

The Relationships Between Stress, Patient-Healthcare Provider Interactions, Family Support, and Perceived Transportation Costs on Adherence to Pulmonary Tuberculosis Treatment

Tyas Cahya Pertiwi¹⁾, Nur Hafidha Hikmayani²⁾, Sumardiyono³⁾,
Arsita Eka Prasetyawati⁴⁾, Ratih Puspita Febrinasari²⁾

¹⁾Master's Program in Public Health, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

²⁾Department of Pharmacology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta Indonesia

³⁾Departement Occupational Health and Safety, Vocational School,
Universitas Sebelas Maret, Surakarta, Indonesia

⁴⁾Department of Public Health and Preventive Medicine, Faculty of Medicine,
Universitas Sebelas Maret, Surakarta, Indonesia

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ABSTRACT

Background: Treatment adherence is essential for successful pulmonary tuberculosis therapy and is influenced by psychological, interpersonal, and socioeconomic factors. This study aimed to analyze the association between stress, patient–healthcare provider relationship, family support, and perceived transportation costs with treatment adherence among patients with pulmonary tuberculosis receiving treatment at Primary Health Centers in Surakarta City.

Subjects and Method: An analytical observational study with a cross-sectional design was conducted among 132 patients with drug-susceptible pulmonary tuberculosis in the continuation phase of treatment at 17 Primary Health Centers in Surakarta City. Participants were selected using purposive sampling based on predefined inclusion and exclusion criteria. The independent variables were stress, patient–healthcare provider relationship, family support, and perceived transportation costs, while the dependent variable was treatment adherence. Data were collected using standardized questionnaires and analyzed using the Generalized Ordered Logit Model.

Results: Moderate stress (aOR=0.23; 95% CI=0.07 to 0.75; p=0.015), severe stress (aOR=0.18; 95% CI=0.06 to 0.55; p=0.003), and very severe stress (aOR=0.02; 95% CI = 0.03 to 0.12; p < 0.001), a “fair” patient–healthcare provider relationship (aOR = 40.84; 95% CI = 4.95 to 337.06; p = 0.001), a “good” patient–healthcare provider relationship (aOR = 31.35; 95% CI = 4.70 to 208.97; p < 0.001), and a moderate perception of transportation costs (aOR = 0.31; 95% CI = 0.11 to 0.82; p = 0.018) were significantly associated with adherence to pulmonary tuberculosis treatment. Mild stress, “fair” family support, “good” family support, and “severe” perceived transportation costs were not significantly associated with adherence to pulmonary tuberculosis treatment (p>0.05).

Conclusion: Treatment adherence among patients with pulmonary tuberculosis is associated with psychological, interpersonal, and economic factors. Strengthening patient–healthcare provider communication, integrating stress assessment and management into tuberculosis care, and reducing transportation barriers may improve treatment adherence and treatment outcomes.

Keywords: tuberculosis; pulmonary; medication adherence; psychological stress; social support; health personnel

Correspondence:

Nur Hafidha Hikmayani. Faculty of Medicine, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia. Email: hafidha@staff.uns.ac.id.

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BACKGROUND

Pulmonary tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* that primarily attacks the lungs, although it can also involve other organs such as bones, lymph nodes, and the central nervous system (Alsayed and Gunosewoyo, 2023). The disease is spread through airborne droplets released by individuals with active pulmonary tuberculosis when coughing, sneezing, or talking, while latent infections can progress to active disease when the immune system is compromised (Kristini and Hamidah, 2020). According to the World Health Organization, approximately 10,800,000 people will contract Tuberculosis and 1,250,000 people will die from the disease globally in 2023, making tuberculosis one of the leading causes of death from a single infectious agent (WHO, 2023). Nearly two-thirds of the global tuberculosis burden is concentrated in eight countries, including Indonesia, India, China, Pakistan, the Philippines, Bangladesh, Nigeria, and South Africa (WHO, 2023). These findings indicate that pulmonary tuberculosis remains a major global public health problem, especially in low- and middle-income countries.

Indonesia has the second-highest tuberculosis burden in the world after India, with an estimated 1,060,000 cases and around 134,000 tuberculosis-related deaths annually (WHO, 2023). Although national tuberculosis control programs have strengthened case detection, treatment success remains below the expected target. The Central Java Provincial Health Office reported that the tuberculosis case detection rate reached 90.5% in 2024,

exceeding the national target of 90% (Central Java Provincial Health Office, 2024). However, improvements in case detection have not been accompanied by proportional increases in treatment success, suggesting that barriers to treatment completion remain unresolved. These conditions demonstrate that strengthening treatment adherence is essential to improve tuberculosis control in Indonesia.

