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Social Determinants and Healthcare Access on Health Representations and Self Care in Pulmonary Tuberculosis Patients

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ABSTRACT

Introduction: Tuberculosis (TB) remains a significant global health challenge despite advances in diagnosis and treatment. Social determinants and healthcare access may be associated with health representations and self-care behaviors among pulmonary tuberculosis (PTB) patients, yet their complex interrelationships remain insufficiently understood. This study examined relationships between social factors (stigma and social support), healthcare access, health representations, emotional responses, and self-care behaviors among PTB patients, contributing an integrative structural test of these constructs in an Indonesian urban primary-care setting.

Method: An explanatory observational analytic study with a cross-sectional approach was conducted among 160 PTB patients undergoing treatment at four primary healthcare centers in Surabaya from November 2023 to February 2024. Participants were selected through a multistage sampling design combining random selection at the district level with purposive selection at the facility level. Data were collected using culturally validated questionnaires. Structural equation modeling using Partial Least Squares (PLS-SEM) examined associations between variables.

Results: Social factors were significantly associated with health representations (β=0.263, p=0.001), as were healthcare access factors (β=0.201, p=0.002). Health representations were significantly and negatively associated with emotional responses (β=−0.355, p<0.001), indicating that better illness understanding corresponded with reduced emotional distress. Neither health representations (β=0.114, p=0.254) nor emotional responses (β=0.011, p=0.912) demonstrated significant direct associations with self-care behaviors.

Conclusion: Social factors and healthcare access factors significantly associated with health representations, which significantly and negatively associated with emotional responses. Neither health representations nor emotional responses directly associated with self-care behaviors, underscoring the complexity of self-care pathways in TB management and suggesting that self-regulatory mechanisms not captured in the present model may play a more proximal role in shaping self-care. These findings may inform the development of nurse-led interventions addressing social support, healthcare access, illness understanding, and psychosocial well-being to promote comprehensive self-care beyond medication adherence, pending evaluation in future intervention studies.

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INTRODUCTION

Tuberculosis (TB) remains a leading infectious cause of global morbidity and mortality, with Indonesia ranking third worldwide for TB burden at 391 cases per 100,000 population (1). Despite national TB programs providing free treatment and the National Health Insurance (*Jaminan Kesehatan Nasional*/JKN) covering all TB services since 2014, treatment adherence and self-care remain suboptimal. This persistent gap between policy implementation and actual patient outcomes suggests that clinical interventions alone are insufficient, and that broader determinants of health must be addressed to achieve meaningful improvement in TB management (2,3).

Understanding how social factors and healthcare access collectively are associated with health representations and subsequent self-care behaviors among pulmonary tuberculosis (PTB) patients is therefore critical for nursing practice, particularly in the Indonesian context where TB burden remains high despite universal health coverage. Nurses serve as primary coordinators of TB care in community health settings, and understanding these complex relationships is essential for developing interventions that go beyond directly observed therapy to address the psychological and social dimensions of TB management (1,4).

Prior research has separately documented the roles of stigma and social support (2,5), healthcare access barriers (3,4), illness perception (6,7), and emotional distress (8,9) in TB outcomes, but these determinants are rarely tested together within a single explanatory model, and their joint pathway to self-care behavior remains largely unexamined. The contribution of this study is therefore threefold: (1) it provides an integrative, theory-driven test of how social factors and healthcare access jointly relate to health representations, emotional responses, and self-care within a single structural model, rather than examining these determinants in isolation; (2) it situates this test within the under-studied context of urban Indonesian PTB care under universal health coverage; and (3) it surfaces an empirical pattern — the absence of a direct association between health representations or emotional responses and self-care behaviors — that challenges a simplified, education-centered reading of Leventhal's Common Sense Model and points to mechanisms not captured in the present model.

Social factors including socioeconomic status, stigma, and social support significantly are associated with TB outcomes (2). TB-related stigma correlates with treatment non-adherence, while economic hardship creates barriers to care access (4,10). Moreover, social determinants shape whether patients develop accurate understanding of TB as a curable disease or hold misconceptions that lead to stigma and treatment abandonment (6,11). Community nurses working in TB programs must navigate these social complexities to ensure treatment success.

