



Association Between Anti-Tuberculosis Drug Side Effects and Medication Adherence Among Pulmonary Tuberculosis Patients at Wijaya Kusumah Hospital, Kuningan, Indonesia

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Abstract. Tuberculosis (TB) remains one of the leading infectious diseases worldwide and continues to be a major public health concern in Indonesia. The success of anti-tuberculosis treatment depends largely on patients' adherence to medication. However, the occurrence of adverse drug reactions during treatment may reduce adherence and compromise treatment outcomes. This study aimed to determine the association between anti-tuberculosis drug side effects and medication adherence among pulmonary tuberculosis patients at Wijaya Kusumah Hospital, Kuningan. A quantitative observational study with a cross-sectional design was conducted among pulmonary tuberculosis patients receiving anti-tuberculosis treatment at Wijaya Kusumah Hospital, Kuningan. A total of 52 respondents were recruited using total sampling. ADRs were assessed using a structured questionnaire, while medication adherence was measured using the eight-item Morisky Medication Adherence Scale (MMAS-8). Data were analyzed using the Chi-square test with a significance level of 0.05. Most respondents experienced severe ADRs (57.7%), while 63.5% demonstrated low medication adherence. Statistical analysis showed a significant association between ADRs and medication adherence ($p = 0.040$). Patients who experienced more severe ADRs were more likely to demonstrate poor adherence during treatment. ADRs were significantly associated with medication adherence among pulmonary tuberculosis patients. Early identification and appropriate management of adverse drug reactions are essential to improve medication adherence and enhance treatment success. Improving medication adherence and reducing treatment failure may contribute to decreasing the transmission of drug-resistant tuberculosis within communities, protecting vulnerable populations, supporting Sustainable Development Goal (SDG) 3 (Good Health and Well-being), and strengthening health systems in resource-limited settings such as Indonesia.

Keywords: Tuberculosis; Anti-Tuberculosis Drugs; Drug Side Effects; Medication Adherence; MMAS-8

1. Introduction

Tuberculosis (TB) remains one of the leading infectious diseases and a major global public health concern. According to the World Health Organization (WHO), TB is among the leading causes of death from infectious diseases worldwide, with millions of new cases reported annually (1). Indonesia is one of the countries with the highest TB burden, making TB control a national health priority (1,2). Despite the availability of effective anti-tuberculosis treatment, achieving successful treatment outcomes remains challenging because of the prolonged treatment duration, adverse drug reactions, and poor medication adherence (1-3).

The standard treatment for pulmonary tuberculosis consists of a combination of first-line anti-tuberculosis drugs administered continuously for at least six months (3,14,15,16). Although this regimen has proven effective, patients frequently experience adverse drug reactions, including nausea, vomiting, dizziness, skin rash, arthralgia, peripheral neuropathy, and hepatotoxicity (3,10,13). These adverse drug reactions may reduce patients' willingness to continue treatment, resulting in treatment interruption, therapeutic failure, relapse, and the development of drug-resistant tuberculosis (3,13,14,16). In this study, the term "adverse drug reactions (ADRs)" refers to the drug side effects experienced by patients during anti-tuberculosis treatment, and this terminology is used consistently throughout the manuscript.

Medication adherence is one of the most important determinants of successful tuberculosis treatment. Poor adherence reduces treatment effectiveness, prolongs the infectious period, increases healthcare costs, and contributes to multidrug-resistant tuberculosis (MDR-TB) (1,3,13). Therefore, identifying factors associated with medication adherence is essential to improve treatment outcomes and achieve national and global tuberculosis control targets (1-3).

Previous studies have demonstrated that adverse drug reactions are associated with reduced medication adherence among patients with tuberculosis (4-9). However, the strength of this association may vary across healthcare settings because of differences in patient characteristics, access to healthcare services, treatment monitoring, and educational background (5-9). Consequently, local evidence is needed to better understand the relationship between anti-tuberculosis drug side effects and medication adherence in different populations.

Wijaya Kusumah Hospital, Kuningan, is one of the healthcare facilities providing tuberculosis treatment services in West Java. During anti-tuberculosis treatment, several patients reported experiencing adverse drug reactions that might affect their adherence to medication. However, evidence regarding this relationship among patients treated at this hospital remains limited.

Therefore, this study aimed to determine the association between ADRs and medication adherence among pulmonary tuberculosis patients receiving treatment at Wijaya Kusumah Hospital, Kuningan. The findings of this study are expected to provide evidence for healthcare professionals in developing strategies to minimize adverse drug reactions, improve medication adherence, and enhance tuberculosis treatment outcomes. Furthermore, improving medication adherence through early identification and management of anti-tuberculosis drug side effects may contribute not only to better patient outcomes but also to reducing the transmission of drug-resistant tuberculosis, protecting community health, supporting Sustainable Development Goal (SDG) 3 (Good Health and Well-being), and strengthening sustainable health systems in high TB-burden countries such as Indonesia.

