

## Original Research

**Association Between Diabetes Mellitus and GeneXpert MTB/RIF Results in Suspected Tuberculosis Patients**  
**Erlinda Triana Putri<sup>1</sup>, Didik Wahyudi<sup>2\*</sup>**<sup>1</sup>Sarjana Terapan Medical Laboratory Technology Study Program, Sekolah Tinggi Ilmu Kesehatan Nasional, Jl Raya Solo – Baki, Kwarasan, Grogol, Sukoharjo, Central Java, Indonesia<sup>2</sup>Diploma III Medical Laboratory Technology Study Program, Sekolah Tinggi Ilmu Kesehatan Nasional, Jl Raya Solo – Baki, Kwarasan, Grogol, Sukoharjo, Central Java, Surakarta, Indonesia**ABSTRACT**

**Background:** Tuberculosis (TB) remains a major global health problem, and Diabetes Mellitus (DM) may increase susceptibility to *Mycobacterium tuberculosis* infection due to impaired immunity. This study aimed to determine the association between DM status and Molecular Rapid Test (TCM) results among suspected TB patients.

**Methods:** This observational analytic study used a cross-sectional design with secondary data obtained from medical records of suspected TB patients who underwent TCM examination at UPT Puskesmas Wonosari I, Gunungkidul Regency, during 2022–2025. A total of 552 patients were included using total sampling.

**Results:** Data were analyzed descriptively and using Fisher's Exact Test. Among the patients, 50 (9.1%) had DM and 502 (90.9%) did not. TCM examination showed MTB detected in 37 patients (6.7%) and not detected in 515 patients (93.3%). Positive TCM results were found in 14.0% of DM patients and 6.0% of non-DM patients. Statistical analysis showed no significant association between DM status and TCM results ( $p=0.066$ ).

**Conclusion:** DM status was not significantly associated with TCM examination results among suspected TB patients.

**KEYWORDS:** Diabetes Mellitus, Tuberculosis, Molecular Rapid Test, TCM, GeneXpert

**ARTICLE HISTORY**

Received : May 08, 2026

Revised : May 11, 2026

Accepted : June 30, 2026

**Corresponding Author:**Didik Wahyudi  
Sekolah Tinggi Ilmu Kesehatan  
Nasional.

Email:

[didik.wahyudi@stikesnas.ac.id](mailto:didik.wahyudi@stikesnas.ac.id)**INTRODUCTION**

Tuberculosis (TB) remains one of the leading infectious diseases worldwide and continues to be a major public health challenge, particularly in developing countries. According to the World Health Organization (WHO) (WHO, 2024), Indonesia ranks among the countries with the highest burden of tuberculosis globally (Prakoso et al., 2023). The persistence of TB cases is influenced by several risk factors, including Diabetes Mellitus (DM) (Wijayanti, 2024), which is known to impair immune function and increase susceptibility to *Mycobacterium tuberculosis* infection (Leegaard et al., 2011; Chabaria et al., 2023). Diabetes Mellitus contributes to immune dysfunction through impaired

macrophage activity, reduced neutrophil chemotaxis, and disruption of cellular immune responses (Rohman et al., 2023). These conditions increase the risk of latent TB activation and progression to active tuberculosis (Prakoso et al., 2023). Previous studies reported that individuals with DM have approximately three times higher risk of developing active tuberculosis compared to non-diabetic individuals (Soelistijo et al., 2021). In addition, hyperglycemia has been associated with higher bacterial burden and more severe TB manifestations (Sina et al., 2024; Rahmawati et al., 2025; (Jeon & Murray, 2018).