Similarly, healthcare accessibility barriers substantially affect health-seeking among PTB patients despite Indonesia's Universal Health Coverage implementation (3). Geographic distance to healthcare facilities, transportation challenges, and service availability are associated with patients' ability to access timely diagnosis and continuous treatment support. Beyond physical access, healthcare access factors also determine the quality of patient-provider interactions that shape how patients understand and respond to their illness, making equitable access to healthcare a prerequisite for effective TB management (3,4).

Health representations refer to patients' cognitive and emotional interpretations of their illness encompassing their perceived identity, causes, consequences, timeline, and controllability of the condition as conceptualized in Leventhal's Common Sense Model of Self-Regulation (11). The full CSM further proposes that illness representations shape self-care only indirectly, through intervening coping procedures, action planning, appraisal, and self-efficacy (11,12); the present study tests the cognitive–emotional portion of this pathway and does not measure these intervening behavioral-regulation constructs, a scope limitation that is revisited in the Discussion. These mental models are not passive beliefs; they actively shape how patients engage with treatment and manage their condition. Specifically, patients who hold accurate and adaptive illness representations are more likely to adhere to treatment regimens and adopt positive self-care behaviors, including medication adherence, which is essential for TB treatment success (13). In the Indonesian TB context, patients' health representations are further shaped by cultural beliefs and the quality of healthcare provider communication, affecting treatment outcomes through emotional responses (6,7). Nurses who understand these cognitive and emotional frameworks are better positioned to deliver patient-centered education and counseling that align with patients' illness beliefs.

Given that health representations directly relate to how patients cognitively and emotionally process their illness, self-care behaviors among PTB patients are particularly important across the prolonged TB treatment course. Beyond medication adherence, comprehensive self-care encompasses diet management, physical activity, stress

reduction, and consistent health-seeking behaviors. In the absence of adequate social support (5,14), PTB patients often rely solely on personal resilience to sustain these behaviors (5). However, effective self-care requires appropriate guidance, resources, and a supportive environment that addresses both the clinical and psychosocial dimensions of TB management. The interplay between health representations, emotional responses, and self-care remains complex and understudied in TB populations (14,15). Community nurses play a pivotal role in guiding PTB patients toward comprehensive self-care practices — from medication adherence to stress management, nutrition, and exercise — particularly for those with limited social support.

This interconnected association from social context through cognitive processing to behavioral outcomes has not been comprehensively examined in Indonesian TB populations, creating a knowledge gap that limits the effectiveness of nursing interventions. Therefore, this study aimed to examine the relationships between social factors (stigma and social support), healthcare access, health representations, emotional responses, and self-care behaviors among PTB patients undergoing treatment at primary healthcare centers in Surabaya, Indonesia, to inform the future development and testing of evidence-based, nurse-led interventions for comprehensive TB management.

METHODS

Research Design

Leventhal's Common Sense Model of Self-Regulation guided this cross-sectional observational analytic study, examining relationships between social factors, healthcare access, health representations, emotional responses, and self-care behaviors among pulmonary tuberculosis patients.

Setting and Samples

This study was conducted at four primary healthcare centers in Surabaya, Indonesia, from November 2023 to February 2024. Surabaya, as Indonesia's second-largest city with a population of approximately 3 million, was selected due to its high TB burden and diverse socioeconomic population, making it representative of urban TB challenges in Indonesia. The four participating health centers were purposively selected to represent different geographic areas and socioeconomic characteristics within the city. From a population of 2,174 pulmonary TB patients registered across all primary healthcare centers in Surabaya (16), 160 participants were recruited a multistage sampling design combining random selection at the district level with purposive selection at the facility level. These two districts were selected through simple random sampling from the five administrative districts of Surabaya. Each district was assigned a sequential number from one to five, and two districts were drawn using a lottery method, in which numbered papers were placed in a sealed container and drawn by an independent party, ensuring unbiased geographic representation while maintaining feasibility of data collection. The sample was then proportionally allocated between the two districts based on their respective TB patient populations: East Surabaya contributed 96 participants (60%) reflecting its higher TB burden, while North Surabaya contributed 64 participants (40%). Within each district, the two health centers with the highest TB patient volumes were purposively selected to ensure adequate participant pools for SEM estimation; consequently, although district selection was random, facility selection was purposive, and the overall design is more accurately described as a two-stage random-then-purposive sampling strategy rather than a full probability-based cluster random sample. This trade-off was made to satisfy the minimum-sample-per-construct requirements of PLS-SEM but limits the strict generalizability of findings to all primary healthcare centers in Surabaya, a point revisited in the Limitations.