2. Methods

This quantitative observational study employed a cross-sectional design to determine the association between adverse drug reactions (ADRs) and medication adherence among pulmonary tuberculosis patients. The study was conducted at Wijaya Kusumah Hospital, Kuningan, West Java, Indonesia, from July to August 2025. The study population consisted of pulmonary tuberculosis patients receiving anti-tuberculosis

treatment during the study period. A total sampling technique was applied, and 52 respondents who met the inclusion and exclusion criteria were enrolled in the study.

The inclusion criteria were pulmonary tuberculosis patients aged ≥ 18 years who had received anti-tuberculosis treatment for at least one month and agreed to participate by providing written informed consent. Patients with incomplete data, those who refused to participate, and those who did not meet the eligibility criteria were excluded from the study.

Data were collected through face-to-face interviews using structured questionnaires. ADRs were assessed using an 11-item questionnaire adapted from Oktaviani (11) and categorized as mild (score 0–6) or severe (score 7–11). Medication adherence was measured using the 8-item Morisky Medication Adherence Scale (MMAS-8) (12) and classified as adherent (score 0–4) or non-adherent (score 5–8).

Data processing included editing, coding, data entry, and data cleaning before statistical analysis. Descriptive statistics were used to summarize respondents' characteristics, ADRs, and medication adherence. The association between anti-tuberculosis drug side effects and medication adherence was analyzed using the Chi-square test. When the assumptions for the Chi-square test were not fulfilled, Fisher's Exact Test was applied. A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics version 27.

This study was approved by the Health Research Ethics Committee, Faculty of Pharmacy, Universitas YPIB, Indonesia (Ethical Approval No. 483/KEPK/EC/VIII/2025). Written informed consent was obtained from all participants prior to data collection, and the confidentiality and anonymity of respondents were maintained throughout the study.

3. Results and Discussion

3.1 Characteristics of Respondents

Table 1. Characteristics of Respondents (n = 52)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	18–25	7	13.5
	26–35	9	17.3
	36–45	17	32.7
	46–55	8	15.4
	56–65	4	7.7
	≥ 66	7	13.5
Sex	Male	29	55.8
	Female	23	44.2
Educational level	Elementary School	23	44.2
	Junior High School	5	9.6
	Senior High School/Vocational School	21	40.4
	College/University	2	3.8
	No Formal Education	1	1.9
Occupation	Daily Laborer	4	7.7

Characteristic	Category	Frequency (n)	Percentage (%)
	Teacher	1	1.9
	Housewife	9	17.3
	Private Employee	22	42.3
	Farmer	9	17.3
	Unemployed	1	1.9
	Self-employed	6	11.5

Table 1 shows that the majority of respondents were aged 36–45 years (32.7%), followed by those aged 26–35 years (17.3%). Male respondents accounted for 55.8% of the study population, while females represented 44.2%. Most respondents had completed elementary school (44.2%), and the largest occupational group was private employees (42.3%).

The present study found that most respondents were within the productive age group (36–45 years). Individuals in this age range generally have greater occupational and social activities, increasing their exposure to *Mycobacterium tuberculosis*. This finding is consistent with national and global tuberculosis reports showing that tuberculosis predominantly affects adults of productive age (1–3).

Male respondents accounted for more than half of the study population. This finding is in agreement with previous studies indicating that pulmonary tuberculosis is more common among men because of occupational exposure, smoking habits, and delayed healthcare-seeking behavior (1,2,15,17).

Most respondents had only completed elementary education. Lower educational attainment may limit patients' understanding of tuberculosis treatment and the importance of medication adherence. Previous studies have reported that educational level is associated with patients' knowledge and adherence to anti-tuberculosis treatment (5,7–9).

3.2 Distribution of Adverse Drug Reactions (ADRs)

Table 2 presents the distribution of anti-tuberculosis drug side effects among pulmonary tuberculosis patients.

Table 2. Distribution of Adverse Drug Reactions (ADRs) (n = 52)

Variable	Frequency (n)	Percentage (%)
Time of experiencing adverse drug reactions		
Early treatment phase	46	88.5
Sixth month of treatment	6	11.5
Severity of adverse drug reactions		
Mild	22	42.3
Severe	30	57.7

The majority of respondents (88.5%) experienced adverse drug reactions during the early phase of treatment, while 57.7% experienced severe adverse drug reactions.

These findings are expected because the intensive phase of tuberculosis treatment involves the administration of multiple first-line anti-tuberculosis drugs, thereby increasing the likelihood of adverse drug reactions (3,13–15,17). Similar findings have also been reported in previous studies (4,10). Routine monitoring during the intensive treatment phase is therefore essential to identify adverse drug reactions early, provide appropriate management, and prevent treatment interruption (3,13).

