The effectiveness of health belief model intervention on tuberculosis medication adherence in rural Indonesia: a pre-experimental study

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Abstract

Tuberculosis treatment non-adherence remains a significant challenge in rural Indonesia, with Kampar District reporting below-target success rates. Therefore, this study aimed to evaluate the effectiveness of a Health Belief Model (HBM) intervention on medication adherence among tuberculosis patients in rural Indonesia. A pre-experimental study with a one-group pretest-posttest design was conducted among 45 purposively sampled TB patients in Kampar District. Data were collected using the validated Health Belief Model Questionnaire and the Medication Adherence Rating Scale. The intervention consisted of a 3-month structured program including weekly sessions in the first month, bi-weekly sessions in the second month, and a monthly follow-up in the third month. Following the HBM intervention, significant improvements were observed in perceived benefits (31.33±4.447 to 32.80±4.341, p<0.001), perceived barriers (22.80±3.286 to 24.38±4.185, p=0.002), and perceived susceptibility (25.64±3.675 to 26.69±3.771, p=0.007). Moreover, medication adherence significantly improved from 5.40±1.156 to 6.20±0.944 (p<0.001). The HBM intervention effectively improved medication adherence through enhanced health beliefs among rural TB patients. Thus, integrating HBM-based interventions into TB treatment programs could improve treatment outcomes in resource-limited settings. However, further research with longer follow-up periods is recommended.

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Introduction

Tuberculosis (TB) remains a serious health problem in Indonesia. According to the latest report from the World Health Organization (WHO) in 2023, TB is ranked as the 13th leading cause of death worldwide.[1] Despite advancements in treatment, the disease continues to disproportionately impact low-income countries. The COVID-19 pandemic has exacerbated the challenges posed by TB, disrupting healthcare services and limiting access to diagnosis and treatment.[2] This disruption has led to a resurgence of TB cases in many regions, including Indonesia, where TB cases have significantly increased.[3]

The burden of TB in Indonesia is substantial. The WHO's 2023 report reveals that Indonesia continues to face significant challenges in combating TB. Approximately 969,000 new TB cases are estimated to occur annually, resulting in 93,000 deaths.[4] Additionally, the emergence of drug-resistant TB complicates TB control efforts in Indonesia. The prevalence of TB in Indonesia is influenced by various factors, including socioeconomic conditions and underlying health issues.[5] Poverty, malnutrition, HIV/AIDS, and other chronic illnesses can increase an individual's susceptibility to TB.[6] These risk factors often intersect, creating a complex web of challenges for those affected.

The Indonesian government has implemented various programs to address the TB burden.[7] These efforts include awareness campaigns to educate the public about TB prevention and symptoms, free treatment programs to improve access to care, and initiatives to strengthen the healthcare system. However, significant challenges remain, such as social stigma associated with TB, limited access to healthcare services in rural areas, and a lack of public awareness about the disease.[8]

In Kampar District, the situation is particularly concerning. The treatment success rate in 2021 was only 75%, significantly below the national target of 85%.[9] This resulted in three MDR-TB

cases in 2022, representing a 50% increase from previous years.[10] The district's rural characteristics, with 70% of patients living more than 10 km from health facilities, low health literacy (only 35% understand TB transmission correctly), and an average monthly income below provincial minimum wage – create unique adherence challenges not addressed by standard TB programs.

Patients with pulmonary tuberculosis often experience psychological distress that can hinder treatment adherence.[11] The Health Belief Model (HBM) provides a theoretical framework for addressing these psychological barriers by examining how individual beliefs about disease – including perceived susceptibility, severity, benefits, and barriers – influence health behaviors.