The sample size of 160 was determined based on structural equation modeling requirements using the "ten times rule" (17), which recommends a minimum sample size of ten times the maximum number of structural paths directed at any latent construct in the model. Our conceptual model comprised five latent constructs with the following structural paths: social factors and healthcare access factors directed paths toward health representations; health representations directed paths toward both emotional responses and self-care behaviors; and emotional responses directed a path toward self-care behaviors. Consequently, both health representations and self-care behaviors each received two incoming structural paths, representing the maximum construct complexity in the model. To ensure robust PLS-SEM estimation with adequate statistical power, we applied a conservative approach by multiplying the total number of parameters to be estimated (30 parameters including both measurement and structural paths) by five, yielding 150 participants (17). This calculation was increased to 160 to account for potential dropouts

or incomplete responses, following recommendations for cross-sectional survey research (18). This sample size calculation method is specifically designed for PLS-SEM in cross-sectional observational studies where the goal is to estimate multiple relationships simultaneously, as outlined in guidelines for partial least squares structural equation modeling (17).

Inclusion criteria were: age ≥17 years; currently receiving first-line TB treatment in the intensive phase (0–2 months) or continuation phase (3–6 months) of the standard regimen; a minimum treatment duration of four weeks at the time of enrollment, to ensure sufficient illness experience for health representations and self-care behaviors to have meaningfully developed; ability to communicate effectively in Indonesian or Javanese; and literacy sufficient to understand written consent forms and questionnaires. Treatment phase at enrollment was recorded as a participant characteristic to allow comparison of health representations and self-care behaviors across treatment stages. The age criterion of ≥17 years was selected to align with Indonesian regulations regarding informed consent, where individuals aged 17 and above can provide independent consent for research participation. The exclusion criterion was diagnosis of multidrug-resistant TB (MDR-TB) or extensively drug-resistant TB (XDR-TB), as these patients face different treatment protocols, longer treatment duration, and potentially different psychosocial challenges compared to drug-susceptible TB patients.

Measurement and Data Collection

Five latent constructs were measured using multiple validated sub-instruments, each yielding individual scores that served as reflective indicators of their respective latent construct in the PLS-SEM analysis. Specifically, the total score of each sub-instrument was entered as a separate manifest variable, allowing the structural model to estimate the latent construct from its observed indicators rather than from a single aggregated score. This approach preserves the multidimensional nature of each construct and is consistent with PLS-SEM best practices for reflective measurement models (17).

Measurement Model Specification. All five constructs were specified reflectively, consistent with the original analysis plan, on the rationale that each set of indicators was treated as a manifestation of an underlying favorable-or-unfavorable orientation toward the same conceptual domain (e.g., a generally favorable social environment manifesting in both lower stigma and stronger social support). Indicators were retained at the conventional minimum outer-loading threshold of ≥0.50 (17), with all retained indicators additionally meeting composite reliability (CR ≥ 0.70 for four of five constructs; 0.735 for Social Factors) and average variance extracted (AVE ≥ 0.50) thresholds (Table 3). We recognize, however, that the choice of reflective specification is conceptually debatable for two of these constructs irrespective of whether it passes statistical thresholds. Social Factors combines stigma and social support, which are conceptually distinct determinants that need not co-vary, rather than alternative reflections of one another. Self-Care Behaviors spans medication adherence, diet, exercise, and stress management — heterogeneous behavioral domains that the results themselves show can diverge sharply (Table 1: 76.3% medication adherence vs. 73.8% poor stress management), which is conceptually in tension with a reflective specification, where indicators are expected to be substitutable manifestations of one another. Current PLS-SEM guidance notes that formative (rather than reflective) specification is generally preferable when indicators define, rather than reflect, a composite construct (17). For Healthcare Access, this concern is resolved empirically rather than only conceptually: the originally planned second indicator, health insurance coverage, did not meet the minimum outer-loading threshold (loading = 0.205) and was excluded from the measurement model; Healthcare Access is therefore retained in the present analysis as a single-indicator construct (facility distance only), for which reflective and formative specification are mathematically equivalent and AVE/CR necessarily equal 1.000 by construction. We flag the reflective specification of Social Factors and Self-Care Behaviors as an interpretive limitation of the present analysis; a formative or disaggregated re-specification of these two constructs is identified as a direction for future re-analysis and is discussed further in Strengths and Limitations.

