The 7th Proceeding Strada International Conference on Health
Kediri – East Java, Indonesia, September 24-25, 2025
https://proceeding.thesich.org | Page 118-125

Association between Medication Adherence and Tuberculosis Treatment Outcomes: A Retrospective Cohort Study at a Primary Health Center in Kediri, Indonesia

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ABSTRACT

Tuberculosis (TB) remains a significant public health burden in Indonesia, where treatment success is often limited by poor patient adherence. This study aimed to evaluate the association between medication adherence and treatment outcomes among TB patients at the North Region of Kediri City primary healthcare centre, Indonesia. A retrospective cohort design was employed involving 38 patients who received clinical pharmacy services between 2024 and 2025. Adherence was measured using pharmacist records from the Drug Therapy Monitoring (DTM) log, while treatment outcomes were determined from final treatment status. Statistical analysis using Spearman's correlation demonstrated a significant association between adherence and treatment outcomes ($p = 0.002$; $r = 0.519$). Patients with high adherence were more likely to achieve cure, whereas all non-adherent patients experienced incomplete treatment. These findings underscore the crucial role of pharmacists in strengthening patient adherence through sustained counseling and education. Optimizing clinical pharmacy services at the primary care level may therefore enhance treatment success and contribute to national TB elimination efforts.

Keywords: clinical pharmacy, medication adherence, pharmacist's role, treatment outcomes, tuberculosis

BACKGROUND

Tuberculosis remains one of the leading infectious diseases globally and a persistent threat to public health. The World Health Organization (WHO) reported that in 2023, an estimated 10.8 million people fell ill with TB and 1.25 million deaths occurred worldwide, surpassing HIV/AIDS and malaria as the top cause of mortality from a single infectious agent (World Health Organization, 2024). Despite global efforts, the End TB Strategy milestones for 2025 are still off track, with treatment success rates stagnating in many high-burden countries.

Indonesia ranks as the second highest TB-burden country worldwide, after India, contributing significantly to the global TB caseload. In 2023, Indonesia reported approximately 1.06 million new TB cases and 134,000 deaths, with a treatment success rate of 84% for drug-sensitive TB and only 58% for drug-resistant TB, still below the 80% target set by WHO (Ministry of Health Republic of Indonesia, 2025a; World Health Organization, 2024). This illustrates the urgent need for stronger interventions to improve adherence and treatment outcomes.

At the local level, Kediri City, East Java, is among the regions with a high TB notification rate. In 2023, a total of 1,897 TB cases were reported, representing 161% of the national detection target, including 354 pediatric TB cases (358% of target) (Kediri City Health Office, 2024). Such figures highlight both the effectiveness of case detection efforts and the persistent burden of TB in the community.

A key challenge in TB control is ensuring patient adherence to anti-tuberculosis therapy. Poor adherence has been consistently linked to treatment failure, relapse, and the emergence of multidrug-resistant TB (MDR-TB) (Rahayu et al., 2021; World Health Organization, 2022). Studies suggest that three major dimensions of adherence—regular drug collection, proper consumption as prescribed, and completion of treatment—are critical determinants of treatment success.

Pharmacists play an increasingly recognized role in clinical pharmacy services for TB patients, particularly through medication counseling, drug therapy monitoring, and patient education. Evidence shows that pharmacist-led interventions improve knowledge, motivation, and adherence, ultimately enhancing treatment outcomes (Iskandar et al., 2023; Awad et al., 2024). However, limited empirical data exist from Indonesia on the direct association between adherence and treatment outcomes at the primary care level.

This study addresses that gap by evaluating the relationship between medication adherence and TB treatment outcomes at the North Region of Kediri City primary healthcare centre, Indonesia. By highlighting the role of pharmacists in clinical services, the findings contribute to strengthening local TB control strategies and support national and global targets for TB elimination.

METHODS

This study employed a retrospective cohort design with total sampling. The study was conducted at the North Region of Kediri City primary healthcare centre, from January to June 2025. The study population consisted of 39 TB patients, and after applying inclusion and exclusion criteria, 38 patients were included in the analysis.

Design and samples: Patients included were those diagnosed with drug-sensitive TB, drug-resistant TB, pulmonary TB, extrapulmonary TB, or childhood TB who received anti-tuberculosis drugs and had complete pharmacist drug therapy monitoring (DTM) records. Patients who died within the first week of treatment or transferred to other facilities were excluded.