Surakarta City, Indonesia, is one of the districts with a high tuberculosis burden in Central Java. In 2024, the tuberculosis case detection rate reached 117%, whereas the treatment success rate was only 84.9%, remaining below the national target of 90% (Central Java Provincial Health Office, 2024). Furthermore, the number of pulmonary tuberculosis cases increased from 2,022 in 2023 to 2,474 in 2024, while deaths during treatment rose from 99 to 139 patients (Surakarta City Health Office, 2022; 2023; 2024). During the same period, the treatment success rate declined from 88.31% in 2022 to 84.87% in 2024 (Surakarta City Health Office, 2022; 2023; 2024). These findings suggest that improving treatment adherence remains a major challenge for tuberculosis control in Surakarta City.

Treatment adherence is a key determinant of successful pulmonary tuberculosis therapy because incomplete treatment increases the risk of treatment failure, relapse, continued disease transmission, and multidrug-resistant tuberculosis (Laksono et al., 2024). Previous studies have shown that psychological stress reduces patients' motivation to complete long-term treatment, whereas a positive

patient–healthcare provider relationship improves communication, trust, and commitment to treatment (Minggarwati et al., 2023). Family support has also been associated with better treatment adherence by providing emotional and practical assistance throughout therapy (Kusbandia et al., 2024). In addition, transportation costs may limit patients' access to healthcare services and reduce attendance at scheduled follow-up visits, particularly among economically vulnerable populations (Guo et al., 2021; Im et al., 2025). These findings suggest that adherence to medication is influenced by a variety of psychological, psychosocial, social, and economic factors.

Although previous studies have identified stress, patient–healthcare provider relationships, family support, and transportation-related barriers as determinants of treatment adherence, these factors have generally been examined separately (Mohammedhussein et al. 2023). Most previous studies focused on only one or two determinants of treatment adherence and did not simultaneously examine psychological, psychosocial, social, and economic factors within a single analytical model. In addition, studies assessing stress have primarily focused on coping or psychological distress rather than overall stress as perceived by patients during treatment. Few studies have simultaneously evaluated these multidimensional determinants within a single analytical model among pulmonary tuberculosis patients receiving treatment in Primary Health Centers. Moreover, evidence from Indonesia remains limited, particularly in PHCs serving patients in Surakarta City, Indonesia, despite the declining treatment success rate. This lack of comprehensive evidence limits the development of integrated interventions targeting multiple

barriers to treatment adherence. Therefore, further research is needed to examine the combined influence of these factors on treatment adherence in Primary Health Centers.

This study aimed to analyze the association between stress, patient–healthcare provider relationships, family support, and perceived transportation costs with treatment adherence among pulmonary tuberculosis patients receiving treatment at Primary Health Centers in Surakarta City. Unlike previous studies, this study simultaneously evaluated these multidimensional determinants in a single analytical model among patients with drug-susceptible pulmonary tuberculosis in the continuation phase of treatment at Primary Health Centers. The findings are expected to provide evidence for developing comprehensive interventions that address psychological, psychosocial, social, and economic barriers to treatment adherence. Improving treatment adherence may increase treatment success, reduce tuberculosis transmission, and prevent the emergence of drug-resistant tuberculosis. The study is also expected to support healthcare professionals in designing patient-centered interventions that improve adherence throughout the treatment period. Ultimately, the findings may contribute to strengthening tuberculosis control programs implemented through Primary Health Centers in Indonesia.

SUBJECTS AND METHOD

1. Study Design

This study was conducted using a cross-sectional research design in Surakarta City, Central Java, Indonesia from March to May 2026.

2. Population and Sample

The study population consisted of all pulmonary tuberculosis patients undergoing

treatment at 17 primary health centers in Surakarta. A purposive sampling method was employed, and 132 pulmonary tuberculosis patients who met the eligibility criteria were enrolled in the study. The inclusion criteria were patients with drug-susceptible pulmonary tuberculosis (DS-TB) in the continuation phase of treatment (3–6 months), aged 18–59 years, and currently receiving anti-tuberculosis treatment. The exclusion criteria included patients who were unable to communicate effectively because of cognitive impairment or impaired consciousness, patients who had transferred to another health facility before completing treatment, and those who declined to participate in the study.