The implementation of Molecular Rapid Test (Tes Cepat Molekuler/TCM) using GeneXpert MTB/RIF has become an important advancement in tuberculosis diagnosis (Ambarwati et al., 2024; (Tegegne et al., 2017). This method enables rapid and accurate detection of *Mycobacterium tuberculosis* DNA and rifampicin resistance (Ugarte-Gil et al., 2020). Several studies reported that TB patients with Diabetes Mellitus tend to have higher positivity rates on TCM examination due to increased bacterial load associated with impaired immunity (Chabaria et al., 2023; Leegaard et al., 2011; (Arisandi et al., 2023). Gunungkidul Regency is one of the regions in Yogyakarta Special Region with relatively high tuberculosis incidence (Rohman et al., 2023). Reports from the local health office indicated increasing TB cases, particularly in Wonosari District. At the same time, the prevalence of Diabetes Mellitus in the working area of UPT Puskesmas Wonosari I also remains high, potentially increasing the burden of TB-DM comorbidity (Prakoso et al., 2023; Rahmawati et al., 2025; Arisandi Desto, 2023). Although several studies have investigated the relationship between tuberculosis and Diabetes Mellitus, findings regarding the association between DM status and TCM examination results remain inconsistent. Therefore, this study aimed to analyze the relationship between Diabetes Mellitus status and TCM examination results among suspected tuberculosis patients at UPT Puskesmas Wonosari I, Gunungkidul Regency.

## **MATERIALS AND METHOD**

This study used an observational analytic design with a cross-sectional approach to determine the relationship between Diabetes Mellitus status and TCM examination results among suspected tuberculosis patients. The study was conducted at UPT Puskesmas Wonosari I, Gunungkidul Regency, Special Region of Yogyakarta. Data collection and analysis were carried out from December 2025 to February 2026. The population included all suspected tuberculosis patients who underwent TCM examination during the period of January 2022 to December 2025. Sampling was conducted using total sampling technique. A total of 552 patients who met the inclusion criteria were included in the study. Inclusion Criteria: Suspected tuberculosis patients who underwent TCM examination. Patients with complete medical records indicating Diabetes Mellitus status. Exclusion Criteria: Incomplete medical record data. Invalid or unreadable TCM examination results (Sugiyono, 2021; WHO, 2024). The independent variable was Diabetes Mellitus status categorized into DM positive and DM negative. The dependent variable was TCM examination result categorized into MTB detected and MTB not detected. Data Collection: Secondary data were collected from medical records, laboratory registers, and TCM examination reports. Data collected included Diabetes Mellitus status and TCM examination results (Jasmin et al., 2023). Statistical Analysis: Data were analyzed descriptively using frequency distribution and percentages. Bivariate analysis was performed using Fisher's Exact Test (Fang et al., 2025) because one of the contingency table cells had an expected count less than five. Statistical significance was determined at

p<0.05 (Mulyati et al., 2024; (Jasmin et al., 2023) This study obtained ethical clearance and permission from the relevant health authorities and UPT Puskesmas Wonosari I.

RESULTS

A total of 552 suspected tuberculosis patients were included in this study. Distribution of Diabetes Mellitus status is presented in Table 1.

Table 1. Distribution of Diabetes Mellitus Status among Suspected Tuberculosis Patients

| Diabetes Mellitus Status | n   | %    |
|--------------------------|-----|------|
| DM Positive              | 50  | 9.1  |
| DM Negative              | 502 | 90.9 |
| Total                    | 552 | 100  |

The distribution of TCM examination results is presented in Table 2.

Table 2. Distribution of TCM Examination Results

| TCM Examination Results | n   | %    |
|-------------------------|-----|------|
| MTB Detected            | 37  | 6.7  |
| MTB Not Detected        | 515 | 93.3 |
| Total                   | 552 | 100  |

The relationship between Diabetes Mellitus status and TCM examination results is shown in Table 3.

Table 3. Cross-tabulation of Diabetes Mellitus Status and TCM Examination Results

| Diabetes Mellitus Status | MTB Not Detected | MTB Detected | Total |
|--------------------------|------------------|--------------|-------|
| DM Negative              | 472              | 30           | 502   |
| DM Positive              | 43               | 7            | 50    |
| Total                    | 515              | 37           | 552   |

Among patients with Diabetes Mellitus, 7 patients (14.0%) had positive TCM results. In contrast, among non-DM patients, 30 patients (6.0%) had positive TCM results. Bivariate analysis using Fisher’s Exact Test produced a p-value of 0.066 (p>0.05), indicating no statistically significant relationship between Diabetes Mellitus status and TCM examination results.