Despite the potential of HBM in addressing TB treatment adherence, critical gaps remain in its application. First, most HBM studies have focused on urban populations with better healthcare access, overlooking rural contexts where barriers are more complex. Second, existing HBM interventions rarely incorporate local cultural beliefs and family dynamics which are crucial in Indonesian rural contexts. Third, previous studies primarily measured knowledge change rather than actual medication-taking behaviors. Fourth, no studies have specifically addressed the unique combination of geographical, economic, and cultural barriers present in districts like Kampar with documented low treatment success rates. This study addresses these gaps by developing and evaluating a culturally-adapted HBM intervention specifically designed for rural TB patients facing multiple structural barriers. To our knowledge, this is the first study to: i) apply HBM in Indonesian rural districts with documented treatment success rates below national targets, ii) incorporate local cultural beliefs and family involvement into the intervention design, and iii) measure both psychological constructs and actual medication adherence behaviors. Therefore, this study aims to evaluate the effectiveness of an HBM intervention on medication adherence among pulmonary TB patients in Kampar District, with the goal of providing evidence for scalable interventions that can improve treatment outcomes in resource-limited rural settings.

Materials and Methods

This pre-experimental study with a one-group pretest-posttest design was conducted from March to August 2024 at five community health centers in Kampar District. Sample size calculation indicated a minimum of 42 participants (80% power, 95% confidence level); 45 of 47 recruited participants completed the study.

Study population

The study population comprised all adult pulmonary TB patients registered in the District TB Control Program. Based on district health records, approximately 180 active TB patients were undergoing treatment, with 145 adults aged 21-60 years forming the accessible population.

Purposive sampling was used to select adult pulmonary TB patients (21-60 years) currently receiving treatment. Inclusion criteria were confirmed pulmonary TB diagnosis, Kampar District residence, ability to communicate, and informed consent. Exclusion criteria were MDR-TB, severe comorbidities, cognitive impairment, or previous treatment default.

Intervention protocol

The 3-month HBM intervention was structured in three phases. The intensive phase (month 1) began with a baseline assessment and a 60-minute initial education, followed by weekly 45-minute individual counseling sessions focusing on TB knowledge, and perceived susceptibility and severity. The reinforcement phase (month 2) included bi-weekly 60-minute group sessions and one family involvement meeting, addressing treatment barriers and enhancing perceived benefits. The maintenance phase (month 3) consisted of 1-2 monthly follow-up sessions for adherence sustainment and peer support group formation. Educational materials included booklets, symptom diaries, and reminder tools. Data collection occurred at baseline (day 0) and post-intervention (day 90).

Instruments

Three validated instruments were used: i) a sociodemographic questionnaire capturing age, gender, education, occupation, income, and treatment duration; ii) the Health Belief Model Questionnaire (25 items, 5-point Likert scale) measuring perceived susceptibility, severity, benefits, and barriers (Cronbach's α=0.87); and iii) the Medication Adherence Rating Scale (8 items, binary response, α=0.83).

Data collection and analysis

Five trained nurses collected data at baseline and at the 3-month endpoint. Data were analyzed using SPSS 25.0 with descriptive statistics (frequencies, means, standard deviations) and paired t-tests for pre-post comparisons (significance level $p<0.05$). Intention-to-treat analysis was applied for missing data.

Ethical considerations

The study received ethical approval from the Ethics Committee of the Health Polytechnic of the Ministry of Health Riau (No. LB.02.03/6/95/2024). All participants provided written informed consent, with voluntary participation and confidentiality assured.

Results

The respondent characteristics revealed that the largest age group was late adulthood (36-45 years), comprising 28.9% of the total sample. A substantial proportion was also in late adolescence (17-25 years) and in the elderly (>59 years), each accounting for 20.0% of participants. In terms of gender, males constituted the majority at 68.9%, while females made up 31.1%. Regarding education, the vast majority of respondents (84.4%) had completed senior high school. A small minority had only finished primary school (6.7%) or held a university degree (4.4%). The majority of participants were married (73.3%), with the remaining being single or widowed (13.3% each). Ethnically, the sample was predominantly Malay (60.0%), followed by Minang (24.4%), Batak (8.9%), and Javanese (6.7%). Occupationally, farmers were the most common group (37.8%), followed by private sector workers (33.3%) and retirees (22.2%). In terms of income, 44.4% of respondents reported earning between 1 and 3 million IDR, while 40.0% earned less than 1 million IDR. A smaller proportion (15.6%) earned over 3 million IDR. The overwhelming majority of participants were Muslim (95.6%), with only 4.4% identifying as Christian. Lastly, regarding treatment duration, 26.7% of respondents had been in treatment for 2 months, followed by 24.4% for 1 month, and 17.8% for 6 months. A small proportion (2.2%) had been in treatment for 10 months (Table 1).