3. Study Variables

The dependent variable in this study is adherence to pulmonary tuberculosis treatment. The independent variables include stress, the patient–healthcare provider relationship, family support, and perceived transportation costs.

4. Operational Definition of Variables

Stress: The level of psychological distress experienced by patients during pulmonary tuberculosis treatment. Stress is categorized as normal (0 to 7), mild stress (8 to 11), moderate stress (12 to 15), severe stress (16 to 20), and very severe stress (≥ 21).

Patient–healthcare provider relationship: the quality of interaction, communication, support, and trust established during the treatment process. Patient–healthcare provider relationship was categorized as was categorized as poor (0 to 11), fair (12 to 22), and good (23 to 33).

Family support: the emotional and practical assistance, encouragement, and motivation provided by the family to the patient during treatment. Family support was categorized as was categorized as poor (0 to 11), fair (12 to 22), and good (23 to 33).

Perceived transportation costs: the patient’s subjective assessment of the cost, barriers to access, and the impact of transportation costs on treatment adherence. Perceived transportation costs were categorized as low (0 to 10), moderate (11 to 20), and high (21 to 30).

Treatment adherence: the patient’s level of consistency in following the treatment recommendations and schedule prescribed by healthcare providers. Adherence was categorized as low (score < 6), medium (scores 6 to 7), and high (score 8).

5. Study Instruments

Data were collected through face-to-face interviews using a structured questionnaire after respondents signed an informed consent form. Stress levels were measured using the Perceived Stress Scale-10 (PSS-10). Medication adherence was measured using the Morisky Medication Adherence Scale-8 (MMAS-8). The variables of patient–healthcare provider relationship, family support, and perceived transportation costs were measured using questionnaires developed by the researchers based on the indicators of each variable and had undergone validity and reliability testing.

6. Data analysis

Univariate analysis was used to describe the characteristics of respondents and the distribution of each research variable. Bivariate analysis was performed using simple ordinal logistic regression to assess the relationship between each independent variable and adherence to pulmonary tuberculosis treatment. Multivariate analysis used multiple ordinal logistic regression. Prior to interpreting the results, a proportional odds assumption test was performed using the Brant test. If the proportional odds assumption was not met or a condition of perfect prediction was found, the analysis proceeded using the Generalized Ordered Logit Model. The results of the

analysis are presented in the form of Odds Ratios (aOR), 95% Confidence Intervals (95%CI), and p-values with a significance level of 5% ($p < 0.05$).

7. Research Ethics

Participation is based on the patient's written consent, following an explanation of the study's objectives, benefits, procedures, and potential risks. Participant confidentiality is strictly maintained, and data are used exclusively for scientific purposes. This study has been approved by the Health Research Ethics Committee of Kusuma Husada University, Surakarta (No. 3355/-UKH.LO2/EC/III/2026; March 12, 2026).

RESULTS

1. Sample Characteristics

Table 1 shows the characteristics of the study respondents, which consisted of 132 adult pulmonary tuberculosis patients who were currently undergoing or had recently completed treatment at all primary health centers in Surakarta City. The majority of respondents were male, totaling 78

(59.09%). Based on educational level, the majority of respondents had completed high school, totaling 70 (53.03%). Based on occupation, the majority of respondents worked in the private sector, totaling 58 (43.94%), and in terms of income, the majority of respondents had low income (<minimum wage), totaling 83 (62.88%). Based on the study variables, the majority of respondents fell into the normal stress category, totaling 40 (30.30%). Regarding the variable of the patient-healthcare provider relationship, the majority of respondents fell into the "good" category, totaling 104 (78.79%). Regarding the family support variable, the majority fell into the "good" category, totaling 97 (73.48%). Regarding the perceived transportation costs variable, the majority of respondents fell into the "high" category, totaling 96 (72.73%), and regarding the treatment adherence level variable, the majority of respondents demonstrated high adherence, totaling 71 (53.79%).

