

Determinants of Treatment Adherence Among Pulmonary Tuberculosis Patients : A Health Belief Model Approach in Pariaman City, Indonesia

Faktor-faktor yang Memengaruhi Kepatuhan Pengobatan pada Pasien Tuberkulosis Paru: Pendekatan Health Belief Model di Kota Pariaman, Indonesia

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Abstract

Tuberculosis remains a major public health problem in Indonesia, and medication nonadherence continues to reduce treatment success despite the availability of effective therapy. The Health Belief Model (HBM) provides a framework for understanding treatment adherence based on patients' health beliefs. This study aimed to analyze determinants of treatment adherence among pulmonary tuberculosis patients using the Health Belief Model approach in Pariaman City, Indonesia. A mixed-methods study with an explanatory sequential design was conducted from August 2023 to June 2024. The quantitative phase employed a cross-sectional design involving 107 pulmonary tuberculosis patients selected through proportional random sampling. The sample size was determined using the Lemeshow formula, yielding a minimum of 97 participants, with an additional 10% included to account for potential dropouts, resulting in a final sample of 107 patients. Independent variables included perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy. The qualitative phase involved in-depth interviews with 12 purposively selected informants to explore program implementation related to treatment adherence. Poor perceptions were reported for susceptibility (43.9%), severity (41.1%), benefits (46.7%), barriers (44.9%), and self-efficacy (52.3%). Bivariate analysis showed that perceived severity ($p=0.007$) and perceived benefits ($p<0.001$) were significantly associated with treatment adherence. Multivariate analysis identified perceived benefits as the strongest determinant of treatment adherence ($OR=5.103$; 95% CI: 2.165-12.027; $p<0.001$). Qualitative findings revealed that limited human resources, funding constraints, and inconsistent patient education contributed to poor perceived benefits, supporting the quantitative finding that perceived benefits was the strongest determinant of adherence. Health authorities should strengthen patient education, ensure adequate human and financial resources, and implement standardized monitoring and counseling programs to improve treatment adherence and tuberculosis control outcomes.

Keywords: Health belief model; Medication adherence; pulmonary tuberculosis.

Abstrak

Tuberkulosis masih menjadi masalah kesehatan masyarakat utama di Indonesia, dan ketidakpatuhan terhadap pengobatan terus menurunkan keberhasilan terapi meskipun pengobatan yang efektif telah tersedia. *Health Belief Model (HBM)* memberikan kerangka teori untuk memahami kepatuhan berobat berdasarkan keyakinan kesehatan pasien. Penelitian ini bertujuan menganalisis determinan kepatuhan berobat pada pasien tuberkulosis paru menggunakan pendekatan Health Belief Model di Kota Pariaman, Indonesia. Penelitian menggunakan metode campuran dengan desain *explanatory sequential* yang dilaksanakan pada Agustus 2023 hingga Juni 2024. Tahap kuantitatif menggunakan desain *cross-sectional* dengan melibatkan 107 pasien tuberkulosis paru yang dipilih melalui *proportional random sampling*. Besar sampel ditentukan menggunakan rumus Lemeshow dengan jumlah minimal 97 responden, kemudian ditambah 10% untuk mengantisipasi *dropout*, sehingga diperoleh total sampel sebanyak 107 responden. Variabel independen meliputi persepsi kerentanan, persepsi keparahan, persepsi manfaat, persepsi hambatan, dan efikasi diri. Tahap kualitatif dilakukan melalui wawancara mendalam terhadap 12 informan yang dipilih secara purposif untuk mengeksplorasi pelaksanaan program terkait kepatuhan berobat. Persepsi yang kurang baik ditemukan pada persepsi kerentanan (43,9%), persepsi keparahan (41,1%), persepsi manfaat (46,7%), persepsi hambatan (44,9%), dan efikasi diri (52,3%). Analisis bivariat menunjukkan bahwa persepsi keparahan ($p=0,007$) dan persepsi manfaat ($p<0,001$) berhubungan signifikan dengan kepatuhan berobat. Analisis multivariat menunjukkan bahwa persepsi manfaat merupakan determinan terkuat kepatuhan berobat ($OR=5,103$; IK95%: 2,165-12,027; $p<0,001$). Temuan kualitatif menunjukkan bahwa keterbatasan sumber daya manusia, kendala pendanaan, dan pendidikan pasien yang belum konsisten berkontribusi terhadap rendahnya persepsi manfaat, sehingga mendukung temuan kuantitatif bahwa persepsi manfaat merupakan determinan terkuat kepatuhan berobat. Otoritas kesehatan perlu memperkuat edukasi pasien, memastikan kecukupan sumber daya manusia dan pendanaan, serta menerapkan program pemantauan dan konseling yang terstandar untuk meningkatkan kepatuhan berobat dan keberhasilan pengendalian tuberkulosis.

