

Knowledge, Attitudes, and Anti-Tuberculosis Medication Adherence among Patients with Pulmonary Tuberculosis: A Cross-Sectional Study

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ABSTRACT

Background: Adherence to anti-tuberculosis medication is essential for successful tuberculosis treatment, while patients' knowledge and attitudes may influence their treatment-related behavior. Understanding these factors is important for strengthening patient education and adherence-support strategies.

Objective: This study aimed to examine the relationship between knowledge, attitudes, and anti-tuberculosis medication adherence among patients with pulmonary tuberculosis.

Methods: A cross-sectional study was conducted among 41 patients with pulmonary tuberculosis treated in the isolation ward. Data on patients' knowledge, attitudes, and adherence to anti-tuberculosis medication were collected using structured instruments. Descriptive analysis was used to characterize the study variables, while Spearman's rank correlation test was performed to examine the relationships between knowledge, attitudes, and medication adherence.

Results: Most participants had moderate levels of knowledge (24/41, 58.5%) and attitudes (27/41, 65.9%). Overall, 31 participants (75.6%) were classified as adherent to anti-tuberculosis medication. Participants with moderate knowledge accounted for 21 (51.2%) of those classified as adherent, while 24 (58.5%) adherent participants had moderate attitudes. Knowledge was significantly and positively correlated with medication adherence ($r = 0.565$, $p < 0.001$). Attitudes also demonstrated a significant positive correlation with medication adherence ($r = 0.643$, $p < 0.001$).

Conclusion: Knowledge and attitudes were significantly associated with anti-tuberculosis medication adherence among patients with pulmonary tuberculosis. These findings highlight the importance of strengthening patient-centered health education that addresses both treatment knowledge and attitudes to support sustained medication adherence.

Keywords: Tuberculosis; Anti-tuberculosis medication; Medication adherence; Knowledge; Attitudes; Pulmonary tuberculosis; Patient education

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What are the main findings?

1. Most patients had moderate levels of knowledge and attitudes toward tuberculosis treatment, while the majority demonstrated adherence to anti-tuberculosis medication.

2. Better knowledge about tuberculosis treatment was associated with higher adherence to anti-tuberculosis medication.
3. More positive attitudes toward treatment were associated with better

adherence to anti-tuberculosis medication.

INTRODUCTION

Tuberculosis (TB) remains a major public health challenge, and the success of treatment depends substantially on patients' ability to maintain adherence to a prolonged anti-tuberculosis medication regimen. Incomplete adherence may contribute to treatment failure, relapse, continued transmission, and the emergence of drug resistance. Evidence indicates that medication adherence is not determined by a single factor but results from interactions among individual, social, healthcare, and structural factors. Therefore, understanding patient-related factors that may influence treatment-taking behavior is important for developing appropriate educational and supportive strategies for patients with pulmonary tuberculosis (Alipanah et al., 2018; Munro et al., 2007; Shringarpure et al., 2023).

Patient knowledge is an important component of tuberculosis management because patients need to understand the disease, treatment duration, medication-taking procedures, possible adverse effects, and consequences of interrupting therapy. Previous research has demonstrated an association between tuberculosis-related knowledge and treatment-related behaviors, although adequate knowledge does not necessarily guarantee optimal adherence. For example, knowledge about TB and preventive behaviors has been shown to vary across patient populations, while studies among ambulatory patients have examined the relationship between knowledge, treatment adherence, and treatment outcomes. These findings suggest that patient education should extend beyond the provision of information and consider whether knowledge is translated into appropriate treatment behavior (Adisa et al., 2021; Huddart et al., 2018).

In addition to knowledge, patients' attitudes toward tuberculosis and its treatment may influence their willingness to follow medication regimens consistently. The Health Belief Model study by Azizi et al. (2018) demonstrated that treatment adherence was associated with patients' perceptions and beliefs concerning tuberculosis and its treatment. Similarly, evidence from Indonesia indicates that educational approaches can improve patients' knowledge, attitudes, and treatment-related practices, while online-based education has also been investigated as a strategy for improving treatment attitudes and medication adherence among tuberculosis patients (Azizi et al., 2018; Dameria et al., 2023; Indraswari et al., 2022).