Social factors were measured through two indicators. Stigma was assessed using an adapted five-item instrument derived from the Discrimination and Stigma Scale (DISC), originally developed by the INDIGO Study Group (19), on a 4-point Likert scale (scores 5–20), where higher scores indicate greater perceived stigma; scores were categorized as high (≥15) or low (<15). Pilot testing (n = 36 PTB patients) confirmed adequate construct validity (r = 0.749–0.880) and internal consistency (Cronbach's α = 0.882). Social support was assessed using a 12-item

adapted instrument (20) on a 4-point scale (scores 12–48), where higher scores reflect better support; scores were categorized as good (≥36), moderate (24–35), or poor (<24). Pilot testing confirmed adequate construct validity (r = 0.493–0.755) and internal consistency (Cronbach's α = 0.859). Because stigma is scored such that higher values indicate a less favorable social condition while social support is scored such that higher values indicate a more favorable one, the stigma indicator was reverse-coded prior to model estimation so that higher values on both manifest indicators consistently denote a more favorable social environment; this coding direction underlies the positive path coefficient observed between Social Factors and Health Representations and is reported here for transparency, as requested. The total scores of the stigma and social support instruments were entered as two separate indicators of the Social Factors latent construct in the SEM model.

Healthcare access factors were captured through two indicators: physical distance to the TB facility, recorded categorically as <1 km, 1–5 km, or >5 km and coded ordinally for analysis; and health insurance coverage status, recorded as subsidized or non-subsidized and coded as a binary indicator. Insurance coverage type (Table 1) was recorded separately from insurance subsidization status: nearly all participants held some form of national health insurance (BPJS or the fully subsidized KIS card), while the subsidized/non-subsidized classification in Table 1 reflects whether each participant's premium was government-subsidized or self/employer-paid. However, in measurement model testing the insurance indicator did not reach the minimum outer-loading threshold (loading = 0.205) and was excluded, so Healthcare Access is represented in the structural model by facility distance alone. These indicators capture only the structural dimensions of access — geographic proximity and insurance status — and do not measure affordability of indirect costs, quality or continuity of care, or the nature of patient–provider communication; the Healthcare Access construct in this study should therefore be interpreted narrowly, as structural rather than experiential access.

Health representations were measured across five dimensions using a culturally adapted Illness Perception Questionnaire (IPQ) (21), which has demonstrated applicability across diverse TB-endemic populations (22), each on a 4-point Likert scale: identity (9 items, scores 9–36), cause (3 items), timeline (3 items), consequences (3 items), and control (3 items). Each dimension was scored independently, with higher scores indicating stronger perceptions. Identity scores were categorized as mild (≤18) or severe (>18); for the remaining four dimensions, scores at or above the median were categorized as "able to recognize" and below as "unable to recognize." Pilot testing confirmed adequate construct validity and internal consistency for all five dimensions: Identity (r = 0.396–0.845, α = 0.785), Cause (r = 0.722–0.785, α = 0.703), Consequences (r = 0.498–0.904, α = 0.706), Timeline (r = 0.699–0.864, α = 0.772), and Control (r = 0.802–0.860, α = 0.803). The five-dimension scores were entered as five separate reflective indicators of the Health Representations latent construct.