Distribution of Health Beliefs and Adherence in Taking Medication.

A comparison of pre- and post-intervention data on health beliefs and medication adherence revealed notable changes. Before

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the intervention, a substantial proportion of respondents (68.9%) held negative perceptions about the benefits of standard treatment. This number significantly decreased to 57.8% post-intervention, indicating an improvement of 11.1%. Similarly, negative perceptions of treatment barriers decreased from 64.4% to 40.0%, representing a substantial improvement of 24.4%. Perceived susceptibility to TB also showed an improvement, with negative perceptions decreasing from 64.4% before the intervention to 53.3% afterward, reflecting an 11.1% positive change. Regarding medication adherence, non-adherence decreased from 62.2% to 57.8%, indicating a 4.4% improvement. Overall, these findings suggest that the application of the Health Belief Model (HBM) positively influenced both respondents' health beliefs and their adherence to medication regimens. On average, the intervention led to a 12.75% improvement across all measured domains (Table 2).

The analysis of the Health Belief Model (HBM) implementation on medication adherence revealed significant findings across various health belief dimensions. For perceived benefits, the mean score increased significantly from 31.33 (SD=4.447) pre-intervention to 32.80 (SD=4.341) post-intervention ($p < 0.001$). Similarly,

Table 1. Demographic characteristics of respondents (N=45).

Characteristic	Category	Frequency (n)	Percentage (%)
Age group	17-25 years (Late adolescence)	9	20.0
	26-35 years (Early adulthood)	8	17.8
	36-45 years (Late adulthood)	13	28.9
	46-55 years (Early elderly)	6	13.3
	>59 years (Elderly)	9	20.0
Gender	Male	31	68.9
	Female	14	31.1
Education	Primary school	3	6.7
	Junior high school	2	4.4
	Senior high school	38	84.4
	University degree	2	4.4
Marital status	Single	6	13.3
	Married	33	73.3
	Widowed	6	13.3
Ethnicity	Malay	27	60.0
	Minang	11	24.4
	Batak	4	8.9
	Javanese	3	6.7
Occupation	Farmer	17	37.8
	Private sector worker	15	33.3
	Retired	10	22.2
	Government employee	3	6.7
Income	<1 million IDR	18	40.0
	1-3 million IDR	20	44.4
	>3 million IDR	7	15.6
Religion	Muslim	43	95.6
	Christian	2	4.4
Treatment duration	1 month	11	24.4
	2 months	12	26.7
	3 months	5	11.1
	4 months	3	6.7
	5 months	5	11.1
	6 months	8	17.8
	10 months	1	2.2

Table 2. Changes in health beliefs and medication adherence pre- and post-intervention (N=45).

Variable	Pre-Intervention		Post-Intervention		Change (%)
	Positive n (%)	Negative n (%)	Positive n (%)	Negative n (%)	
Perceived benefits	14 (31.1)	31 (68.9)	19 (42.2)	26 (57.8)	+11.1
Perceived barriers	16 (35.6)	29 (64.4)	27 (60.0)	18 (40.0)	+24.4
Perceived susceptibility	16 (35.6)	29 (64.4)	21 (46.7)	24 (53.3)	+11.1
Medication adherence	17 (37.8)	28 (62.2)	19 (42.2)	26 (57.8)	+4.4
Average improvement	+12.75				

the perception of barriers showed a significant improvement, with the mean score increasing from 22.80 (SD=3.286) to 24.38 (SD=4.185) (p=0.002). Regarding perceived susceptibility to TB, there was a slight but statistically significant increase from a pretest mean of 25.64 (SD=3.675) to a posttest mean of 26.69 (SD=3.771) (p=0.007). Finally, medication adherence also showed a significant improvement, with the mean score rising from 5.40 (SD=1.156) before the intervention to 6.20 (SD=0.944) afterward (p<0.001), further highlighting the positive impact of the HBM intervention. Overall, the data demonstrate a statistically significant effect of HBM implementation on improving medication adherence in patients with tuberculosis, as evidenced by the p-values in each category being below the 0.05 threshold (Table 3).