Kata Kunci: Health belief model; Kepatuhan pengobatan; Tuberkulosis paru.



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Introduction

Tuberculosis (TB) remains one of the leading infectious diseases and continues to be a major global public health challenge. According to the *Global Tuberculosis Report 2025*, an estimated 10.7 million people developed TB worldwide in 2024, resulting in approximately 1.23 million deaths, including 150,000 among people living with HIV. Despite being a preventable and curable disease, TB remains the leading cause of death from a single infectious agent and a major contributor to antimicrobial resistance due to inadequate treatment coverage, particularly for drug-resistant TB [1]. Indonesia is one of the countries with the highest TB burden, ranking second globally after India. According to the Ministry of Health, an estimated 1.09 million TB cases and 125,000 TB-related deaths occur annually, while approximately 885,000 cases were reported in 2024, highlighting the need to strengthen TB prevention, case detection, and treatment strategies [2].

At the local level, Pariaman City experienced an increase in the TB case detection rate from 51.0% in 2022 to 92.0% in 2023. However, the treatment success rate remained below the national target, decreasing slightly from 85.0% in 2022 to 84.0% in 2023 [3]. Pariaman City was selected as the study setting because the increasing case detection rate accompanied by a declining treatment success rate indicates that improving treatment adherence is essential for strengthening tuberculosis control and achieving national program targets.

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* that primarily affects the lungs and is transmitted through airborne droplets released when infected individuals cough, sneeze, or speak. Although effective treatment is available, successful tuberculosis control depends on patients' adherence to the prescribed treatment regimen. Poor treatment adherence increases the risk of treatment failure, disease relapse, continued transmission, and the development of drug-resistant tuberculosis. Therefore, identifying factors that influence treatment adherence is essential to improve treatment outcomes and support tuberculosis control efforts [1]. Qualitative evidence indicates that adherence is shaped by interactions between patients' beliefs, financial constraints, social support, and the organization of health services, rather than by individual motivation alone [4].

The Health Belief Model (HBM) is one of the most widely used behavioral theories for explaining health-related behaviors based on individuals' perceptions and beliefs. The model consists of six constructs, namely perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy, which collectively influence individuals' decisions to adopt preventive and treatment-related behaviors [5,6]. The HBM was selected because it allows identification of modifiable cognitive factors that can be targeted through health education interventions, unlike socio-demographic factors, which are largely non-modifiable. In the context of tuberculosis, perceived susceptibility reflects patients' perceptions of the risk of recurrent infection or transmitting TB to family members, perceived severity refers to beliefs regarding the seriousness of TB and its consequences, perceived benefits represent beliefs about the effectiveness of treatment, perceived barriers include obstacles such as medication side effects, transportation, stigma, or treatment costs, while self-efficacy reflects patients' confidence in completing the six-month treatment regimen.