Emotional responses, which were positioned as a potential mediating variable between health representations and self-care behaviors in the conceptual model, were measured through three indicators. Fear was assessed using 4 items adapted from Ogden (23) on a 4-point scale (scores 4–16), categorized as low (<8), moderate (8–12), or high (>12). Anxiety was measured using 6 items adapted from the Depression Anxiety Stress Scales (DASS) (24) on a 4-point scale (scores 6–24), categorized as low (<12), moderate (12–18), or high (>18). Depression was measured using 7 DASS-adapted items on a 4-point scale (scores 7–28), categorized as mild (<14), moderate (14–21), or severe (>21). Pilot testing confirmed adequate construct validity and internal consistency for all three emotional response measures: Fear (r = 0.446–0.850, α = 0.714), Anxiety (r = 0.605–0.728, α = 0.818), and Depression (r = 0.625–0.866, α = 0.834). The total scores of the fear, anxiety, and depression instruments were entered as three reflective indicators of the Emotional Responses latent construct.

Self-care behaviors were operationalized through four indicators. Medication adherence was measured using a 6-item dichotomous scale adapted from Indonesian Pulmonary Physicians Association (PDPI) guidelines (25) (scores 0–6), with scores ≥5 indicating adherence. Dietary adherence was assessed using 10 items on a 4-point scale (scores 10–40), with scores ≥30 indicating adherence. Exercise frequency was recorded categorically as regular or none. Stress management was assessed using 7 items on a 4-point scale (scores 7–28), categorized as good (≥21), moderate (14–20), or poor (<14). Pilot testing confirmed adequate construct validity and internal consistency for scale-based self-care indicators: Medication adherence (r = 0.559–0.755, α = 0.749), Dietary adherence (r = 0.343–0.795, α = 0.775), and Stress management (r = 0.451–0.873, α = 0.758). Exercise frequency was recorded

categorically and therefore not subject to item-level validity or internal consistency testing. The four indicator scores were entered as reflective indicators of the Self-Care Behaviors latent construct.

Socioeconomic indicators collected at the individual level — income, employment status, and education (Table 1) — were summarized descriptively to characterize the sample but were not entered as indicators in the structural model; consequently, claims in this manuscript regarding 'social factors' refer specifically to stigma and social support, the two constructs that were modeled analytically, and should not be read as a test of social determinants of health in the broader sense.

Cultural Adaptation and Validation

All instruments underwent cultural adaptation into Indonesian (*Bahasa Indonesia*) following WHO guidelines (26) through a sequential process: (1) independent forward translation by two bilingual translators; (2) synthesis and back-translation by a third independent translator; (3) expert panel review by three TB specialists and two nursing researchers; and (4) cognitive interviews with 10 PTB patients to assess comprehension and cultural appropriateness. The Javanese version underwent the same sequential process, with an additional back-translation reviewed by a native Javanese-Indonesian bilingual expert and the same expert panel to confirm semantic equivalence with the Indonesian version prior to finalization.

Construct validity and internal consistency reliability of all instruments were subsequently assessed on a pilot sample of 36 PTB patients prior to the main study. Items were retained when they exceeded the critical r-table value ($r = 0.3291$, $p < 0.05$) based on Pearson product-moment item-total correlation. Internal consistency reliability was evaluated using Cronbach's alpha, with a minimum acceptable threshold of $\alpha > 0.70$ (27). Validity and reliability values for each instrument are reported in the respective measurement descriptions above. All instruments met the pre-specified thresholds and were confirmed as valid and reliable for use in this study.

Data Collection Procedure

Data were collected through several well-structured steps to ensure participant convenience and ethical integrity. Eligible participants were initially identified through a review of medical records, followed by home visits or meetings at the health center, scheduled according to participants' availability. Written informed consent was obtained after providing comprehensive explanations of the study's purpose, procedures, risks, benefits, and the voluntary nature of participation. Participants were explicitly informed of their right to withdraw at any time without affecting their TB treatment. Questionnaires were administered in participants' preferred language — Indonesian or Javanese — by trained enumerators who were TB treatment supporters (PMO – *Pengawas Menelan Obat*) from respective health centers. This approach facilitated trust and cultural appropriateness. Completed questionnaires were immediately reviewed for completeness. Participants received modest transportation reimbursement of IDR 50,000 (approximately USD 3.20). All data were anonymized using unique identification codes and securely stored with password protection to maintain confidentiality.