DISCUSSION

This study aimed to determine the association between Diabetes Mellitus (DM) status and Molecular Rapid Test (MRT/TCM) results among suspected tuberculosis patients at UPT Puskesmas Wonosari I, Gunungkidul Regency. The findings showed that there was no statistically significant relationship between DM status and TCM examination results (p=0.066). Although the proportion of TCM-positive results was higher among DM patients compared to non-DM patients, the difference was not statistically significant. The findings of this study are consistent with the study conducted by Muzamil et al. (2025), which reported no significant association between blood glucose levels in TB-DM patients and MTB positivity based on TCM examination results. Similarly, (Prakoso et al., 2023) and (Wijayanti, 2024) reported that although Diabetes Mellitus is recognized as an important comorbidity in tuberculosis patients, DM status alone does not always correlate with molecular diagnostic positivity. These findings suggest that factors influencing TCM positivity are multifactorial and not solely determined by metabolic disorders. However, the present findings differ from several previous studies reporting that Diabetes Mellitus significantly increases the risk of active tuberculosis. (Jeon & Murray, 2018) and (Leegaard et al., 2021), through a systematic review, demonstrated that individuals with DM have

approximately three times greater risk of developing active tuberculosis compared to non-diabetic individuals. Zhao et al. (2024) (Ginting et al., 2024) also explained that poor glycemic control contributes to impaired immune responses and worsened TB outcomes. The discrepancy between studies may be influenced by differences in study design, sample characteristics, glycemic control status, and diagnostic methods used. From a theoretical perspective, Diabetes Mellitus can impair both innate and adaptive immune responses. Chronic hyperglycemia reduces macrophage activation, decreases neutrophil chemotaxis, and disrupts T-cell-mediated immunity, thereby facilitating *Mycobacterium tuberculosis* infection (Rahmawati et al., 2025; (Ambarwati et al., 2024) Hyperglycemia also alters cytokine production and pulmonary immune defense mechanisms, increasing susceptibility to active TB infection. Nevertheless, TCM examination primarily detects the presence of *Mycobacterium tuberculosis* DNA in sputum specimens. Therefore, TCM positivity is strongly influenced by bacterial load, sputum quality, and specimen adequacy rather than systemic metabolic conditions alone. The absence of a statistically significant relationship in this study may also be associated with the relatively small number of TCM-positive cases. In addition, this study did not evaluate important clinical variables such as HbA1c level, duration of Diabetes Mellitus, nutritional status, smoking history, or previous tuberculosis treatment, all of which may affect immune function and tuberculosis severity. Patients with well-controlled diabetes may not demonstrate substantially different TCM positivity compared to non-diabetic individuals. Technical and laboratory factors should also be considered. TCM examination sensitivity depends on bacillary concentration in sputum specimens. In paucibacillary conditions, such as early infection or low bacterial burden, TCM may yield negative results despite active infection. According to (Kemenkes RI, 2020; (Sina et al., 2024) sputum quality and proper specimen collection remain critical determinants of TCM diagnostic accuracy. Despite the absence of a significant association, this study highlights the importance of routine TB screening among patients with Diabetes Mellitus because DM remains an important epidemiological risk factor for tuberculosis. Integrated TB-DM screening programs at primary healthcare facilities are recommended to improve early detection and management of both diseases.

## CONCLUSION

There was no statistically significant relationship between Diabetes Mellitus status and TCM examination results among suspected tuberculosis patients at UPT Puskesmas Wonosari I, Gunungkidul Regency, with Fisher's Exact Test showing a p-value of 0.066 ( $p > 0.05$ ). TCM remains an important diagnostic method for tuberculosis regardless of Diabetes Mellitus status. Further studies using longitudinal designs and additional variables such as glycemic control and duration of Diabetes Mellitus are recommended to better understand the relationship between Diabetes Mellitus and tuberculosis.

## ACKNOWLEDGEMENT

The authors would like to express gratitude to UPT Puskesmas Wonosari I, Gunungkidul Regency, for providing access to the data used in this study. Appreciation is also extended to the lecturers and academic staff of Sekolah Tinggi Ilmu Kesehatan Nasional for their guidance and support during the research process.