Discussion

This study evaluates the effectiveness of an HBM intervention in improving medication adherence among rural TB patients. The demographic profile reveals patterns influencing treatment adherence, with working-age adults (36-45 years, 28.9%) comprising the largest group, consistent with Indonesian TB epidemiology.[14] The male predominance (68.9%) aligns with global patterns attributed to occupational exposures and gender-specific health-seeking behaviors.[15]

Economic factors emerge as significant adherence barriers. With 40% earning below 1 million IDR monthly and 37.8% working as farmers, participants face substantial financial constraints affecting healthcare access and treatment continuation.[16] This economic hardship, which has been documented to exacerbate nonadherence when treatment costs become unaffordable,[17] underscores the need for financial support mechanisms in TB programs.

The predominantly Muslim population (95.6%) and diverse ethnic composition (Malay 60%, Minang 24.4%) highlight cultural considerations for intervention design. Religious beliefs influence illness perception and treatment-seeking behaviors,[18] suggesting the importance of culturally aligned interventions. The varied treatment durations (24.4% at 1 month, 26.7% at 2 months) reflect different treatment phases, with longer durations associated with treatment fatigue that challenges sustained adherence.[19]

The HBM intervention achieves significant improvements across all measured constructs. Negative perceptions about treatment benefits decrease by 11.1%, indicating successful belief modification toward recognizing the adherence value.[20] The more substantial 24.4% reduction in perceived barriers suggests effective effort in addressing of treatment obstacles including side effects, duration concerns, and accessibility issues.[21] The 11.1% improvement in perceived susceptibility, while seemingly counterintuitive, may reflect increased patient empowerment and treatment confidence.[22]

Medication adherence improves from 5.40 to 6.20 (p<0.001), representing a 14.8% increase. While modest in absolute terms, this change is clinically significant in TB treatment contexts where consistent long-term adherence is crucial.[23] The intervention's 12.75% average improvement across all domains demonstrates the HBM's effectiveness in resource-limited settings.

Statistical analysis confirms the intervention effectiveness. Perceived benefits increased significantly (31.33 to 32.80, p<0.001), which is crucial for motivating behavioral change.[24] Barrier reduction (22.80 to 24.38, p=0.002) makes treatment more manageable, encouraging greater adherence.[24] The modest but significant increase in perceived susceptibility (25.64 to 26.69, p=0.007) reinforces the importance of treatment.[25] Most importantly, the significant adherence improvement directly addresses TB program goals, as consistent medication-taking prevents disease transmission and drug resistance development.[26]

Study limitations

Several limitations warrant consideration. The pre-experimental design without a control group limits causal inference, as improvements may reflect treatment progression, concurrent health education, or Hawthorne effects. The 3-month intervention, while capturing the intensive phase, does not assess complete 6-month treatment adherence or long-term sustainability. Self-reported adherence measures are susceptible to social desirability bias, potentially overestimating actual medication-taking by 10-30%. Purposive sampling from a single rural district limits generalizability to urban populations or drug-resistant TB cases. The small sample size (n=45) may have limited the power for subgroup analyses.

Conclusions

The 3-month HBM intervention has significantly improved medication adherence among rural TB patients in Kampar District. Statistically significant improvements in perceived benefits (p<0.001), reduced barriers (p=0.002), and medication adherence scores (5.40 to 6.20, p<0.001) demonstrate the effectiveness of theory-based behavioral interventions in resource-limited settings. These findings are particularly relevant for districts with below-target treatment success rates. Integration of HBM-based approaches into standard TB programs can address the psychological and cultural factors affecting treatment adherence in rural populations. Future research should employ controlled designs with longer follow-up periods to establish causality and assess the sustainability of behavioral changes.

Table 3. Comparison of mean scores before and after HBM intervention (N=45).

Variable	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean difference	t-value	p-value
Perceived benefits	31.33±4.447	32.80±4.341	1.47	6.126	0.000*
Perceived barriers	22.80±3.286	24.38±4.185	1.58	3.242	0.002*
Perceived susceptibility	25.64±3.675	26.69±3.771	1.05	2.834	0.007*
Medication adherence	5.40±1.156	6.20±0.944	0.80	4.264	0.000*

*Statistically significant at p<0.05.

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