Previous studies in Indonesia have examined the relationship between HBM constructs and tuberculosis treatment adherence in several regions outside West Sumatra, including Depok and Surabaya [5,7]. In Padang, health beliefs have also been associated with participation in TB screening among household contacts [8]; however, screening participation is a distinct behavior from medication adherence. However, most studies employed quantitative cross-sectional designs, and evidence integrating quantitative and qualitative findings at the primary healthcare level in West Sumatra remains limited. Although previous studies have demonstrated the association between HBM constructs and treatment adherence, few have

explored how program implementation influences patients' health beliefs and adherence behavior. Addressing this research gap is important to provide a more comprehensive understanding of both patient-related and programmatic factors influencing treatment adherence and to support the development of evidence-based interventions in primary healthcare settings. Therefore, this study aimed to (1) identify the association between HBM constructs and treatment adherence among pulmonary tuberculosis patients in Pariaman City; (2) determine the strongest predictor of treatment adherence; and (3) explore programmatic factors influencing treatment adherence through qualitative inquiry.

Methods

Quantitative phase

The quantitative phase employed an observational analytic study with a cross-sectional design involving pulmonary tuberculosis patients registered at seven public health centers in Pariaman City. The sample size was calculated using the Lemeshow formula, resulting in a minimum sample of 97 participants. To anticipate potential dropouts, an additional 10% was added, resulting in a final sample of 107 respondents. Participants were selected using proportional random sampling based on the number of eligible tuberculosis patients registered at each public health center. The sample allocation consisted of 12 patients from Kurai Taji, 13 from Marunggi, 15 from Air Santok, 32 from Pariaman, 14 from Padusunan, 10 from Sikapak Barat, and 11 from Naras Public Health Centers. Eligible participants were pulmonary tuberculosis patients registered in Pariaman City who were willing to participate in the study and were able to read and write. Patients who could not be contacted during data collection or had died were excluded from the study. Treatment adherence was the dependent variable, whereas the independent variables comprised the Health Belief Model (HBM) constructs, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy. Perceived susceptibility referred to patients' perceptions of their vulnerability to tuberculosis-related consequences, perceived severity reflected beliefs regarding the seriousness of tuberculosis, perceived benefits represented beliefs about the effectiveness of treatment, perceived barriers referred to perceived obstacles to treatment adherence, and self-efficacy reflected patients' confidence in completing tuberculosis treatment. Data were collected using a structured questionnaire consisting of 25 items, including five items each for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy. Responses were measured using a four-point Likert scale ranging from strongly disagree to strongly agree. The questionnaire underwent validity and reliability testing among 30 respondents before data collection. All questionnaire items were valid, with corrected item-total correlation coefficients ranging from 0.376 to 0.654, exceeding the critical value ($r = 0.361$). Reliability testing demonstrated acceptable internal consistency, with Cronbach's alpha values of 0.621 for perceived susceptibility, 0.629 for perceived severity, 0.630 for perceived benefits, 0.661 for perceived barriers, and 0.625 for self-efficacy. Treatment adherence was measured using a structured adherence questionnaire administered through face-to-face interviews. Patients were subsequently classified as adherent or non-adherent according to the predefined scoring criteria of the questionnaire. Univariate analysis was conducted to describe respondents' characteristics and study variables. Chi-square tests were performed to examine associations between HBM constructs and treatment adherence. Variables with p -values <0.25 were included in multiple logistic regression analysis to identify the strongest determinants of treatment adherence. Statistical significance was established at $p < 0.05$.

Qualitative phase

The qualitative phase involved purposive sampling of 12 informants, including tuberculosis program managers, healthcare workers, treatment supervisors, and pulmonary tuberculosis patients. A semi-structured interview guide was developed based on the quantitative findings, particularly to explore programmatic factors underlying treatment adherence. Interviews explored program inputs, implementation processes, monitoring and evaluation, and barriers to treatment adherence. Interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis following Braun and Clarke's six-phase framework [9]. Coding was performed independently by two researchers, and discrepancies were resolved through discussion until consensus was achieved. Data trustworthiness was enhanced through source triangulation, member checking, and peer discussion. Integration of quantitative and qualitative findings: the qualitative interview guide was developed based on the quantitative findings, particularly the HBM constructs associated with treatment adherence. Data integration was conducted using a weaving approach,

whereby qualitative findings were used to explain, contextualize, and strengthen the quantitative results in the discussion section, providing a comprehensive understanding of patient-related and programmatic determinants of tuberculosis treatment adherence.