## REFERENCES

Arisandi. (2023). *Studi Epidemiologi Kejadian Tuberculosis DI Kabupaten Gunungkidul D.I. Yogyakarta*. <https://doi.org/10.47701/sikenas.vi.2881>

- Chabaria, E., Perdani, R., Pratiwi, W., Studi D-Iii, P., Kesehatan, A., & Kalimantan, U. (2023). *Overview of the results of the Rapid Molecular Test Examination on Pulmonary Tuberculosis Suspect Patients at RSUD Ulin Banjarmasin in 2023*. <http://jurnal.polanka.ac.id/index.php/JMPL>
- Wijayanti. (2024). *Hubungan Keterkaitan Pengidap Diabetes Melitus Tipe 2 Dengan Kejadian Tuberkulosis Paru*. <https://doi.org/10.36418/syntax-literate.v9i7.15757>
- Ambarwati, D., Ariyanto, Y., Prasetyowati, I., Epidemiologi, D., Kesehatan Masyarakat, F., Jember, U., Kalimantan no, J., Bumi Tegalboto, K., & Timur, J. (2024). Faktor Penyebab Diabetes Melitus Pada Pasien Tuberkulosis Di Kabupaten Ngawi Tatun 2022: Studi Kasus Kontrol Factors Contributing To Dibetes Mellitus In Tuberculosis Patients In Ngawi Regency, 2022: A Case-Contro Study. In *Damianus Journal of Medicine* (Vol. 23, Number 2). <https://doi.org/10.25170/djm.v23i2.3726>
- Fang, L., Wu, Y., Fang, X., & Ning, J. (2025). Recent advances in biomarkers for diabetes mellitus and tuberculosis comorbidity: a comprehensive review. In *Frontiers in Endocrinology* (Vol. 16). Frontiers Media SA. <https://doi.org/10.3389/fendo.2025.1630603>
- Rohman, H., Kidung Enjang, H., & Kusuma, N. (2023). *Mapping the Distribution and Trendline of Tuberculosis Cases in the Gunungkidul Region*. <https://doi.org/10.56727/4487hb11>
- Jasmin, M., Risnawati, Mk., Rahma Sari Siregar, Mk., St Mutiatu Rahmah, Ms., Wahidah Rohmawati, Mk., Lilis Handayani, Mk., Ronald, Mk., apt Bai Athur Ridwan, Mk., apt Made Ary Sarasmita, Mp., Ns Hana Febriyanti, Mf., Dyah Juliastuti, Mk., Mat, S., Fika Tri Anggraini, dr, Yusnita Anggraeni, Mk. M., & Siska Oktari, Mb. (2023). *Metodologi Penelitian Kesehatan Penerbit CV. Eureka Media Aksara*. <https://repository.penerbiteurka.com/media/publications/564349-metodologi-penelitian-kesehatan-c190c771.pdf>
- Jeon, C. Y., & Murray, M. B. (2018). Diabetes mellitus increases the risk of active tuberculosis: A systematic review of 13 observational studies. *PLoS Medicine*, 5(7), 1091–1101. <https://doi.org/10.1371/journal.pmed.0050152>
- Kemenkes RI. (2020). *Petunjuk Teknis Pemeriksaan TBC dengan TCM*. [https://www.researchgate.net/publication/342199085\\_Petunjuk\\_Teknis\\_Pemeriksaan\\_TBC\\_dengan\\_TCM](https://www.researchgate.net/publication/342199085_Petunjuk_Teknis_Pemeriksaan_TBC_dengan_TCM)
- Ginting, Harianti, Sembiring Alprindo, Siagian Nurul, & Mendrofa Wardah. (2024). *Perbedaan Hasil Pemeriksaan Mycobacterium Tuberculosis Metode Tes Cepat Molekuler Dan Mikroskopis dengan Penundaan 18 Jam Di Puskesmas Binjai Serbangan Kabupaten Asahan* (Vol. 7, Number 2), <https://doi.org/10.30743/best.v7i2.11954>
- Leegaard, A., Riis, A., Kornum, J. B., Prahl, J. B., Thomsen, V., Sørensen, H. T., Horsburgh, C. R., & Thomsen, R. W. (2021). Diabetes, glycemic control, and risk of tuberculosis: A population-based case-control study. *Diabetes Care*, 34(12), 2530–2535. <https://doi.org/10.2337/dc11-0902>
- Mulyati, E., Rosihan Arsyad Suryaningsih, M. M., Sri Maryati, M., Kes Leni Gustina, M., Pilifus Junianto, M. S., Kiki Helencia, M., Linda Prasetyaning Widayanti, M., & Harry Mardika, N. (2024). *Pengantar SPSS: Teori, Implementasi Dan Interpretasi*. [www.gitalentera.com](http://www.gitalentera.com)
- Prakoso, D. A., Istiono, W., Mahendradhata, Y., & Arini, M. (2023). Acceptability and feasibility of tuberculosis-diabetes mellitus screening implementation in private