Instruments and data collection: Data were obtained from pharmacist-maintained DTM forms, which documented visit dates, drug adherence, consistency of drug collection, reported side effects, and education provided. Treatment outcomes were extracted from medical records and classified according to national TB program categories (cured, completed, failed, defaulted, ongoing, or died).

Data analysis: Descriptive statistics were used to summarize demographic and clinical characteristics. Spearman's rank correlation test was applied to assess the association between medication adherence (high, low, non-adherence) and treatment outcomes. A p-value <0.05 was considered statistically significant.

Ethical considerations: The study was conducted with permission from the local health authority and ensured confidentiality of patient data in compliance with ethical research standards with No. 0923421/EC/KEPK/I/09/2025 from Strada Indonesia University ethical committee.

RESULTS

The study evaluated TB treatment adherence and outcomes at the North Region of Kediri City primary healthcare centre, during the first semester of 2025, involving 38 patients. Patient demographics showed a predominance of adults (71.05%), followed by elderly patients (21.05%), with a smaller proportion of adolescents (7.90%). No pediatric patients were recorded, suggesting effective early screening or referral outside primary care. The gender distribution revealed more females (55.26%) than males (44.74%), contrasting with global patterns. Regarding domicile, nearly all patients (97.37%) resided within the North Region of Kediri City primary healthcare center service area, with the majority concentrated in Banjaran village. This localized clustering suggests possible higher community burden or successful screening coverage.

Table 1. Summary of Key Findings

Variable	Category	Frequency (n)	Percentage (%)
Age Group	Adolescents (12–19)	3	7.90
	Adults (20–59)	27	71.05
	Elderly (≥60)	8	21.05
Gender	Male	17	44.74
	Female	21	55.26
Body Weight	<25 kg	1	2.63
	≥25 kg	37	97.37
TB Classification	DS-TB	36	94.74
	DR-TB	2	5.26
TB Type	Pulmonary	35	97.22
	Extrapulmonary	1	2.78
Adherence	High	30	78.95
	Low	3	7.89
	Non-adherent	5	13.16
Treatment Outcome	Cured	20	52.63
	Ongoing Treatment	12	31.58
	Incomplete Treatment	5	13.16
	Death	1	2.63

Body weight distribution indicated that almost all patients (97.4%) weighed ≥25 kg and received adult-dose regimens, with only one patient requiring pediatric anti-tuberculosis therapy. In terms of TB classification, most patients (94.74%) had drug-sensitive TB, while two (5.26%) were diagnosed with multi drug-resistant TB. Pulmonary TB was the dominant form (97.22%), with just one extrapulmonary case. These findings align with epidemiological trends that show pulmonary TB as the most prevalent and transmissible form. Collectively, these demographic and clinical characteristics highlight that TB predominantly affects adults in productive age groups, with a treatment regimen tailored according to weight and bacterial sensitivity.