Results and Discussion

The results and discussion are presented using an explanatory sequential mixed-methods approach. Quantitative findings are presented first to identify the Health Belief Model (HBM) factors associated with treatment adherence, followed by qualitative findings that provide further explanation of the programmatic factors underlying these results.

Table 1. Distribution of Health Belief Model Variables and Treatment Adherence

Variable	poor n (%)	good n (%)
Perceived susceptibility	47 (43.9)	60 (56.1)
Perceived severity	44 (41.1)	63 (58.9)
Perceived benefits	50 (46.7)	57 (53.3)
Perceived barriers	48 (44.9)	59 (55.1)
Self-efficacy	56 (52.3)	51 (47.7)

Based on Table 1, the distribution of Health Belief Model (HBM) constructs showed generally favorable perceptions among participants, although variations were observed across the domains. Perceived susceptibility, perceived severity, perceived benefits, and perceived barriers were predominantly categorized as good. This indicates that most patients demonstrated relatively positive perceptions regarding tuberculosis risk, disease severity, treatment benefits, and barriers related to treatment completion. However, self-efficacy showed the lowest proportion of good perception, suggesting that patients' confidence in completing long-term tuberculosis treatment remained a challenge.

Table 2. Association Between Health Belief Model Variables and Treatment Adherence

Variable	Non-adherent n (%)	Adherent n (%)	P Value	OR (95% CI)
Perceived susceptibility				
Poor	25 (53.2)	22 (46.8)	0.737	-
Good	35 (58.3)	25 (41.7)		
Perceived severity				
Poor	32 (72.7)	12 (27.3)	0.007	3.333 (1.455 - 7.636)
Good	28 (44.4)	35 (55.6)		
Perceived benefits				
Poor	38 (76)	12 (24.0)	<0.001	5.038 (2.175 -11.669)
Good	22 (38.6)	35 (61.4)		
Perceived barriers				
Poor	32 (66.7)	16 (33.3)	0.073	-
Good	28 (47.5)	31 (52.5)		
Self-efficacy				
Poor	35 (62.5)	21 (37.5)	0.227	-
Good	25 (49)	26 (51)		

Based on Table 2, the findings of this study demonstrated that perceived severity and perceived benefits were significantly associated with treatment adherence among pulmonary tuberculosis patients. Among these two constructs, perceived benefits showed the strongest association, indicating that patients who understood the advantages and effectiveness of tuberculosis treatment were more likely to adhere to therapy. According to the Health Belief Model (HBM), individuals are more likely to engage in health-related behaviors when they believe that the recommended action provides meaningful benefits. These findings are consistent with previous studies that reported a significant relationship between perceived benefits and treatment adherence. Patients who recognize the effectiveness and benefits of anti-tuberculosis treatment are more likely to follow the prescribed treatment regimen [10,11]. A cluster-randomized trial in Ethiopia found that HBM-based education combined with psychological counseling reduced treatment nonadherence compared with routine

care [12]. This provides intervention evidence supporting theory-informed counseling, although the present cross-sectional findings do not establish causality.

Perceived severity was also significantly associated with treatment adherence. Patients who perceived tuberculosis as a serious disease had greater motivation to follow the recommended treatment regimen. This finding supports the HBM concept that perceived seriousness of illness can increase individual motivation to take preventive and therapeutic actions. These findings are consistent with previous studies, which have reported a significant association between perceived severity and treatment adherence, indicating that patients who perceive tuberculosis as a serious disease are more likely to comply with treatment [13].