Table 1. Sample characteristics

Characteristics	Category	Frequency	Percentage
Gender	Male	78	59.09%
	Female	54	40.91%
Education	No Formal Education	4	3.03%
	Elementary School	18	13.64%
	Junior High School	28	21.21%
	High School	70	53.03%
	Higher Education	12	9.09%
	Unemployed	28	21.21%
Occupation	Laborer	16	12.12%
	Private Sector	58	43.94%
	Entrepreneur	30	22.73%
Income	Low (<minimum regional wage)	83	62.88%
	High ($\geq$ minimum regional wage)	49	37.12%
Stress	Low	40	30.30%
	Mild	24	18.18%
	Moderate	22	16.67%
	Severe	35	26.52%
	Very Severe	11	8.33%

Characteristics	Category	Frequency	Percentage
Patient-Healthcare Provider Relationship	Poor	10	7.58%
	Fair	18	13.64%
	Good	104	78.79%
Family Support	Poor	6	4.55%
	Fair	29	21.97%
	Good	97	73.48%
Perceived Transportation Costs	Light	96	72.73%
	Medium	28	21.21%
	Heavy	8	6.06%
Treatment Adherence	Low	15	11.36%
	Medium	46	34.85%
	High	71	53.79%

2. Bivariate Analysis

Table 2 shows that most of the study variables have a significant association with medication adherence. Regarding the stress variable, respondents with moderate stress (OR= 0.23; 95% CI=0.07 to 0.70; $p=0.010$), severe stress (OR=0.10; 95% CI=0.01 to 0.13; $p<0.001$), and very severe stress (OR= 0.01; 95% CI=0.01 to 0.06; $p<0.001$) had a lower likelihood of achieving a higher level of medication adherence compared to respondents with normal stress. However, mild stress did not show a significant association with medication adherence (OR= 0.71; 95% CI=0.22 to 2.23; $p=0.555$).

Regarding the patient–healthcare provider relationship variable, respondents who reported a fair relationship (OR= 28.12; 95% CI=5.15–153.59; $p<0.001$) and an excellent relationship (OR=38.84; 95%

CI= 8.56–176.15; $p<0.001$) had a higher likelihood of achieving a higher level of treatment adherence compared to respondents with a poor relationship.

Regarding the family support variable, respondents who received fair family support (OR=13.80; 95% CI=2.17–87.84; $p=0.005$) or good family support (OR= 28.38; 95% CI=4.79–167.98; $p<0.001$) had a higher likelihood of exhibiting a higher level of medication adherence compared to respondents with poor family support.

Respondents who perceived transportation costs as moderate (OR= 0.29; 95% CI= 0.13–0.68; $p=0.004$) and high (OR= 0.07; 95% CI=0.02–0.30; $p<0.001$) were less likely to achieve a higher level of treatment adherence compared to respondents with a low perception of transportation costs.

Table 2. Results of the bivariate analysis of the relationship between stress, patient-healthcare provider interaction, family support, and perceived transportation costs on adherence to pulmonary tuberculosis treatment

Independent Variables	OR	95% CI		p
		Lower Limit	Lower Limit	
Stress				
Normal	Ref.			
Mild Stress	0.71	0.22	2.23	0.555
Moderate Stress	0.23	0.07	0.70	0.010
Severe Stress	0.01	0.01	0.13	<0.001
Very Severe Stress	0.01	0.01	0.06	<0.001
Patient-Healthcare Provider Relationship				
Poor	Ref.			

Independent Variables	OR	95% CI		p
		Lower Limit	Lower Limit	
Fair	28.12	5.15	153.59	<0.001
Good	38.84	8.57	176.12	<0.001
Family Support				
Poor	Ref.			
Fair	13.80	2.17	87.84	0.005
Good	28.38	4.79	167.98	<0.001
Perceived Transportation Costs				
Light	Ref.			
Medium	0.30	0.13	0.68	0.004
Heavy	0.07	0.02	0.31	<0.001

3. Multivariate analysis

Based on the results of the multivariate analysis in Table 3, the stress variable showed that the mild stress category was not significantly associated with adherence to pulmonary tuberculosis treatment (aOR= 0.60; 95% CI=0.18 to 2.06; p= 0.419). However, the moderate stress category (aOR=0.23; 95% CI=0.07 to 0.75; p= 0.015), the severe stress category (aOR= 0.18; 95% CI=0.06 to 0.55; p=0.003), and the very severe stress category (aOR=0.02; 95% CI=0.03 to 0.12; p<0.001) were significantly associated with treatment adherence. These results indicate that the higher the level of stress experienced by patients, the lower their tendency to adhere to pulmonary tuberculosis treatment.

The variable “patient–healthcare provider relationship,” in the “fair” category (aOR=40.84; 95% CI=4.95 to 337.06; p= 0.001) and the “good” relationship category (aOR= 31.35; 95% CI=4.70 to 208.97; p <0.001) were significantly associated with adherence to pulmonary tuberculosis treatment compared to the “poor” relationship category. These findings indicate that a better relationship between patients and healthcare workers can improve patient adherence to treatment.

