

The Value of the TB IgG/IgM Rapid Test and Erythrocyte Sedimentation Rate in Relation to Xpert MTB/RIF Tests in the Diagnosis of Pulmonary Tuberculosis

Endah Permata Sari, *Leka Lutpiatina, Aima Insana

¹Rumah Sakit Pertamina Balikpapan, Kalimantan Timur, ²Medical Laboratory Technology Poltekkes Kemenkes Banjarmasin, Mistar Cokrokusumo Street 4A Banjarbaru Indonesia. *Email: leka.zns@gmail.com

Abstract: Tuberculosis (TB) remains a global health problem, requiring healthcare workers to have accurate and effective diagnostic methods. The Xpert MTB/RIF-based Molecular Rapid Test is recommended as the standard for TB diagnosis, but in clinical practice, healthcare workers still frequently use the TB IgG/IgM Rapid Test and the Erythrocyte Sedimentation Rate (ESR) as complementary tests. This study aimed to determine the relationship between Xpert MTB/RIF test results and the TB IgG/IgM Rapid Test and ESR in pulmonary tuberculosis patients at Pertamina Hospital, Balikpapan. This study used a retrospective, observational analytical study design utilizing secondary data from laboratory tests from January–December 2024. Researchers analyzed data from 250 patients who met the inclusion criteria. They analyzed the relationship between variables using the Spearman correlation test. The results showed that 16.4% of patients had MTB detected on the Xpert MTB/RIF test. Statistical analysis showed a significant positive correlation between Xpert MTB/RIF results and the TB IgG/IgM Rapid Test, with a moderate correlation strength ($r = 0.562$; $p < 0.001$). Furthermore, the analysis also showed a significant correlation between Xpert MTB/RIF results and ESR ($r = 0.183$; $p = 0.004$), but with a very weak correlation strength. The majority of patients with MTB detected by Xpert MTB/RIF had positive TB IgG/IgM Rapid Test results and abnormal ESR values. This study shows that the TB IgG/IgM Rapid Test and ESR are associated with Xpert MTB/RIF results. However, both tests have limited specificity and can therefore only be used as supporting tests and cannot replace molecular testing in the diagnosis of pulmonary tuberculosis.

Keywords: Erythrocyte sedimentation rate; molecular rapid test; pulmonary tuberculosis; tuberculosis IgG/IgM rapid test; tuberculosis diagnosis.

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* (MTB) and remains a global health problem. The World Health Organization (WHO) states that TB is among the top ten causes of death worldwide and is a priority in the Sustainable Development Goals (SDGs)¹. In 2016, the WHO estimated there were approximately 10.4 million TB cases globally, with Indonesia ranking second as the country with the highest TB burden in the world. The WHO reports approximately 1,020,000 TB cases in Indonesia, but only a fraction are successfully detected and

Corresponding Author: Leka Lutpiatina
Medical Laboratory Technology Poltekkes Kemenkes Banjarmasin.
Mistar Cokrokusumo Street 4A Banjarbaru Indonesia.
Email: leka.zns@gmail.com

reported, including approximately 32,000 cases of multidrug-resistant TB (MDR-TB)². This situation highlights the importance of implementing accurate and effective TB diagnostic strategies.

In an effort to improve early TB detection, the WHO has recommended the use of the Xpert MTB/RIF test as the initial diagnostic method for TB and MDR-TB since 2010. The Xpert MTB/RIF test is a molecular method based on the Nucleic Acid Amplification Test (NAAT) that can detect MTB and rifampicin resistance simultaneously in a short time. The Indonesian government regulates the implementation of the Xpert MTB/RIF test through Regulation of the Minister of Health of the Republic of Indonesia Number 67 of 2016. Various studies have reported that this test has high sensitivity and specificity and results quality close to bacterial culture, so the WHO recommends it as the standard for TB diagnosis^{3,4}.