In contrast, perceived susceptibility, perceived barriers, and self-efficacy were not significantly associated with treatment adherence in this study. Although these constructs are important components of HBM, patients' perceptions of disease risk, treatment barriers, and confidence in completing therapy may be influenced by various other factors, such as social support, healthcare access, and treatment experience. An Indonesian qualitative study identified limited treatment knowledge, stigma, travel distance, adverse drug reactions, and income loss as barriers to successful treatment [14]. Thus, the nonsignificant associations observed here should not be interpreted as evidence that practical barriers are unimportant. These findings suggest that improving patients' understanding of treatment benefits and tuberculosis severity may be an important strategy for enhancing treatment adherence. Variables with p-values <0.25 in the bivariate analysis were included in the initial multivariable logistic regression model. These variables included perceived severity, perceived benefits, perceived barriers, and self-efficacy, whereas perceived susceptibility was excluded because it did not meet the selection criteria ($p=0.737$). A backward elimination method was applied to determine the final model. Self-efficacy and perceived severity were sequentially removed from the model because their adjusted p-values were >0.05.

Table 3. Multivariable Logistic Regression Analysis of Factors Associated with Treatment Adherence

Variable	Adjusted OR	95% CI	p-value
Perceived benefits	5.103	2.165 - 12.027	<0.001
Perceived barriers	2.269	0.969 - 5.316	0.059

Based on Table 3, the multivariable analysis demonstrated that perceived benefits remained the strongest independent determinant of treatment adherence after controlling for other variables in the model. Patients with good perceived benefits had 5.103 times higher odds of adhering to tuberculosis treatment compared with those with poor perceived benefits (Adjusted OR=5.103; 95% CI: 2.165–12.027; $p<0.001$). This finding indicates that patients who understand the effectiveness and advantages of tuberculosis treatment are more likely to complete the prescribed treatment regimen.

Based on Table 4, the qualitative findings identified several implementation challenges related to program input, process, and output. Limited human resources, inconsistent cadre involvement, and limited operational capacity affected the continuity of tuberculosis control activities, particularly health education, community engagement, and patient support services. Although TB services were supported by available facilities and funding mechanisms, variations in program implementation reduced the consistency of adherence support activities. Informants reported that some patients discontinued treatment because they felt cured, experienced treatment fatigue, or preferred traditional remedies. These findings provide further explanation for the quantitative results, particularly the significant association between perceived benefits and treatment adherence. In the multivariable analysis, perceived benefits remained the strongest predictor of adherence, and the qualitative findings highlighted how continuous education and adherence support may influence patients' understanding of the importance of completing TB treatment. Similar qualitative research in Ghana identified perceived recovery after the intensive phase and insufficient TB education as barriers to adherence, reinforcing the need to explain why symptom improvement does not indicate treatment completion [15].

Previous studies have emphasized that successful tuberculosis control requires continuous patient education, adequate healthcare personnel, and active community involvement. Limited availability of trained staff and suboptimal participation of community health workers may reduce the effectiveness of adherence support programs. Therefore, strengthening routine health education, optimizing community health worker involvement, and improving operational support are important strategies to enhance tuberculosis treatment adherence and achieve program targets [16]. A systematic review and meta-analysis likewise supported

patient-centered combinations of education, psychosocial or material support, and reminders, while emphasizing that treatment supervision alone does not ensure better outcomes in every setting [17].

This study has several limitations. First, the quantitative phase used a cross-sectional design, which limits the ability to establish causal relationships between Health Belief Model constructs and treatment adherence. Second, treatment adherence and Health Belief Model constructs were assessed using self-reported questionnaires, which may have introduced recall bias and social desirability bias. Third, although the qualitative phase provided deeper insights into TB program implementation, the number of informants was limited, and the findings may reflect the specific context of tuberculosis control programs in Pariaman City and may not be fully generalizable to other settings. Finally, other factors that may influence treatment adherence, such as social support, economic conditions, and patient-related characteristics, were not explored comprehensively in this study.