The family support variable, specifically the categories of “fair” family support (aOR=4.68; 95% CI=0.36 to 61.30; p= 0.240) and “good” family support (aOR= 10.60; 95% CI=0.89 to 126.96; p=0.062), was not significantly associated with adherence to pulmonary tuberculosis treatment. Nevertheless, OR values greater than one indicate a tendency that better family support may improve adherence, although this effect has not yet been proven to be statistically significant.

The variable of perceived transportation costs—specifically, the category of moderate perceived transportation costs—was significantly associated with adherence to pulmonary tuberculosis treatment (aOR= 0.31; 95% CI=0.11 to 0.82; p= 0.018), whereas the category of high perceived transportation costs was not significantly associated (aOR=0.17; 95% CI= 0.03 to 14.85; p = 0.074). These results indicate that the greater the perceived burden of transportation costs, the lower the tendency for patients to adhere to treatment, although this relationship was not statistically significant in the high transportation cost category.

Tabel 3. Results of the multivariate analysis of the relationship between stress, patient-healthcare provider interaction, family support, and perceived transportation costs on adherence to pulmonary tuberculosis treatment

Independent Variables	aOR	95% CI		p
		Lower Limit	Lower Limit	
Stress				
Normal	Ref.			
Mild Stress	0.60	0.18	2.06	0.419
Moderate Stress	0.23	0.07	0.75	0.015
Severe Stress	0.18	0.06	0.55	0.003
Very Severe Stress	0.02	0.03	0.12	<0.001
Patient-Healthcare Provider Relationship				
Poor	Ref.			
Fair	40.84	4.95	337.06	0.001
Good	31.35	4.70	208.97	<0.001
Family Support				
Poor	Ref.			
Fair	4.68	0.36	61.30	0.240
Good	10.60	0.89	126.96	0.062
Perceived Transportation Costs				
Light	Ref.			
Medium	0.31	0.11	0.82	0.018
Heavy	0.17	0.03	14.85	0.074

DISCUSSION

This study demonstrated that stress, patient–healthcare provider relationship, and perceived transportation costs were significantly associated with adherence to pulmonary tuberculosis treatment, whereas family support was not independently associated after adjustment for other variables. These findings support the multidimensional concept of treatment adherence, which explains that adherence is influenced by psychological, interpersonal, and socioeconomic factors rather than by a single determinant.

The present study found that patients experiencing moderate, severe, and very severe stress were significantly less likely to achieve higher treatment adherence than patients with normal stress levels, whereas mild stress was not significantly associated with adherence. The progressive decline in adjusted odds ratios across increasing

stress categories suggests that higher psychological stress may substantially reduce patients' ability to maintain long-term tuberculosis treatment. These findings are consistent with the stress and coping theory proposed by Lazarus and Folkman, which explains that individuals experiencing excessive psychological stress tend to have reduced coping capacity, impaired decision-making, and lower motivation to perform health-related behaviors. During the prolonged tuberculosis treatment period, patients experiencing moderate to severe stress may feel overwhelmed by emotional distress, fear of disease progression, treatment fatigue, and social stigma, all of which may interfere with medication adherence. These findings are also in agreement with Sitorus and Barus (2018), who reported that higher stress levels increased the likelihood of treatment non-adherence among pulmonary tuberculosis patients.

Similarly, Tola et al. (2017) demonstrated that psychological distress reduced patients' motivation to take medication regularly and attend scheduled follow-up visits. The absence of a significant association among patients with mild stress may indicate that mild psychological pressure remains within patients' adaptive coping capacity and therefore has not yet substantially affected adherence behavior.

Among all variables included in the multivariable model, the patient–healthcare provider relationship demonstrated the strongest association with treatment adherence. Patients reporting fair and good relationships with healthcare providers were substantially more likely to achieve higher adherence than those reporting poor relationships. This finding is consistent with the patient-centered care model, which emphasizes that effective communication, mutual trust, empathy, and shared decision-making enhance patients' engagement with treatment. Similar findings were reported by Mariska et al. (2025), who found that positive interactions between patients and healthcare providers significantly improved tuberculosis treatment adherence. Herawati et al., (2020) also concluded that therapeutic relationships built on trust increased patients' confidence and willingness to complete treatment, while Arhani et al., (2024) and Ayumar et al. (2023) highlighted the importance of effective communication in improving patients' understanding of treatment and maintaining adherence. Nevertheless, the adjusted odds ratios observed in this study were relatively large and accompanied by very wide confidence intervals, indicating limited precision of the estimated effect sizes. This may be attributable to the relatively small number of participants in the reference category, sparse data across several response categories, or imbalance in

the distribution of participants, resulting in unstable parameter estimation. Therefore, although the direction of the association consistently indicates that better patient–healthcare provider relationships improve adherence, the magnitude of the association should be interpreted cautiously.