However, an important gap remains much of the existing literature has examined treatment adherence through broad determinants, qualitative barriers, or educational interventions, while evidence simultaneously examining knowledge, attitudes, and medication adherence within the same pulmonary tuberculosis patient population remains context-dependent and limited, particularly at the local hospital level. Moreover, previous studies have produced evidence from different healthcare settings and populations, making local assessment necessary because educational needs and treatment-related perceptions may vary across contexts. Therefore, this study aims to examine the levels of knowledge and attitudes and their relationship with anti-tuberculosis medication adherence among patients with pulmonary tuberculosis. The findings are expected to provide an evidence base for strengthening patient-centered health education and adherence-support strategies in tuberculosis care (Pradipta et al., 2020; Shringarpure et al., 2023).

METHOD

A cross-sectional study was conducted among 41 patients with pulmonary tuberculosis in the isolation ward of RSU

Mokoyurli, Buol Regency, Indonesia, from June 24 to July 24, 2019. Data on knowledge, attitudes, and adherence to anti-tuberculosis medication were collected using structured questionnaires. The study received ethical approval from the Health Research Ethics Committee (KEPK) of STIKES Surya Mitra Husada Kediri, Indonesia (657/KEPK/SMH/2020). Descriptive statistics were used to describe the study variables, while Spearman's rank correlation test was applied to examine the relationships between knowledge, attitudes, and anti-tuberculosis medication adherence, with statistical significance set at $p < 0.05$.

RESULTS

Table 1. Sociodemographic Characteristics of Participants (n = 41)

Characteristic	Category	n	%
Age	17-27 years	5	12.2
	28-38 years	13	31.7
	39-49 years	23	56.1
Sex	Male	12	29.3
	Female	29	70.7
Education	No formal education	3	7.3
	Elementary school	9	22
	Junior high school	2	4.9
	Senior high school	27	65.9
Occupation	Civil servant	3	7.3
	Employee	10	24.4
	Self-employed	7	17.1
	Housewife	21	51.2

Table 1 illustrates the sociodemographic characteristics of the 41 participants. Most

participants were aged 39-49 years (23, 56.1%), female (29, 70.7%), had completed senior high school (27, 65.9%), and were housewives (21, 51.2%).

Table 2. Distribution of Knowledge, Attitudes, and Medication Adherence (n = 41)

Variable	Category	n	%
Knowledge	Poor	10	24.4
	Moderate	24	58.5
	Good	7	17.1
Attitude	Poor	8	19.5
	Moderate	27	65.9
	Good	6	14.6
Medication adherence	Non-adherent	10	24.4
	Adherent	31	75.6

Table 2 illustrates the distribution of participants according to knowledge, attitudes, and anti-tuberculosis medication adherence. Most participants had moderate knowledge (24, 58.5%) and moderate attitudes (27, 65.9%). Regarding medication adherence, 31 participants (75.6%) were adherent, while 10 (24.4%) were non-adherent.

Table 3. Spearman's Rank Correlations among Knowledge, Attitude, and Medication Adherence

Variables	Spearman's ρ	p-value	n
Knowledge-Attitude	0.785	<0.001	41
Knowledge-Medication adherence	0.565	<0.001	41
Attitude-Medication adherence	0.643	<0.001	41

Table 3 illustrates the correlations among knowledge, attitudes, and anti-tuberculosis medication adherence. Knowledge was positively correlated with medication adherence ($\rho = 0.565, p < 0.001$), while attitude showed a positive correlation with medication adherence ($\rho = 0.643, p < 0.001$). Knowledge was also strongly and positively correlated with attitude ($\rho = 0.785, p < 0.001$).

DISCUSSION

This study found that most patients with pulmonary tuberculosis had moderate levels of knowledge (58.5%) and attitudes (65.9%) toward tuberculosis treatment, while 75.6% demonstrated adherence to anti-tuberculosis medication. Knowledge was significantly and positively correlated with medication adherence ($\rho = 0.565, p < 0.001$), indicating a moderate association, whereas attitude showed a stronger positive correlation with adherence ($\rho = 0.643, p < 0.001$). These findings suggest that patients' cognitive understanding and treatment-related attitudes are important behavioral components of medication adherence. Similar evidence has shown that knowledge about tuberculosis is associated with patients' understanding of treatment requirements and the consequences of treatment interruption. Adisa et al. (2021) reported that although many patients understood TB transmission and curability, knowledge regarding medication adherence remained insufficient. Likewise, Mientarini et al. (2018) identified significant relationships between knowledge, attitudes, and medication adherence among pulmonary TB patients in Indonesia. However, the present findings should be interpreted as associations rather than causal effects because of the cross-sectional design.