Despite this, in clinical practice, particularly in healthcare facilities, medical personnel still frequently use TB IgG/IgM serology as a supporting test. The TB IgG/IgM serology test is an immunochromatography-based rapid test that aims to detect IgG and IgM antibodies to *M. tuberculosis*, thus providing an indication of acute or chronic infection. However, TB serology has diagnostic limitations, with reported sensitivities ranging from 41–55% and specificities of around 96%⁵. Despite this, healthcare facilities still widely use anti-*M. tuberculosis* antibody testing, especially in patients who experience difficulties with bacteriological examination. Research by Rachmayanti et al. (2020) showed that the TB IgG/IgM rapid test has low sensitivity (35%) and high specificity (94%)⁶. Therefore, this test is not recommended as a sole test and should be combined with other diagnostic methods. In addition to serological tests, healthcare workers still widely use the Erythrocyte Sedimentation Rate (ESR) as a supporting test in TB patients. ESR testing is useful for monitoring disease progression and response to treatment, although it is non-specific⁷. Several studies have shown that TB patients generally experience elevated ESR values. Bhavana (2020) reported that TB patients experienced an elevated ESR with an average value of 41–60 mm/hour, which correlated with other inflammatory parameters⁸. Batool et al. (2022) reported that almost all newly diagnosed TB patients experienced an elevated ESR⁹, while Ongwae et al. (2023) showed a significant difference in ESR values between pulmonary TB patients and the control group¹⁰. In Indonesia, healthcare facilities still widely use ESR testing because the procedure is simple, fast, and relatively inexpensive¹¹.

Although various diagnostic methods have been widely used, studies specifically evaluating the relationship between Xpert MTB/RIF results and TB IgG/IgM Rapid Test and ESR values are still limited, especially in the context of healthcare facilities in Indonesia. Several national studies have assessed the accuracy of each test separately, but studies analyzing the correlation between the three parameters in a single patient population are still rare. To date, no research has been found specifically assessing the relationship between these three parameters in the Kalimantan region, including in Balikpapan City. Therefore, this study was conducted to provide an empirical overview of the relationship between Xpert MTB/RIF results, TB IgG/IgM Rapid Test, and ESR values in tuberculosis patients at Pertamina Hospital Balikpapan, so that it can serve as a basis for evaluating the use of TB supporting examinations in clinical practice.

This study aimed to determine the relationship between Xpert MTB/RIF results, TB IgG/IgM Rapid Test results, and Erythrocyte Sedimentation Rate (ESR) in tuberculosis patients at Pertamina Hospital, Balikpapan.

MATERIALS AND METHODS

This is an observational analytical study with a retrospective design using secondary data in the form of laboratory test results and patient medical records. This study aimed to analyze the relationship between Xpert MTB/RIF results and TB IgG/IgM Rapid Tests and Erythrocyte Sedimentation Rate (ESR) in patients with pulmonary tuberculosis.

The researchers conducted this study at the Clinical Pathology Laboratory of Pertamina Hospital, Balikpapan, Indonesia. Data were collected from patient laboratory test results conducted between January and December 2024.

The study population included all suspected pulmonary tuberculosis patients undergoing laboratory tests at Pertamina Hospital, Balikpapan, during that period, totaling 667 patient records. The researchers used a purposive sampling technique based on predetermined inclusion and exclusion criteria. They included patients aged 17–80 years who underwent Molecular Rapid Tests (Xpert MTB/RIF), TB IgG/IgM Rapid Tests, and ESR. Researchers excluded patients who did not undergo all of these tests, were under 17 years of age, refused Xpert MTB/RIF testing, or were undergoing immunosuppressant therapy. Based on these criteria, researchers analyzed data from 250 patients who met the inclusion criteria.

The Xpert MTB/RIF test results were used as the reference standard in this study. The TB IgG/IgM Rapid Test results and ESR values were compared with the Xpert MTB/RIF findings. The Xpert MTB/RIF test was performed using the GeneXpert MTB/RIF system using sputum samples according to standard procedures. Serological testing was performed using the Answers TB IgG/IgM Rapid Test kit according to the manufacturer's instructions; this test uses an immunochromatographic method to qualitatively detect IgG and IgM antibodies to *Mycobacterium tuberculosis* from serum samples. The ESR test was performed using an automated ESR analyzer using EDTA blood samples. Interpretation of ESR results refers to the hospital laboratory reference range, where values 0–10 mm/hour are considered normal and values >10 mm/hour are categorized as elevated for all patients.