Family support was not significantly associated with treatment adherence after adjustment for other variables, although patients with better family support tended to have higher adjusted odds ratios. According to social support theory, emotional, informational, and instrumental support from family members may improve patients' psychological well-being and encourage treatment completion. Previous studies by Ulfah et al. (2018), Herawati et al. (2020), and Malik et al. (2025) consistently demonstrated that stronger family support improved adherence by providing encouragement, supervision, and assistance throughout treatment. The discrepancy between those findings and the present study may be explained by differences in study populations, healthcare settings, cultural backgrounds, and statistical models. After controlling for stress, patient–healthcare provider relationship, and transportation costs, the independent contribution of family support became statistically non-significant, suggesting that its influence may operate indirectly through psychological adaptation or improved interaction with healthcare providers rather than acting as a direct determinant of adherence. In addition, the confidence intervals for family support were also very wide, reflecting considerable statistical uncertainty that may have resulted from limited sample size or low variability within the family support categories.

Perceived transportation costs were also associated with treatment adherence. Patients perceiving transportation costs as

moderately burdensome were less likely to achieve higher treatment adherence than those reporting lower transportation costs, whereas the high-cost category was not statistically significant after adjustment. These findings support Green's behavioral theory, which identifies enabling factors, including financial accessibility and transportation, as important determinants of health behavior. Similar results were reported by Widiastutik et al. (2020), who identified transportation expenses as one of the indirect costs contributing to treatment interruption among tuberculosis patients. Wingfield et al. (2021) likewise emphasized that transportation costs remain an important socioeconomic barrier to accessing tuberculosis services, particularly in low-resource settings. The non-significant finding in the high-cost category may indicate that some patients continue treatment despite substantial transportation expenses because of strong personal motivation, family assistance, or supportive healthcare providers. Another possible explanation is the relatively small number of participants reporting high transportation costs, resulting in reduced statistical power and wider confidence intervals.

Overall, the multivariable findings indicate that treatment adherence among pulmonary tuberculosis patients is influenced by the interaction of psychological, interpersonal, and socioeconomic factors. The strongest determinant identified in this study was the patient–healthcare provider relationship, followed by stress level and perceived transportation costs. These findings are consistent with previous evidence demonstrating that adherence behavior is multifactorial. Mohammedhussein et al. (2023) emphasized the importance of psychological factors, Mariska et al. (2025) highlighted the role of healthcare provider support, and Wingfield et al. (2021)

underscored the influence of socioeconomic barriers on treatment continuity. Together, these findings strengthen the evidence that comprehensive tuberculosis control programs should address multiple dimensions simultaneously rather than focusing exclusively on medication provision.

Several limitations should be acknowledged when interpreting the findings. First, the cross-sectional design limits the ability to establish causal relationships between the independent variables and treatment adherence. Second, adherence and psychosocial variables were measured using self-reported questionnaires, making the findings susceptible to recall bias and social desirability bias. Third, several adjusted odds ratios were accompanied by wide confidence intervals, indicating limited precision of the estimates. This may have resulted from the relatively modest sample size, unequal distribution of participants across exposure categories, and sparse observations within several reference groups, leading to unstable regression estimates. Consequently, the magnitude of some associations should be interpreted with caution despite their statistical significance.

In conclusion, this study showed that stress, patient–healthcare provider relationship, and perceived transportation costs were significantly associated with adherence to pulmonary tuberculosis treatment, whereas family support was not independently associated after adjustment for other variables. The patient–healthcare provider relationship emerged as the strongest determinant of treatment adherence. These findings imply that tuberculosis control programs should integrate routine psychological assessment and stress management, strengthen communication skills and patient-centered care among healthcare providers, and reduce transpor-

tation-related barriers through community-based services, transportation assistance, or decentralized treatment delivery. Future longitudinal studies with larger and more diverse populations are recommended to improve the precision of effect estimates and to further clarify the causal pathways linking psychosocial and socioeconomic factors with tuberculosis treatment adherence.

AUTHOR CONTRIBUTION

All authors made substantial contributions to the conception and design of the study, data collection, analysis and interpretation of results, drafting and revising the manuscript, and approved the final version of the manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest in this research.

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