- primary care clinics in Yogyakarta, Indonesia: a qualitative study. *BMC Public Health*, 23(1). <https://doi.org/10.1186/s12889-023-16840-z>
- Rahmawati, Y. H., Kusyairi, A., & Hafshawaty Fakultas Kesehatan Program Studi, U. S. (2025). Hubungan Nilai Gula Darah Pasien TBC-DM Dengan Tingkat Positif MTB (*Mycobacterium Tuberculosis*) Berdasarkan Hasil TCM (Tes Cepat Molekuler) DI UPT Puskesmas Maron. In 54 | *Health research Journal* (Vol. 3), <https://ejournal.dpdppnikabprobolinggo.org/index.php/health-research-journal/article/view/91/57>
- Sina, I., Kedokteran dan Kesehatan-Fakultas Kedokteran Universitas Islam Sumatera Utara, J., Alziwinindya Batubara, F., Penelitian, A., Lukito, A., & Artikel B S T R A K, H. 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*. 23(2), <https://doi.org/10.30743/ibnusina.v23i2.615>
- Soelistijo, Suastika Ketut, Lindharto Dharma, Decorri Eva, & Permana Hikmat. (2021). *Pedoman Pengelolaan Dan Pencegahan Diabetes Melitus Tipe 2 Dewasa Di Indonesia-2021*, Perkeni Penerbit PB. Perkeni, <https://pbperkeni.or.id/wp-content/uploads/2021/11/22-10-21>
- Sugiyono. (2024). *Metode Penelitian Kuantitatif*. Alfabeta CV., [https://digilib.stekom.ac.id/assets/dokumen/ebook/feb\\_35efe6a47227d6031a75569c2f3f39d44fe2db43\\_1652079047.pdf](https://digilib.stekom.ac.id/assets/dokumen/ebook/feb_35efe6a47227d6031a75569c2f3f39d44fe2db43_1652079047.pdf)
- Tegegne, B. S., Habtewold, T. D., Mengesha, M. M., & Burgerhof, J. G. M. (2017). Association between diabetes mellitus and multi-drug-resistant tuberculosis: A protocol for a systematic review and meta-analysis. *Systematic Reviews*, 6(1). <https://doi.org/10.1186/s13643-017-0407-9>
- Ugarte-Gil, C., Alisjahbana, B., Ronacher, K., Riza, A. L., Koesoemadinata, R. C., Malherbe, S. T., Cioboata, R., Llontop, J. C., Kleynhans, L., Lopez, S., Santoso, P., Marius, C., Villaizan, K., Ruslami, R., Walzl, G., Panduru, N. M., Dockrell, H. M., Hill, P. C., Allister, S. M., ... van Crevel, R. (2020). Diabetes mellitus among pulmonary tuberculosis patients from 4 tuberculosis-endemic countries: The tandem study. *Clinical Infectious Diseases*, 70(5), 780–788. <https://doi.org/10.1093/cid/ciz284>
- WHO. (2024). *2024 Global tuberculosis report*. <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2024>