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Intensity of Treatment Support as Determinants of Medication Adherence among Tuberculosis Patients

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Abstract

Introduction**:** Tuberculosis (TB) remains a major public health problem, with treatment adherence being a critical determinant of therapeutic success. The Directly Observed Treatment Short-course (DOTS) strategy emphasizes the role of treatment supervisors; however, evidence regarding the influence of supervision intensity on patient adherence remains limited. This study aimed to examine the relationship between the intensity of medication supervision by treatment supporters (PMO) and medication adherence among pulmonary tuberculosis patients. Methods**:** An analytical observational study with a case–control design was conducted from December 2025 to January 2026 at a primary health center in Surabaya, Indonesia. A total of 22 pulmonary TB patients who met the inclusion criteria were included using total sampling. Data were collected using structured questionnaires to assess PMO characteristics, supervision intensity, and patient adherence, measured using the Morisky Medication Adherence Scale-8 (MMAS-8). Data were analyzed using Fisher's Exact test. Results**:** Among the 22 pulmonary tuberculosis patients, 13 of 15 patients (86.7%) receiving high-intensity PMO supervision were adherent to treatment, compared with none of the 7 patients receiving moderate-to-low-intensity supervision. Fisher's Exact test indicated a statistically significant association between supervision intensity and medication adherence ($p < 0.001$). **Conclusion:** These findings suggest that the quality and consistency of supervision play a more important role than demographic attributes of treatment supporters. Strengthening structured and intensive supervision may enhance treatment adherence and support tuberculosis control efforts.

Keywords: Tuberculosis, Medication Adherence, Treatment Supervision, Directly Observed Treatment Short-course, Tuberculosis Control

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1. Introduction

TB remains a global public health challenge (Ferrari et al., 2024; Snow et al., 2020), not only because of its high incidence rate, but also due to the low success rate of treatment, which is influenced by patient compliance with long-term therapy. Although TB treatment regimens have been standardized and proven effective, non-compliance with medication remains a major obstacle contributing to treatment failure, disease recurrence, and the emergence of drug-resistant tuberculosis (Tirore et al., 2024). According to the Global Tuberculosis Report, there are an estimated 10.7 million cases of TB globally in 2024, with mortality rates remaining significant, indicating that TB control is not yet fully optimal (WHO, 2025). This situation underscores that the success of TB programs depends not only on the availability of drugs but also on factors that influence patient adherence behavior during treatment (Grigoryan et al., 2022).

In an effort to improve the success of TB treatment, a medication adherence strategy through the DOTS approach involving medication supervisors has long been implemented as the standard for TB control programs. This approach is designed to ensure that patients take their medication regularly during the long treatment period (Lasmaria et al., 2025). However, various studies show that the presence of PMOs alone does not always correlate with optimal patient compliance (Siregar et al., 2023). The implementation of treatment supervision in practice is often administrative in nature and focuses on the presence of supervisors, without considering the quality of interaction, frequency of supervision, or continuity of support provided to patients. This condition shows that the effectiveness of treatment accompaniment is not only determined by the presence of supervisors, but also by the intensity and form of accompaniment carried out during the therapy process.

Treatment support for TB patients is essentially a process involving continuous interaction between patients and supporters, who play a role in shaping compliance behavior during the treatment period (WHO, 2006) In this context, the intensity of support refers not only to the frequency of medication supervision, but also includes the consistency of support, the quality of communication, and the level of involvement of the support person in helping patients overcome obstacles during treatment (Agus & Rosmiati, 2026). upport with adequate intensity has the potential to increase patients' understanding of the importance of treatment, strengthen motivation, and provide the emotional support needed to undergo long-term therapy (Dilas et al., 2023). Conversely, sporadic or purely formal support tends to be less effective in encouraging sustained medication adherence.

Based on the limited empirical evidence that specifically examines the role of the intensity of medication adherence supervision in promoting adherence to pulmonary TB treatment, this study aims to analyze the relationship between the intensity of PMO supervision and the level of medication adherence in tuberculosis patients. This study defines the intensity of supervision as a behavioral construct that reflects the frequency, consistency, and quality of support received by patients during therapy, rather than merely the formal presence of supervisors. With this approach, the study is expected to contribute to a richer understanding of the optimization of pulmonary TB treatment supervision

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strategies and serve as a basis for the development of more effective supervision interventions that are oriented towards patient needs.

2. Research Methods

This study is an analytical observational study with a case-control design that aims to analyze the relationship between the intensity of PMO assistance and the level of treatment adherence among pulmonary TB patients. The case group and control group were formed based on the patients' treatment adherence status. The study was conducted from December 2025 to January 2026 at the Siwalankerto Community Health Center in Surabaya.

The population in this study consisted of all pulmonary tuberculosis patients who were registered and undergoing treatment at the Siwalankerto Community Health Center, Surabaya, during the study period. The sampling technique used was total sampling, in which all members of the population who met the inclusion criteria and did not meet the exclusion criteria were recruited as research samples.