Researchers obtained research data from medical records systems and laboratory test records, then coded, cleaned, and tabulated data before analysis. Researchers used descriptive analysis to describe patient characteristics and the distribution of laboratory test results. Researchers analyzed the relationship between Xpert MTB/RIF test results and the TB IgG/IgM Rapid Test and ESR using the Spearman correlation test. The researchers used the Spearman correlation test because the research variables were ordinal or dichotomous and did not meet the assumption of a normal distribution. All statistical analyses were conducted using SPSS version 25.0 software, with a statistical significance level set at $p < 0.05$.

This study received ethical approval from the Health Research Ethics Committee of the Banjarmasin Ministry of Health Polytechnic, under certificate number 1242/KEPK-PKB/2024, and research permit from Pertamina Hospital Balikpapan. The researchers maintained complete patient confidentiality and analyzed all data anonymously.

RESULTS AND DISCUSSION

Characteristics of Study Subjects

This study analyzed data from 250 patients with suspected pulmonary tuberculosis who underwent Xpert MTB/RIF, TB IgG/IgM Rapid Tests, and Erythrocyte Sedimentation Rates (ESR). The distribution of subject characteristics by gender and age group is presented in Table 1.

Table 1. Characteristics of Study Participants (n = 250)

Characteristics	n	%
Sex		
Male	166	66.4
Female	84	33.6
Age group (years)		
17–25	31	12.4
26–35	56	22.4
36–45	47	18.8
46–55	40	16.0
56–65	30	12.0
>65	46	18.4

The majority of study subjects were male, representing 66.4%. The largest age group among study subjects was 26–35 years old (22.4%), followed by 36–45 years old (18.8%), and 65 years and older (18.4%), as presented in Table 1. The researchers present the distribution of Molecular Rapid Test (Xpert MTB/RIF) results among all study subjects in Table 2.

Table 2. Distribution of Xpert MTB/RIF Assay Results (n = 250)

Xpert MTB/RIF result	n	%
MTB not detected	209	83.6
MTB detected	41	16.4

A total of 209 patients (83.6%) had undetectable MTB results, while 41 patients (16.4%) had detectable MTB results. The distribution of Molecular Rapid Test (MTC) results by gender and age group is shown in Table 3.

Table 3. Distribution of Xpert MTB/RIF Results by Sex and Age Group

Characteristics	MTB not detected, n (%)	MTB detected, n (%)
Sex		
Male	141 (67.5)	25 (61.0)
Female	68 (32.5)	16 (39.0)
Age group (years)		
17–25	28 (13.4)	3 (7.3)
26–35	45 (21.5)	11 (26.8)
36–45	44 (21.1)	3 (7.3)
46–55	32 (15.3)	8 (19.5)
56–65	21 (10.0)	9 (22.0)
>65	39 (18.7)	7 (17.1)

MTB cases were detected more often in male patients than in female patients. Based on age, the highest proportion of MTB detected was in the 26–35 age group (26.8%) and 56–65 age groups (22.0%).

Relationship between Xpert MTB/RIF Results and TB IgG/IgM Rapid Tests

The distribution of TB IgG/IgM Rapid Test results and their relationship to Xpert MTB/RIF results is presented in Table 4.

Table 4. Association between Xpert MTB/RIF Results and TB IgG/IgM Rapid Test Results

Xpert MTB/RIF result	Rapid test negative, n(%)	Rapid test positive, n(%)
MTB not detected	194 (92.8)	15 (7.2)
MTB detected	15 (36.6)	26 (63.4)

Table 5. Spearman Correlation between Xpert MTB/RIF Results and TB IgG/IgM Rapid Test Results (n = 250)

Parameter	Value
Correlation coefficient (r)	0.562
p-value	<0.001

The majority of patients with detectable TB IgG/IgM Rapid Test results were positive (63.4%), while patients with undetectable TB IgG/IgM Rapid Test results were predominantly negative (92.8%) (Table 4). Spearman's correlation test results showed a significant positive relationship between Xpert MTB/RIF results and TB IgG/IgM Rapid Test results ($r = 0.562$; $p < 0.001$), with a moderate to strong correlation (Table 5).