Integration of Quantitative and Qualitative Findings

Table 4. Summary of qualitative findings

Theme	Subtheme	Main Findings	Representative Quotes
Program Input	Human resources	Human resources were available but limited. Most TB programs were managed by a single TB officer, and the involvement of TB cadres was inconsistent due to limited incentives.	"I am the only person responsible for the TB program, including data entry and field activities." (IF 7, TB program officer) "TB cadres are currently inactive because there is no incentive provided. Therefore, the health center does not impose too many responsibilities on cadres in carrying out their duties." (IF 7, TB program officer)
	Funding	TB program funding was mainly provided through BOK funds. However, limited funding affected cadre incentives and several program activities.	"The program funding comes from BOK, but it is often insufficient to support program activities." (IF 3, TB program officer)
	Facilities and health promotion media	Most health facilities and TB supporting equipment were available. However, the utilization of educational media by patients remained limited.	"Health promotion media such as leaflets and posters are available, but many patients do not pay attention to the education provided." (IF 5, TB program officer)
Program Process	Patient education and community empowerment	TB education, contact investigation, and treatment monitoring were implemented; however, these activities were not conducted consistently.	"Health education is provided during integrated health post activities or community health activities, but the schedule is not always determined." (IF 2, TB program officer)
	Treatment monitoring and evaluation	Monitoring was performed through home visits and telephone follow-up; however, the frequency varied among health centers.	"Monitoring is conducted, but there is no fixed schedule. We only occasionally monitor patients' medication intake." (IF 1, TB program officer)
	Barriers during implementation	Treatment discontinuation was mainly related to patients feeling cured, stigma, treatment fatigue, and preference for traditional medicine.	"Many patients feel that they have recovered during the second month of treatment, so they stop taking their medication." (IF 6, TB program officer)
Program Output	Treatment adherence achievement	Treatment adherence achievement	Treatment adherence achievement

The qualitative findings provided further explanations for the quantitative results. The quantitative analysis showed that perceived benefits was the strongest determinant of tuberculosis treatment adherence. Qualitative interviews indicated that limited and inconsistent patient education activities may contribute to inadequate understanding of the importance and benefits of completing tuberculosis treatment. In addition, although self-efficacy was not significantly associated with treatment adherence in the quantitative analysis,

more than half of participants had poor self-efficacy. Qualitative findings suggested that limited monitoring, insufficient patient support, and inconsistent follow-up may influence patients' confidence in completing long-term tuberculosis therapy. The WHO operational handbook recommends repeated education and counseling throughout TB treatment, including clear explanations of treatment duration, benefits, adverse effects, and follow-up arrangements [18].

Conclusions

This study demonstrates that the Health Belief Model (HBM) is a useful framework for explaining treatment adherence among patients with pulmonary tuberculosis in Pariaman City. Among the HBM constructs, perceived benefits emerged as the strongest predictor of treatment adherence, indicating that patients who recognize the importance and effectiveness of completing tuberculosis treatment are more likely to follow the prescribed regimen. The qualitative findings further explain that adherence is influenced not only by individual health beliefs but also by program implementation factors, including limited human resources, financial constraints, and inconsistent implementation of patient education, community empowerment, and treatment monitoring activities. Therefore, improving treatment adherence requires an integrated approach through HBM-based health education that emphasizes treatment benefits and disease severity, strengthening community health worker involvement, ensuring continuous patient counseling, and optimizing routine monitoring and evaluation systems. Future studies should apply longitudinal designs, incorporate objective measures of adherence, and evaluate the effectiveness of HBM-based interventions to improve tuberculosis treatment outcomes.

Conflict of Interest

The author declares that there are no conflicts of interest regarding the design, implementation, analysis, or reporting of this study. All research processes were conducted objectively and independently, without any external interference.

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