Inclusion criteria included: (1) pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) treatment; (2) patients who had a medication supervisor (PMO); and (3) patients aged ≥17 years. Exclusion criteria included: (1) patients with immunocompromised conditions, including HIV infection and diabetes mellitus; (2) patients who could not be contacted or were absent during the data collection process; and (3) patients with cognitive impairments that could affect their ability to provide information.

A questionnaire divided into three sections was used as a data collection instrument. The first section of the questionnaire contained questions related to respondent characteristics and PMO. The second section consisted of eight questions with a scoring system of 2 (always), 1 (sometimes), and 0 (never). This section is used to determine the intensity of PMO assistance. The third section uses the Morisky Medication Adherence Scale-8 (MMAS-8), which consists of 8 questions with a Guttman scoring system of "Yes" (0) and "No" (1), with a maximum score of 8 and a minimum score of 0. The entire questionnaire was compiled based on tuberculosis control guidelines and previous studies.

Data were processed using univariate analysis to describe the characteristics of respondents descriptively. Bivariate analysis was performed using cross tabulation. Fisher's Exact test was performed to determine the relationship between the intensity of PMO assistance and patient treatment compliance. All data were analyzed using IBM SPSS for Windows Ver. 24 (IBM Corp., 2016). A p-value < 0.05 indicated a significant relationship.

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3. Research Results and Discussion

a. Result

Table 1. Characteristics of Pulmonary TB Patients

Characteristics	Frequency	Percentage (%)
Age		
< 20 years old	4	18,2
20-29 years old	4	18,2
30-39 years old	3	13,6
40-49 years old	6	27,3
≥ 50 years old	5	22,7
Gender		
Male	8	36,4
Female	14	63,6
Education Level		
Elementary School	3	13,6
Junior High School	3	13,6
Senior High School	15	68,2
D3/D4/S1	1	4,5
Occupation		
Housewife	6	27,3
Self-employed	5	22,7
Private employee	5	22,7
Retired	1	4,5
Student	5	22,7

When viewed by age group, the distribution of respondents shows that most patients are in the productive age range. The 40–49 age group is the largest, with 6 people (27.3%), followed by the ≥50 age group with 5 people (22.7%). Meanwhile, patients aged <20 years and 20–29 years numbered 4 people (18.2%) each, while the 30–39 age group was the smallest with 3 people (13.6%). Based on gender, the majority of respondents were female, namely 14 people (63.6%), while male respondents numbered 8 people (36.4%). In terms of education level, most patients had a high school education, namely 15 people (68.2%). Respondents with elementary and junior high school education numbered 3 people each (13.6%), while respondents with D3/D4/S1 education numbered only 1 person (4.5%). Based on employment status, most of the pulmonary TB patients in this study were housewives, namely 6 people (27.3%). The self-employed, private employees, and students groups each numbered 5 people (22.7%), while respondents with retired status were the smallest group, namely 1 person (4.5%).

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Table 2. Characteristics of PMO TB Patients

Characteristic	Frequency	Percentage (%)
Age		
< 20 years old	0	0
20-29 years old	4	18,2
30-39 years old	6	27,3
40-49 years old	6	27,3
≥ 50 years old	6	27,3
Gender		
Male	9	40,9
Female	13	59,1
Education Level		
Elementary School	3	13,6
Junior High School	0	0
Senior High School	19	86,4
D3/D4/S1	0	0
Occupation		
Housewife	14	63,6
Self-employed	8	36,4
Private employee	0	0
Retired	0	0
Student	0	0
Family PMO Status		
Parents	8	36,4
Spouse	10	45,5
Children	3	13,6
Health cadres	1	4,5

When viewed by age group, most PMOs are in the adult and elderly age ranges, with 6 people (27.3%) in each of the 30–39, 40–49, and ≥50 age groups. Meanwhile, there are 4 PMOs (18.2%) aged 20–29. Based on gender, the majority of PMOs are female, namely 13 people (59.1%), while males number 9 people (40.9%). In terms of education level, most PMOs have a high school education background, namely 19 people (86.4%). PMOs with elementary school education number 3 people (13.6%). Based on employment status, the majority of PMOs were housewives, namely 14 people (63.6%), followed by 8 entrepreneurs (36.4%). In terms of the PMO's relationship with the patient, most PMOs were the patient's spouse, namely 10 people (45.5%), followed by 8 parents (36.4%). There were 3 PMOs (13.6%) who were children of patients, while only 1 PMO (4.5%) was a health cadre.