Relationship of Xpert MTB/RIF Results with Erythrocyte Sedimentation Rate

The distribution of ESR results and their relationship with Xpert MTB/RIF are shown in Table 6.

Table 6. Distribution of Erythrocyte Sedimentation Rate (ESR) by Xpert MTB/RIF Results

Xpert MTB/RIF result	Normal ESR, n (%)	Elevated ESR, n (%)
MTB not detected	97 (46.4)	112 (53.6)
MTB detected	9 (22.0)	32 (78.0)

Table 7. Spearman Correlation between Xpert MTB/RIF Results and Erythrocyte Sedimentation Rate (ESR) (n = 250)

Parameter	Value
Correlation coefficient (r)	0.183
p-value	0.004

The majority of patients with MTB results detected an abnormal Erythrocyte Sedimentation Rate (ESR) value, at 78.0%, as shown in Table 6. The Spearman correlation test showed a statistically significant relationship between Molecular Rapid Test (MTC) results and ESR values ($r = 0.183$; $p = 0.004$), but the correlation was very weak, as shown in Table 7.

Patient Characteristics by Gender and Age

The majority of patients in this study were male, consistent with previous research Listiyowati et al (2023)¹² and various other studies. Men are known to have a higher risk of tuberculosis due to smoking, alcohol consumption, and environmental exposures that can reduce immunity and damage lung defense mechanisms^{13,14}. In addition, men tend to engage in more outdoor activities and have broader social interactions, increasing the risk of exposure to *Mycobacterium tuberculosis*¹⁵.

The productive age group (<60 years) dominated the tuberculosis patients in this study, consistent with the findings of Listiyowati et al. (2023). The productive age group has high levels of activity and social interaction and a higher prevalence of smoking, increasing the risk of TB infection¹³.

Relationship between Xpert MTB/RIF Test Results and TB IgG/IgM Rapid Test

The results of this study showed a significant positive relationship between the results of the Xpert MTB/RIF and the TB IgG/IgM Rapid Test, with a moderate correlation strength ($r = 0.562$; $p < 0.001$). This finding indicates that there is generally concordance in the direction of results between molecular and serological antibody tests.

However, this study also found discrepancies in test results: patients with detectable MTB but negative TB IgG/IgM Rapid Test results, and patients with undetectable MTB but positive TB IgG/IgM Rapid Test results. This discrepancy can be explained by the concept of the window period in antibody-based tests. The window period concept has been widely reported in antibody-based rapid diagnostic tests, particularly in comparisons between molecular and rapid tests for infectious diseases, such as COVID-19¹⁶. The same principle can be analogized to TB antibody testing, where IgM and IgG formation takes a certain amount of time after exposure to MTB infection, so that in the early phase of infection, antibodies are not yet adequately formed.

In addition to the window period factor, discrepancies in TB IgG/IgM Rapid Test results can also be influenced by antibody cross-reactivity, impaired antibody formation, and immunocompromised patients. This is in line with the findings of Pottumarthy et al. (2000), who reported the sensitivity of TB IgG/IgM testing ranged from 41–55% with a specificity of around 96%⁵. Research by Rachmayanti et al. (2020) also reported a low sensitivity of 35% despite a high specificity of 94%⁶. Therefore, this test is not recommended as a sole diagnostic test and should be combined with other diagnostic methods.

Thus, although the TB IgG/IgM Rapid Test in this study showed a significant association with Xpert MTB/RIF results, this test is qualitative and nonspecific and cannot replace Xpert MTB/RIF as the primary method for diagnosing pulmonary tuberculosis. These findings support the WHO recommendation that molecular testing be the standard for TB diagnosis¹⁷.

Relationship of Xpert MTB/RIF Test Results with Erythrocyte Sedimentation Rate

This study also showed a statistically significant association between Xpert MTB/RIF test results and ESR values ($r = 0.183$; $p = 0.004$), although the correlation was very weak. The majority of patients with MTB results detected had abnormal ESR values, reflecting the presence of an active inflammatory process in TB patients. These findings align with those of Listiyowati et al. (2023), who reported a significant association between GeneXpert MTB/RIF results and ESR values ($p = 0.000$; OR = 0.032) (12), and Hasnawati's (2018) study, which reported an increased ESR in pulmonary TB patients¹⁸.