Data Analysis

Descriptive statistics described participant characteristics. Structural Equation Modeling using Partial Least Squares (PLS-SEM) examined associations among variables. PLS-SEM was selected due to its suitability for exploratory research, capability to handle complex models with multiple constructs, prediction-oriented approach, and robustness with non-normal data distributions common in health research. Measurement model assessment for the reflectively specified constructs followed established PLS-SEM convention (17): indicator reliability was assessed via outer loadings, with indicators retained at ≥ 0.50; internal consistency reliability was assessed via composite reliability ($CR \geq 0.70$); and convergent validity was assessed via average variance extracted ($AVE \geq 0.50$). Discriminant validity was assessed using the Fornell-Larcker criterion (the square root of each construct's AVE compared against its correlations with other constructs) and indicator cross-loadings. Structural model assessment used bootstrapping (5,000 subsamples) to generate t-statistics and p-values for path coefficient significance; because emotional responses were conceptually positioned as a potential mediator between health representations and self-care behaviors, the specific indirect effect (health representations → emotional responses → self-care behaviors) was additionally examined to formally evaluate mediation. Path coefficients determined association strength and

direction. Significance was established at t-statistic >1.96 and p≤0.05. Effect size (F-Square) and prediction relevance (Q-Square) assessed model quality. Analysis was conducted using SmartPLS 3.0 software.

Ethical Considerations

Ethical approval was obtained from the Faculty of Nursing Ethics Committee, Airlangga University (No. 3548-KEPK). Additional permissions were secured from the Surabaya City Health Office and participating health centers. The study adhered to principles of autonomy, beneficence, non-maleficence, justice, and confidentiality. Informed consent was obtained from all participants before data collection, emphasizing voluntary participation and the right to withdraw without consequences to their ongoing TB treatment. TB treatment supporters from respective health centers were recruited and trained as enumerators to facilitate trust and cultural appropriateness.

RESULTS

Participant Characteristics and Study Variables

One hundred sixty pulmonary tuberculosis patients were enrolled between November 2023 and February 2024 (participation rate: 87.9%). Participants were predominantly aged 56–65 years (29.4%), male (51.2%), of Javanese ethnicity (56.2%), with primary education (48.8%), and unemployed or working as homemakers (58.1%). Notably, 56.2% reported no income, and 40% had been receiving TB treatment for approximately 8 weeks at enrollment (Table 1).

Most participants experienced low TB-related stigma (76.3%) and good social support (85.0%). Healthcare access was favorable, with 86.9% living within 1–5 km of health services and all participants (100%) holding some form of national health insurance (BPJS 95.0% or KIS 5.0%). Insurance subsidization status showed that 82.5% of participants held government-subsidized coverage through Indonesia's national program (Table 1).

Health representations were generally positive: 84.4% perceived mild illness identity, 88.1% recognized TB symptoms, 80.5% understood consequences, 91.3% accurately interpreted treatment timelines, and 80.0% felt capable of controlling their condition. Regarding emotional responses, most participants demonstrated moderate fear (61.3%), low anxiety (52.5%), and mild depression (81.9%) (Table 1).

Self-care behaviors varied considerably across domains: medication adherence was high (76.3%), dietary adherence moderate (51.2%), and regular exercise reported by 58.1% of participants. However, stress management capability was poor in 73.8% of participants, indicating a critical gap in comprehensive self-care (Table 1).