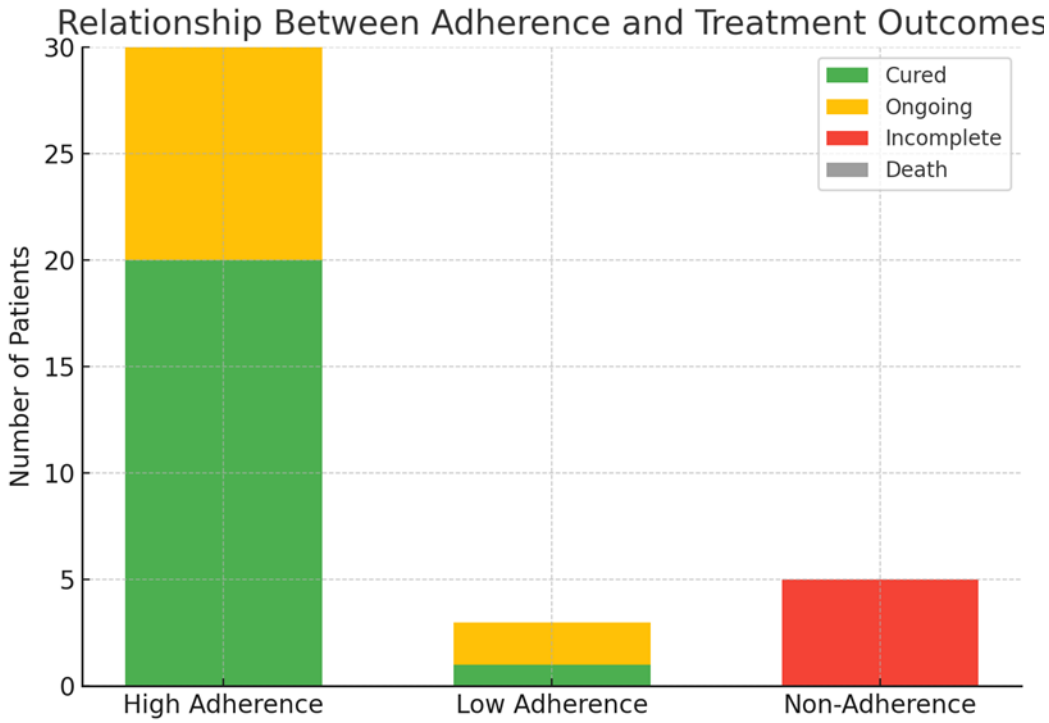

Figure. Relationship Between Adherence and Treatment Outcomes

Adherence to TB treatment was encouraging, as 78.95% of patients demonstrated high adherence to their anti-tuberculosis therapy regimen. In contrast, 7.89% of patients exhibited low adherence, while 13.16% were non-adherent. This suggests that while most patients complied with therapy, a notable subgroup remains at risk of incomplete treatment and subsequent complications. The primary contributors to poor adherence include medication side effects, limited understanding, inadequate support, and socioeconomic constraints. The overall adherence pattern underscores the positive impact of pharmaceutical counseling and structured monitoring but also points to the need for intensified interventions targeting non-adherent patients.

Treatment outcomes demonstrated that 52.63% of patients were cured, while 31.58% were still undergoing treatment at the time of data collection. However, 13.16% had incomplete treatment, and one patient (2.63%) died during therapy. These results reflect both the effectiveness and challenges of TB treatment in primary care. Although more than half of patients achieved cure, the proportion of incomplete treatment underscores the persistent risks of relapse and resistance. The mortality case further highlights the need for early identification of high-risk patients and enhanced clinical monitoring to prevent fatal outcomes.

Statistical analysis confirmed a significant correlation between adherence and treatment success, with a Spearman's correlation coefficient of 0.60 ($p < 0.001$). Patients with high adherence achieved markedly better outcomes, with 20 cured and 10 still completing treatment, while none defaulted. Conversely, all five non-adherent patients failed to complete therapy, reinforcing the strong causal link between adherence and treatment failure. These findings provide compelling evidence that adherence is the most critical determinant of TB treatment outcomes. Consequently, pharmacists' interventions through consistent counseling, monitoring, and patient support are pivotal in sustaining adherence and improving treatment success within primary care settings.

DISCUSSION

This study provides compelling evidence of the central role of medication adherence in determining TB treatment outcomes at the primary healthcare level. Patients who maintained high adherence were significantly more likely to achieve cure, whereas all non-adherent patients failed to complete treatment. These finding underscores adherence as a fundamental determinant of therapeutic success, consistent with prior studies conducted in Indonesia and other high-burden countries (Rahayu et al., 2021; Iskandar et al., 2023). Importantly, it also aligns with the WHO emphasis on adherence as a cornerstone of global TB control strategies (WHO, 2022).

Global literature strongly supports the relationship between adherence and treatment outcomes. A meta-analysis by Osei et al. (2020) reported that poor adherence increased the likelihood of treatment failure and relapses by more than twofold. Similarly, Tola et al. (2019) demonstrated that interventions such as directly observed therapy (DOT), digital adherence technologies, and patient-centered counseling substantially improve adherence and reduce drug resistance. The present study's findings reinforce this body of evidence by showing that adherence is not only statistically correlated with outcomes but also practically decisive for treatment success.

The adherence profile of this cohort revealed encouraging results, with 78.95% of patients maintaining high adherence. However, 13.2% of patients were classified as non-adherent, and all of them experienced incomplete treatment. This mirrors findings from Ethiopia, where forgetfulness, stigma, and adverse drug reactions were key drivers of non-adherence (Gebreweld et al., 2018). Notably, the relatively high proportion of adherent patients in Kediri may reflect the active involvement of pharmacists in medication therapy monitoring, which is supported by systematic reviews demonstrating the effectiveness of pharmacist-led interventions in improving adherence and treatment success (Iskandar et al., 2023; Awad et al., 2024).