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Table 3. Relationship Between Characteristics And Intensity Of Medication Supervision And Treatment Adherence Among Patients With Pulmonary TB

Characteristics	Patient Adherence		*p-value
	Adherent	Non-adherent	
Age			
< 20 years old	0	0	
20-29 years old	2	2	
30-39 years old	3	3	
40-49 years old	3	3	
≥ 50 years old	5	1	
Gender			
Male	5	4	
Female	8	5	
Education Level			
Elementary School	1	2	
Junior High School	0	0	
Senior High School	12	7	
D3/D4/S1	0	0	0,000
Occupation	0	0	
Housewife	8	6	
Self-employed	5	3	
Private employee	0	0	
Retired	0	0	
Student	0	0	
Family PMO Status			
Parents	5	3	
Spouse	6	4	
Children	1	2	
Health cadres	1	0	
Intensity of PMO Assistance			
High	13	2	
Medium-Low	0	7	

Based on Table 3, the distribution of treatment adherence among pulmonary TB patients varied according to PMO characteristics. Patient adherence was found in all PMO age groups, with the highest number in PMOs aged ≥50 years. Based on gender, patients accompanied by female PMOs showed greater adherence than those accompanied by male PMOs. Most adherent patients were in the PMO group with a high school education level and in the PMO group with a status of housewife or entrepreneur. In terms of the relationship between PMOs and patients, adherence was more common in patients accompanied by spouses or parents than by children. The most notable difference was seen in the intensity of PMO support, where almost all patients who received high-intensity support were in the treatment-compliant group, while all patients with moderate to low-intensity support were in the non-compliant group. The results of Fisher's Exact test showed a significant relationship between the intensity of PMO accompaniment and the treatment adherence of pulmonary TB patients ($p < 0.05$).

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b. Discussion

The present study found a significant association between the intensity of treatment supervision by PMO and medication adherence among patients with pulmonary tuberculosis. Patients who received high-intensity supervision from their PMOs were more likely to be adherent to their anti-TB therapy compared to those who received lower-intensity support. This finding aligns with evidence from systematic reviews indicating that interventions involving directly observed therapy (DOT) and structured supervision are associated with improved treatment adherence and outcomes in tuberculosis programs worldwide (Alipanah et al., 2018; Müller et al., 2018). Although the effectiveness of DOT may vary across settings, enhanced adherence strategies including direct observation by trained personnel and community based supporters have been consistently associated with increased treatment completion and reduced loss to follow-up in TB patients, when compared with self-administered therapy (Alipanah et al., 2018). Such support likely contributes to adherence by promoting regular medication intake, addressing patient barriers to treatment, and reinforcing patient engagement with the regimen.

The significant association between high-intensity supervision by treatment supporters and medication adherence observed in this study may reflect both structured supervision and broader behavioral support mechanisms documented in the literature. Several studies have reported that the role and quality of medication supervisors are associated with improved adherence among patients with pulmonary tuberculosis, suggesting that supportive behaviors such as consistent reminders and active facilitation of treatment can influence adherence outcomes (Istiani et al., 2024; Swarjana et al., 2021). Another study also emphasizes that higher adherence levels are related to adequate caregiver support and patient education, reinforcing the notion that adherence is shaped by both social and educational factors (Hardianita & Nurlaeli, 2025). Qualitative insights further indicate that PMOs contribute beyond simple observation by providing emotional encouragement, monitoring side effects, and facilitating access to care, which may help patients sustain long-term treatment engagement (Pasaribu et al., 2023). These findings complement the global evidence base and provide a localized understanding of how intensity and nature of supervision influence treatment adherence in TB patients.

In this study, variations in medication adherence were observed across different characteristics of treatment supervisors. However, these findings indicate that demographic characteristics of PMO's did not emerge as dominant factors associated with treatment adherence. This suggests that structural and behavioral aspects of supervision, such as the manner and consistency in which supervision is delivered, may play a more substantial role than demographic attributes alone. This interpretation is consistent with the findings of Agustin et al. (2025) , who reported no significant association between PMO age, sex, and educational level and medication adherence among patients with tuberculosis. Similar results were also reported by Fadlilah (2017), who found that PMO characteristic including age, sex, educational level, occupation, and relationship to the patient were not significantly associated with tuberculosis treatment

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adherence. Taken together, these findings suggest that adherence to tuberculosis treatment is more strongly related to how supervision is conducted rather than who serves as the treatment supervisor.

Overall, the findings of this study emphasize the importance of improving the quality and intensity of PMO support in promoting TB treatment adherence. Active, consistent, and sustained PMO involvement throughout the patient's treatment period is considered a key aspect in ensuring treatment continuity (Sasmita et al., 2025). Strengthening the role of PMOs, including through standardized training to improve the knowledge and communication skills of PMOs and health workers, has the potential to increase the effectiveness of support and encourage patient adherence to treatment. In the context of primary health care, such as community health centers, strengthening more structured support mechanisms can contribute to the success of treatment and TB control programs as a whole.

4. Conclusion

This study demonstrates a significant association between the intensity of medication supervision by treatment supporters and treatment adherence among patients with pulmonary tuberculosis. High-intensity supervision was associated with better adherence to anti-tuberculosis therapy, while demographic characteristics of PMO's were not found to be dominant factors influencing adherence. These findings highlight that the effectiveness of treatment supervision is determined more by how supervision is conducted rather than by who performs it. Strengthening structured, consistent, and active PMO involvement may contribute to improved treatment adherence and support the success of tuberculosis control programs, particularly in primary health care settings.

5. Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest related to the research, authorship, or publication of this article.

Statement of informed consent

Informed consent was obtained from all participants before data collection. Participation was voluntary, and all participants were informed about the purpose of the study and their right to withdraw at any time without any consequences.

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