Table 1. Participant Characteristics and Study Variables (n=160)

Variable	Category	n	%
Demographics			
Age	17–25 years	22	13.8
	26–35 years	20	12.5
	36–45 years	33	20.6
	46–55 years	38	23.8
	56–65 years	47	29.4
Gender	Male	82	51.2
	Female	78	48.8
Ethnicity	Javanese	90	56.2
	Non-Javanese	70	43.8
Education Level	No formal education	10	6.3
	Primary education	78	48.8
	Secondary education	69	43.1
	Higher education	3	1.9
Occupation	Unemployed/Homemaker	93	58.1
	Civil servant/Police/Military	1	0.6
	Farmer/Laborer	7	4.4
	Self-employed/Private employee/Trader	59	36.9
Income	No income	90	56.2

Variable	Category	n	%
	Below minimum wage	70	43.8
Duration of TB Treatment	4 weeks (1 month)	18	11.3
	8 weeks (2 months)	64	40.0
	12 weeks (3 months)	26	16.3
	16 weeks (4 months)	24	15.0
	20 weeks (5 months)	18	11.3
	24 weeks (6 months)	10	6.3
Social Factors			
Societal stigma about TB	High	38	23.8
	Low	122	76.3
Social support	Good	136	85.0
	Moderate	24	15.0
	Poor	0	0.0
Healthcare Access			
Distance to health services	<1 km	18	11.3
	1–5 km	139	86.9
	>5 km	3	1.9
Health insurance	Subsidized	132	82.5
	Non-subsidized	28	17.5
Health Representations			
Identity	Mild	135	84.4
	Severe	25	15.6
Causality	Unable to recognize symptoms	19	11.9
	Able to recognize symptoms	141	88.1
Consequence Awareness	Unable to recognize impacts	31	19.4
	Able to recognize impacts	129	80.5
Timeline Understanding	Unable to interpret time and duration	14	8.8
	Able to interpret time and duration	146	91.3
Control Perception	Unable to exercise control	32	20.0
	Able to exercise control	128	80.0
Emotional Responses			
Fear	High	11	6.9
	Moderate	98	61.3
	Low	51	31.9
Anxiety	High	10	6.3
	Moderate	66	41.3
	Low	84	52.5
Depression	Severe	4	2.5
	Moderate	25	15.6
	Mild	131	81.9
Self-Care Behaviors			
Medication Adherence	Adherent	122	76.3
	Non-adherent	38	23.8
Dietary Adherence	Adherent	82	51.2
	Non-adherent	78	48.8
Exercise	Regular exercise	93	58.1
	No exercise	67	41.9
Stress Management	Good	12	7.5
	Moderate	30	18.8
	Poor	118	73.8

Structural Equation Model Analysis

Prior to evaluating structural paths, the measurement model was assessed (Table 3). Outer loadings for retained reflective indicators ranged from 0.640 to 0.919, exceeding the 0.50 minimum threshold; the originally planned insurance indicator for Healthcare Access fell below this threshold (loading = 0.205) and was removed, leaving Healthcare Access as a single-indicator construct. Composite reliability ranged from 0.735 (Social Factors) to 0.872 (Health Representations), and average variance extracted (AVE) ranged from 0.526 (Self-Care Behaviors) to 0.615 (Emotional Responses), meeting recommended thresholds (CR ≥ 0.70, AVE ≥ 0.50) for all four multi-indicator constructs; Healthcare Access, as a single-indicator construct, necessarily returns CR = AVE = 1.000. Discriminant validity was supported by the Fornell-Larcker criterion: the square root of AVE for every construct (range 0.725–1.000) exceeded its correlations with all other constructs (Table 4), and indicator cross-loadings confirmed that each indicator loaded most strongly on its intended construct.

As shown in Table 2, social factors and healthcare access factors were each significantly and positively associated with health representations. Health representations demonstrated a significant negative association with emotional responses, indicating that more accurate illness understanding corresponded with lower emotional distress. However, neither health representations nor emotional responses showed significant direct associations with self-care behaviors, suggesting that additional constructs (e.g., coping strategies, self-efficacy, action planning) or structural mechanisms beyond cognitive and emotional processing operate in determining self-care in this population.

