies and targeted health promotion efforts, particularly for populations identified as having higher potential risk for pulmonary tuberculosis. Emphasis should be placed on early screening and education to reduce morbidity in vulnerable groups.

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Conflicts of Interest

The authors declare no conflict of interest.

References

Abbas, U., Masood, K. I., Khan, A., Irfan, M., Saifullah, N., Jamil, B., & Hasan, Z. (2022). Tuberculosis and diabetes mellitus: Relating immune impact of co-morbidity with challenges in disease management in high burden countries. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, *29*(November), 100343. https://doi.org/10.1016/j.jctube.2022.100343

Adlanta, V., Sari, R. S., & Octavia, N. A. H. (2022). Angka Kejadian Tuberkulosis Paru Pada Pasien Diabetes Melitus Tipe Ii Yang Rawat Inap Di Rs Umum Daerah Dr. Pirngadi Medan. *Ibnu Sina: Jurnal Kedokteran Dan Kesehatan - Fakultas Kedokteran Universitas Islam Sumatera Utara*, *21*(2), 223–232. https://doi.org/10.30743/ibnusina.v21i2.303

Alves, L. S., Berra, T. Z., Alves, Y. M., Ferezin, L. P., Vinci, A. L. T., Tavares, R. B. V., Tártaro, A. F., Gomes, D., & Arcêncio, R. A. (2025). Geographic inequalities and factors associated with unfavorable outcomes in diabetes-tuberculosis and diabetes-covid comorbidities in Brazil. *Scientific Reports*, *15*(1), 1–15. https://doi.org/10.1038/s41598-025-93476-6

Anisah, A., Sumekar, D. W., & Budiarti, E. (2021). Hubungan Demografi dan Komorbid dengan Kejadian Tuberkulosis Resisten Obat (TB RO). *Jurnal Ilmiah Kesehatan Sandi Husada*, *10*(2), 568–574. https://doi.org/10.35816/jiskh.v10i2.655

Batubara, F. A., & Lukito, A. (2024). Relationship Of Type II Diabetes Mellitus With The Risk Of Enhancement The Incidence Of Pulmonary Tuberculosis At Haji General Hospital Medan In 2022. *Ibnu SIna: Jurnal Kedokteran Dan Kesehatan Faklutas Kedokteran Universitas Islam Sumatera Utara*, *23*(2), 178–185.

Chen, Z., Liu, Q., Song, R., Zhang, W., Wang, T., Lian, Z., Sun, X., & Liu, Y. (2021). The association of glycemic level and prevalence of tuberculosis: a meta-analysis. *BMC Endocrine Disorders*, *21*(1), 1–14. https://doi.org/10.1186/s12902-021-00779-6

Gautam, S., Shrestha, N., Mahato, S., Nguyen, T. P. A., Mishra, S. R., & Berg-Beckhoff, G. (2021). Diabetes among tuberculosis patients and its impact on tuberculosis treatment in South Asia: a systematic review and meta-analysis. *Scientific Reports*, *11*(1), 1–12. https://doi.org/10.1038/s41598-021-81057-2

Goig, G. A., Windels, E. M., Loiseau, C., Stritt, C., Biru, L., Borrell, S., Brites, D., & Gagneux, S. (2025). Ecology, global diversity and evolutionary mechanisms in the Mycobacterium tuberculosis complex. *Nature Reviews Microbiology*, 1–13.

Guo, S., Lei, S., Li, J., Li, L., Chen, H., & Chongsuvivatwong, V. (2022). Gradient association between pulmonary tuberculosis and diabetes mellitus among households with a tuberculosis case: a contact tracing-based study. *Scientific Reports*, *12*(1), 1–10. https://doi.org/10.1038/s41598-022-05417-2

Hartono, D. S. (2020). Hubungan Self Care Dengan Komplikasi Diabetes Mellitus Pada Pasien Diabetes Mellitus Tipe Ii Di Poli Penyakit Dalam Rsud Dokter Mohamad Saleh Kota Probolinggo. *Journal of Nursing Care & Biomolecular*, *4*(2), 2019–2111.

Indonesia, K. K. R. (2023). *Laporan Program Pengendalian Tuberkulosis Indonesia 2023*. Kementerian Kesehatan RI. https://tbindonesia.or.id

Jiang, Y., Zhang, W., Wei, M., Yin, D., Tang, Y., Jia, W., Wang, C., Guo, J., Li, A., & Gong, Y. (2024). Associations between type 1 diabetes and pulmonary tuberculosis: a bidirectional mendelian randomization study. *Diabetology and Metabolic Syndrome*, *16*(1), 1–9. https://doi.org/10.1186/s13098-024-01296-x

Mahato, R. K., Htike, K. M., Koro, A. B., Yadav, R. K., Sharma, V., Kafle, A., & Ojha, S. C. (2025). Spatial autocorrelation with environmental factors related to tuberculosis prevalence in Nepal, 2020–2023. *Infectious Diseases of Poverty*, *14*(1), 15.