The moderate correlation between knowledge and adherence in this study ($\rho = 0.565$) indicates that having better knowledge may support adherence, but knowledge alone is

unlikely to fully determine treatment-taking behavior. This interpretation is consistent with evidence showing that adherence is influenced by multiple patient-level, treatment-related, socioeconomic, and health-system factors. Munro et al. (2007) demonstrated that TB treatment adherence is a complex and dynamic behavior shaped by interacting barriers and facilitators rather than by a single determinant. Similarly, Azizi et al. (2018) found that perceived threat, perceived benefits, perceived barriers, and self-efficacy explained a substantial proportion of variation in TB treatment adherence, with self-efficacy emerging as an important predictor. Adisa et al. (2021) also reported that healthcare inaccessibility and pill burden were important reasons for treatment non-adherence despite relatively high general TB knowledge. In contrast, Yani et al. (2022) found no significant relationship between TB knowledge and medication compliance among patients with drug-resistant TB in Indonesia, further indicating that the contribution of knowledge may depend on treatment context and other behavioral or structural factors.

The stronger association between attitude and medication adherence in the present study ($\rho = 0.643, p < 0.001$) suggests that patients' perceptions and willingness to engage with treatment may be more closely related to adherence behavior than factual knowledge alone. Positive treatment attitudes may facilitate persistence with a prolonged medication regimen, particularly when patients perceive treatment as beneficial and recognize the consequences of interruption. Evidence from Indonesia supports this interpretation. Indraswari et al. (2022) reported that online-based health education improved treatment attitudes and medication adherence among TB patients, while Dameria et al. (2023) demonstrated improvements in patients' knowledge, attitudes, and practices following

tuberculosis education using video and leaflets. Nevertheless, attitude should not be considered independently from the social environment. Chen et al. (2020) demonstrated that family, social, and policy support were associated with TB treatment adherence, while Alinaitwe et al. (2025) found that medication reminders, encouragement, and emotional support from family members were significantly associated with adherence. Thus, strengthening positive treatment attitudes may be more effective when combined with practical and interpersonal support throughout the treatment period.

The findings have practical implications for TB services because approximately one-quarter of participants (24.4%) remained non-adherent despite the relatively high overall adherence rate. This indicates that routine treatment services should not rely solely on providing information but should incorporate patient-centered strategies addressing motivation, perceived barriers, self-efficacy, and social support. Systematic reviews have shown that interventions designed to improve TB medication adherence can be beneficial, although their effectiveness varies according to intervention type and implementation context (Alipanah et al., 2018; Pradipta et al., 2020). Shringarpure et al. (2023) further emphasized that adherence is influenced by competing individual, interpersonal, treatment, and health-system factors, supporting a multidimensional approach to adherence promotion. Therefore, tuberculosis education should be continuous and tailored to patients' knowledge gaps and treatment attitudes, while adherence monitoring should be complemented by counseling, family involvement, and identification of practical barriers. Overall, the present study adds local evidence that both knowledge and attitudes are significantly associated with anti-tuberculosis medication adherence, while also indicating that improving adherence requires interventions extending beyond information provision alone.

CONCLUSION

Knowledge and attitudes were significantly and positively associated with anti-tuberculosis medication adherence among patients with pulmonary tuberculosis. Although most participants demonstrated moderate knowledge and attitudes and were adherent to treatment, a proportion remained non-adherent. These findings support the need for patient-centered health education that strengthens treatment knowledge and promotes positive attitudes toward medication adherence. Because of the cross-sectional design, the observed associations should not be interpreted as causal relationships.

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CONFLICT OF INTEREST

No conflict of interest.

AUTHOR CONTRIBUTIONS

Dian Novita: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, and Writing – Review & Editing.

ARTIFICIAL INTELLIGENCE DISCLOSURE

Authors remain fully responsible for the accuracy, originality, integrity, and final content of their manuscript, regardless of any AI-assisted tools used during its preparation.

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