However, the high proportion of abnormal ESR values in the group of patients with undetectable MTB results confirms that the ESR is a non-specific inflammatory parameter. ESR values can increase in various conditions other than TB, such as anemia, autoimmune diseases, other infections, malignancies, kidney failure, obesity, aging, and certain physiological conditions such as menstruation and pregnancy¹⁹. Therefore, despite a statistically significant association, the ESR value cannot be used as a specific diagnostic indicator for TB.

The results of this study are consistent with previous research showing that the ESR is more appropriate as an indicator of inflammation and monitoring therapy response. Bhavana (2020) reported an increase in ESR with an average value of 41–60 mm/hour in TB patients, while Batool et al. (2022) and Ongwae et al. (2023) also reported a significant increase in ESR in TB patients compared to the control group^{9,10}. The mechanism of ESR elevation in TB is related to the inflammatory process caused by MTB infection, which triggers increased levels of fibrinogen and acute-phase proteins, resulting in the formation of erythrocyte rouleaux and an increased erythrocyte sedimentation rate¹¹.

This study has several limitations. First, its retrospective design, utilizing secondary data, relies on the completeness and quality of medical records, so the potential for information bias cannot be completely avoided. Second, this study did not compare test results with MTB culture, the gold standard for TB diagnosis. Third, this study did not analyze in depth other clinical factors, such as HIV status, nutritional status, previous TB treatment history, and the patient's immunological condition, which could potentially influence TB IgG/IgM Rapid Test results and ESR values.

The results of this study confirm that the TB IgG/IgM Rapid Test and ESR are positively associated with Xpert MTB/RIF test results, but both have limitations in terms of specificity. Therefore, these two tests should be used as complementary tests to molecular testing and not as a substitute for Xpert MTB/RIF in the diagnosis of pulmonary TB. Xpert MTB/RIF testing should remain the primary reference for establishing a diagnosis and making treatment decisions. Future studies are recommended to use a prospective design, include MTB culture as the gold standard, and consider patient clinical and immunological factors to obtain a more comprehensive picture.

CONCLUSION

This study shows a significant positive correlation between the results of the Xpert MTB/RIF and the TB IgG/IgM Rapid Test, with moderate correlation strength, and a significant correlation between the Xpert MTB/RIF and the Erythrocyte Sedimentation Rate (ESR), with very weak correlation strength. The TB IgG/IgM Rapid Test and ESR showed an association with tuberculosis infection status, but both are non-specific and have diagnostic limitations. Therefore, the TB IgG/IgM Rapid Test and ESR cannot be used as a substitute for the Xpert MTB/RIF examination, but rather as complementary examinations in the clinical evaluation of pulmonary tuberculosis patients. Molecular testing remains the primary method for establishing the diagnosis and making decisions about TB therapy.