Demographic patterns observed in this study further contextualize adherence dynamics. Adults constituted most patients, consistent with global epidemiological evidence that TB predominantly affects individuals in their productive years (WHO, 2023). The elderly, representing over 20% of cases, remain a vulnerable group due to comorbidities such as diabetes and hypertension, which complicate treatment and adherence (Bain et al., 2021). The absence of pediatric patients may indicate effective early detection programs or referral practices, though future research should verify these interpretations.

A noteworthy finding was the gender distribution, which revealed more female than male patients. This contrasts with global TB epidemiology, where men typically bear a higher disease burden (WHO, 2024). In Kediri, women may be more proactive in seeking healthcare, potentially explaining the observed difference. Previous studies suggest that sociocultural factors, including caregiving roles and health-seeking behaviors, influence gender disparities in TB diagnosis and treatment (Horton et al., 2016). Tailored, gender-sensitive outreach is therefore essential to ensure that men—who may delay care due to work or social stigma—are adequately reached.

The clinical characteristics of patients also provide valuable insights. The predominance of drug-sensitive TB (94.74%) is encouraging, as it suggests that first-line regimens remain effective for most patients. However, the presence of drug-resistant TB cases, albeit small, reflects the persistent challenge of antimicrobial resistance, which requires specialized treatment protocols and intensive monitoring (WHO, 2022). Similarly, the overwhelming predominance of pulmonary TB is consistent with its transmissibility and easier diagnosis compared to extrapulmonary TB (Molepo et al., 2023). These findings reinforce the

importance of systematic screening and bacteriological confirmation in primary care.

Weight-based dosing emerged as another critical determinant of treatment success. With 97.4% of patients weighing ≥25 kg, most received adult-dose regimens in line with Ministry of Health guidelines (Indonesian Ministry of Health, 2022). Correct dosing ensures therapeutic efficacy and minimizes the risks of resistance or adverse effects. Moreover, monitoring weight gain during therapy serves as an indirect marker of recovery, further strengthening the role of nutritional and clinical monitoring in TB management (Iskandar et al., 2023).

Perhaps the most impactful contribution of this study lies in the demonstrated correlation between adherence and treatment outcomes. The Spearman's correlation coefficient ($\rho = 0.60$, $p < 0.001$) confirmed a moderately strong and statistically significant association, validating adherence as a powerful predictor of cure. Importantly, highly adherent patients achieved markedly better outcomes, with no incomplete treatments reported, whereas all non-adherent patients failed therapy. These findings align with prior studies in both Indonesia and Africa, which consistently identify non-adherence as the leading cause of treatment failure, relapse, and resistance (Rahayu et al., 2021; Awad et al., 2024).

The central role of pharmacists in this process cannot be overstated. Pharmacists provided not only medication but also counseling, adverse effect monitoring, and ongoing education, thereby directly influencing adherence. Previous evidence from Indonesia confirms that pharmacist counseling improves TB knowledge and adherence (Mulyadi et al., 2021). International studies also highlight the added value of integrating pharmacists into multidisciplinary TB teams, with measurable improvements in treatment success rates (Bain et al., 2021). Scaling up these pharmacist-led interventions at the primary care level may significantly contribute to Indonesia's TB elimination target by 2030.

This study highlights the intricate interplay between patient demographics, clinical characteristics, adherence behaviors, and treatment outcomes in TB management. While the cure rate of 52.63% is encouraging, the proportion of ongoing and incomplete treatments indicates that further improvements are necessary. Strengthening adherence-support mechanisms, enhancing patient education, and expanding pharmacist-led interventions will be essential strategies for overcoming these challenges. The findings from Kediri thus offer both local and global relevance, reaffirming adherence as the cornerstone of TB treatment success and underscoring the vital role of pharmacists in advancing TB elimination efforts.

CONCLUSION

There is a significant association between medication adherence and TB treatment outcomes at the North Region of Kediri City primary healthcare centre, Indonesia. Patients with high adherence are more likely to be cured, while non-adherence leads to incomplete treatment. Strengthening the role of pharmacists in providing continuous counseling, patient education, and adherence monitoring is essential to improve treatment outcomes and support TB elimination strategies at the primary care level.

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