3.3 Types of Adverse Drug Reactions (ADRs)

Table 3 summarizes the types of adverse drug reactions experienced by the respondents during anti-tuberculosis treatment.

Table 3. Types of Adverse Drug Reactions (ADRs)

Adverse Drug Reaction	Frequency (n)	Percentage (%)
Loss of appetite	21	6.4
Nausea	39	11.8
Abdominal pain	19	5.8
Reddish urine	37	11.3
Joint pain	44	13.5
Fever	25	7.7
Tingling sensation	25	7.7
Skin rash	29	8.9
Burning sensation in the feet	33	10.4
Hearing impairment	21	6.4
Visual disturbance	33	10.1

Note: Respondents were allowed to report more than one adverse drug reaction; therefore, the total percentage exceeds 100%.

These findings are consistent with previous studies reporting that gastrointestinal disorders, arthralgia, peripheral neuropathy (manifested as a burning sensation in the feet), visual disturbances, and discoloration of body fluids are among the most common adverse effects associated with first-line anti-tuberculosis drugs (3,4,10,14). Reddish urine is a well-recognized and harmless adverse effect of rifampicin, whereas joint pain is commonly associated with pyrazinamide-induced hyperuricemia (3,14,15).

3.4 Distribution of Medication Adherence

Table 4 presents the distribution of medication adherence among pulmonary tuberculosis patients.

Table 4. Distribution of Medication Adherence Among Pulmonary Tuberculosis Patients (n = 52)

Medication Adherence	Frequency (n)	Percentage (%)
Adherent	19	36.5
Non-adherent	33	63.5
Total	52	100.0

A total of 33 respondents (63.5%) were categorized as non-adherent, while 19 respondents (36.5%) were adherent to anti-tuberculosis therapy. Medication adherence is a key determinant of successful tuberculosis treatment. Poor adherence contributes to treatment failure, disease relapse, prolonged transmission, and the development of multidrug-resistant tuberculosis (1,3,13). Previous studies also reported that medication adherence is influenced by patients' knowledge, motivation, family support, duration of treatment, and adverse drug reactions (5–9). These findings indicate that improving patients' understanding of tuberculosis treatment through continuous education and counseling may enhance medication adherence and treatment success (3,7,8).

3.5 Association Between Adverse Drug Reactions (ADRs) and Medication Adherence

Table 5 shows the association between anti-tuberculosis drug side effects and medication adherence.

Table 5. Association Between Adverse Drug Reactions (ADRs) and Medication Adherence (n = 52)

Severity of ADRs	Adherent n (%)	Non-adherent n (%)	Total n (%)	p-value
Mild	12 (54.5)	10 (45.5)	22 (42.3)	
Severe	7 (23.3)	23 (76.7)	30 (57.7)	
Total	19 (36.5)	33 (63.5)	52 (100.0)	0.040*

Fisher's Exact Test.

The present study demonstrated a statistically significant association between adverse drug reactions (ADRs) and medication adherence ($p = 0.040$). Patients who experienced more severe adverse drug reactions were more likely to have poor medication adherence.

The present findings support previous evidence demonstrating that adverse drug reactions significantly reduce medication adherence among patients with tuberculosis (4,7–10). Drug-related discomfort may discourage patients from completing the lengthy treatment regimen, thereby increasing the risk of treatment interruption, treatment failure, and multidrug-resistant tuberculosis (1,3,13,19).

These findings emphasize the importance of early detection and appropriate management of adverse drug reactions. Regular monitoring, patient counseling, and pharmaceutical care services should be strengthened to minimize the impact of adverse drug reactions and improve medication adherence among pulmonary tuberculosis patients (3,13–15,19).

Conclusion

This study demonstrated a statistically significant association between adverse drug reactions (ADRs) and medication adherence among pulmonary tuberculosis patients at Wijaya Kusumah Hospital, Kuningan ($p = 0.040$). Patients who experienced severe adverse drug reactions were more likely to be non-adherent to anti-tuberculosis treatment than those who experienced mild adverse drug reactions. These findings emphasize the importance of early identification, routine monitoring, and appropriate management of adverse drug reactions to improve medication adherence and optimize treatment outcomes. Healthcare professionals, particularly physicians and pharmacists, should provide continuous patient education and counseling throughout the treatment period. Further multicenter studies with larger sample sizes are recommended to confirm these findings and identify additional factors influencing medication adherence among patients with tuberculosis. Improving medication adherence through effective management of adverse drug reactions may also reduce the spread of drug-resistant tuberculosis, support SDG 3 (Good Health and Well-being), and contribute to sustainable tuberculosis control in Indonesia.

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Conflicts of Interest

The authors declare no conflict of interest.

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