ACKNOWLEDGEMENT

The author would like to thank those who have helped carry out this research.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Rakerkesnas 2018: Kemenkes percepat atasi 3 masalah kesehatan. Jakarta: Kementerian Kesehatan RI; 2018. Accessed on 2025 Dec 21. <https://www.depkes.go.id/article/view/18030700005/rakerkesnas-2018-kemenkes-percepat-atasi-3-masalah-kesehatan.html>
2. Kementerian Kesehatan Republik Indonesia. Tuberkulosis. Jakarta: Pusat Data dan Informasi Kementerian Kesehatan RI; 2018. Accessed on 2025 Dec 21. <https://pusdatin.kemkes.go.id/pdf.php?id=18101500001>
3. Moussa Husseiny SH, Bayoumi FS, Ali AM. Evaluation of GeneXpert MTB/RIF assay for diagnosis of pulmonary tuberculosis. *Saudi Med J*. 2016;37(10):1076–81. <https://smj.org.sa/content/37/10/1076>
4. Pantoja A, Fitzpatrick C, Vassall A, Weyer K, Floyd K. Xpert MTB/RIF for diagnosis of tuberculosis and drug-resistant tuberculosis: a cost and affordability analysis. *Eur Respir J*. 2013;42:708–20. doi:10.1183/09031936.00147912
5. Pottumarthy S, Wells VC, Morris AJ. A comparison of seven tests for serological diagnosis of tuberculosis. *J Clin Microbiol*. 2000;38(6):2227–31. doi:10.1128/JCM.38.6.2227-2231.2000
6. Rachmayanti N, Aryati, Kusmiati T. Diagnostic value of Encode TB IgG and IgM rapid test to support pulmonary tuberculosis diagnosis. *Indones J Clin Pathol Med Lab*. 2020;26(2):138–41.
7. Pratiwi C, Puspitasari E, Nurohmah V. Deskripsi jumlah leukosit dan laju endap darah pada pasien tuberkulosis di Rumah Sakit Paru Dungus Madiun. *Borneo J Med Lab Technol*. 2019.
8. Bhavana G. Reactive thrombocytosis: etiology and its relationship with different hematological parameters, ESR, and CRP in tuberculosis. *Trop J Pathol Microbiol*. 2020;6.
9. Batool Y, Pervaiz G, Arooj A, Fatima S. Hematological manifestations in patients newly diagnosed with pulmonary tuberculosis. *Pak J Med Sci*. 2022;38:1968–72. <https://www.pjms.org.pk/index.php/pjms/article/view/5911>
10. Ongwae J, Musyoki S, Mongare S. Profile of haematological indices among pulmonary tuberculosis patients attending Kisii Teaching and Referral Hospital, Kenya. *Int J Community Med Public Health*. 2023;10:2669–75. <https://www.ijcmph.com/index.php/ijcmph/article/view/11523>
11. Kasih KN, Sulastina NA. Analisis laju endap darah pada pasien tuberkulosis paru. *J Aisyiyah Medika*. 2019;4:44–52. doi:10.36729/jam.v4i1.232
12. Listiyowati T, Wardani DPK, Sudarsono TA, Wijayanti L. Relationship between results of Genexpert RT-PCR and erythrocyte sedimentation rate in suspected tuberculosis patients. *J Ilmu Teknol Kesehatan*. 2023;10(2).
13. Dewi AASI, Andrika P, Artana IB. Gambaran karakteristik pasien tuberkulosis di Poliklinik Paru RSUP Sanglah Denpasar. *J Med Udayana*. 2020;9(6):22–7.
14. Qo'imah, A., Wardani, D., Sudarsono, T., & Mulyanto, A. Comparison of TSH levels in pulmonary tuberculosis patients at phase 0 and 6 months treatment. *J Ilmu Teknol Kesehat*. 2022;10(1):99–107. doi:10.32668/jitek.v10i1.910

15. Rizqiya RN, Wuryaningsih EW, Deviantony F. Hubungan stigma masyarakat dengan kepatuhan minum obat pasien TB paru di Puskesmas Puhjarak Kecamatan Plemahan Kabupaten Kediri. *J Ilm Kesehat Keperawatan*. 2021;17(1):66–76. doi:10.26753/jikk.v17i1.511
16. Rahmadhaniati R, Rakhmina D, Herlina TE. Literature review: perbandingan hasil diagnosis laboratorium COVID-19 menggunakan metode RT-PCR dan rapid test antigen. *J Kesehatan*. 2022;15(1):44–6.
17. World Health Organization. Global tuberculosis report 2021. Geneva: WHO; 2021. Accessed on 2025 Dec 21. <https://www.who.int/publications/i/item/9789240037021>
18. Hasnawati. Pengaruh infeksi *Mycobacterium tuberculosis* terhadap nilai laju endap darah penderita tuberkulosis paru di Balai Besar Kesehatan Paru Masyarakat Makassar. *Media Analisis Kesehatan*. 2018;1(1):1–?. doi:10.32382/mak.v1i1.119
19. Sorsa A. Diagnostic performance of chest X-ray and erythrocyte sedimentation rate compared with GeneXpert® for tuberculosis case notification among patients living with HIV. *Risk Manag Healthc Policy*. 2020;13:1639–46. doi:10.2147/RMHP.S264447