Noubiap, J. J., Nansseu, J. R., Nyaga, U. F., Nkeck, J. R., Endomba, F. T., Kaze, A. D., Agbor, V. N., & Bigna, J. J. (2019). Global prevalence of diabetes in active tuberculosis: a systematic review and meta-analysis of data from 2·3 million patients with tuberculosis. *The Lancet Global Health*, *7*(4), e448–e460. https://doi.org/10.1016/S2214-109X(18)30487-X

Pahlawati, A., & Nugroho, P. S. (2019). Hubungan Tingkat Pendidikan dan Usia dengan Kejadian Diabetes Melitus di Wilayah Kerja Puskesmas Palaran Kota Samarinda Tahun 2019. *Borneo Student Research*, *1*(1), 1–5. https://doi.org/10.33024/jdk.v8i4.2261

Prathiksha, G., Newtonraj, A., Thiruvengadam, K., Frederick, A., Selvaraju, S., Murugesan, H., Chitra, J., Rani, V., Munivaradhan, P., & Nithyakumar, D. (2025). Tuberculosis and alcohol use; findings from a subnational TB prevalence survey in India. *Indian Journal of Tuberculosis*.

Rickman, H. M., Phiri, M. D., Feasey, H. R. A., Krutikov, M., Shao, H., Horton, K. C., Dowdy, D. W., Nightingale, E. S., Dodd, P. J., & Corbett, E. L. (2025). Sex differences in the risk of Mycobacterium tuberculosis infection: a systematic review and meta-analysis of population-based immunoreactivity surveys. *The Lancet Public Health*, *10*(7), e588–e598.

Safinatin Najiyah, K., Hazmi Fadhilah, W., Tan, W., & Ilmu Kesehatan Masyarakat, B. (2024). Upaya Peningkatan Kewaspadaan Penyakit Diabetes Melitus Melalui Edukasi Dan Skrining Gula Darah Sewaktu. *Versi Cetak)*, *7*(3), 641–648.

Sehgal, I. S., Soundappan, K., Agarwal, R., Muthu, V., Dhooria, S., Prasad, K. T., Salzer, H. J. F., Cornely, O. A., Aggarwal, A. N., & Chakrabarti, A. (2025). Prevalence of Chronic Pulmonary Aspergillosis in Patients With Mycobacterial and Non-Mycobacterial Tuberculosis Infection of the Lung: A Systematic Review and Meta-Analysis. *Mycoses*, *68*(4), e70060.

Singh, S., Zahiruddin, Q. S., Lakhanpal, S., Ballal, S., Kumar, S., Bhat, M., Sharma, S., Kumar, M. R., Dhandh, Y. K., & Rustagi, S. (2025). Wealth-based inequalities in tuberculosis prevalence among households having children and young adults in India: insights from Indian demographic and health surveys (2015–2021). *BMC Infectious Diseases*, *25*(1), 21.

Sunarmi, S., & Kurniawaty, K. (2022). Hubungan Karakteristik Pasien Tb Paru Dengan Kejadian Tuberkulosis. *Jurnal 'Aisyiyah Medika*, *7*(2), 182–187. https://doi.org/10.36729/jam.v7i2.865

WHO, W. H. O. (2023). *WHO TB Country Profile: Indonesia*. https://worldhealthorg.shinyapps.io/tb_profiles/

WHO, W. H. O. (2024). Tuberculosis Fact Sheet. In *World Health Organization*. https://www.who.int/news-room/fact-sheets/detail/tuberculosis

Widiati, B., & Majdi, M. (2021). Analisis Faktor Umur, Tingkat Pendidikan, Pekerjaan dan Tuberkulosis Paru di Wilayah Kerja Puskesmas Korleko, Kabupaten Lombok Timur. *Jurnal Sanitasi Dan Lingkungan*, *2*(2), 173–184.

Zahid, M., Afaq, S., Shafique, K., Qazi, F. K., Khan, U., Asim, M., Nooreen, S., & Shehzad, S. (2025). Effect of glycemic control on tuberculosis treatment outcomes among patients with tuberculosis and diabetes mellitus: A systematic review and meta-analysis. *Tropical Medicine and International Health*, 1–14. https://doi.org/10.1111/tmi.14140