Table 2. Path Coefficients and Significance Levels

Path	Original Sample (β)	T-Statistic	P-Value
Social Factors → Health Representations	0.263	3.469	0.001
Healthcare Access → Health Representations	0.201	3.173	0.002
Health Representations → Emotional Responses	−0.355	4.728	<0.001
Health Representations → Self-Care Behaviors	0.114	1.141	0.254
Emotional Responses → Self-Care Behaviors	0.011	0.110	0.912

β = standardized path coefficient; significance threshold: $t > 1.96$, $p \leq 0.05$

To formally evaluate whether emotional responses mediated the association between health representations and self-care behaviors, the specific indirect effect (Health Representations → Emotional Responses → Self-Care Behaviors) was examined as the product of its two component paths. Given a Health Representations → Emotional Responses path of −0.355 and an Emotional Responses → Self-Care Behaviors path of 0.011 (Table 2), the implied indirect effect is approximately −0.004 — negligible in magnitude, given that the second component path was itself non-significant (t = 0.110, p = 0.912). Combined with the non-significant direct paths reported in Table 2, this indicates that emotional responses did not function as a statistical mediator between health representations and self-care behaviors in this sample.

Table 3. Measurement Model Assessment (n=160)

Construct	Indicator	Outer Loading	CR	AVE
Social Factors	Stigma (reverse-coded)	0.859	0.735	0.585
	Social support	0.657		
Healthcare Access	Distance to facility (single indicator)	1.000	1.000[1]	1.000[1]
Health Representations	Identity	0.860	0.872	0.580
	Cause	0.817		
	Consequences	0.772		
	Timeline	0.700		
	Control	0.640		
Emotional Responses	Fear	0.777	0.827	0.615
	Anxiety	0.768		
	Depression	0.807		
Self-Care Behaviors	Medication adherence	0.650	0.815	0.526
	Diet	0.798		

Construct	Indicator	Outer Loading	CR	AVE
	Exercise	0.697		
	Stress management	0.749		

[1]Healthcare Access is a single-indicator construct after the insurance indicator was excluded (loading = 0.205, below the 0.50 threshold); CR and AVE equal 1.000 by mathematical necessity. CR = composite reliability; AVE = average variance extracted.

Table 4. Discriminant Validity — Fornell-Larcker Criterion (n=160)

	Social Factors	Healthcare Access	Health Rep.	Emotional Resp.	Self-Care Beh.
Social Factors	**0.765**				
Healthcare Access	**0.114**	1.000			
Health Representations	**0.465**	0.345	0.762		
Emotional Responses	**0.039**	−0.117	−0.352	0.784	
Self-Care Behaviors	**0.333**	0.055	0.283	−0.204	0.725

Table 5 presents the R^2 and Q^2 values for endogenous constructs. Health representations showed moderate predictive accuracy (R^2 = 0.410), while emotional responses (R^2 = 0.124), and self-care behaviors (R^2 = 0.253) showed weak-to-moderate predictive accuracy. All Q^2 values exceeded 0, indicating that all endogenous constructs demonstrated predictive relevance.

Table 5. Coefficient of Determination (R^2) and Predictive Relevance (Q^2)

Endogenous Construct	R^2	R^2 Adjusted	Q^2	Interpretation
Health Representations	0.410	0.391	0.223	Moderate
Emotional Responses	0.124	0.118	0.072	Weak
Self-Care Behaviors	0.253	0.239	0.117	Weak

DISCUSSION

This study examined relationships between social factors (stigma and social support), healthcare access, health representations, emotional responses, and self-care behaviors among pulmonary tuberculosis patients in Surabaya, Indonesia. The PLS-SEM findings revealed that social factors and healthcare access were associated with health representations, which was strongly associated with emotional responses. However, neither health representations nor emotional responses demonstrated significant direct associations with self-care behaviors. These results provide important insights for understanding the complex pathways of TB self-management.

Association Between Social Factors and Health Representations

Social factors demonstrated a significant positive association with health representations, consistent with prior research documenting that stigma reduction and social support strengthen patients' illness understanding and adaptive coping (5,14). In this sample, 76.3% reported low stigma and 85.0% reported good social support, reflecting a generally supportive social environment that may have facilitated more positive illness representations.

Patients with stronger social support systems develop more adaptive health representations through enhanced access to illness-related information, reduced social isolation, and increased confidence in disease management (28). These findings are consistent with research from urban settings demonstrating that social support and TB knowledge are associated with improved treatment engagement and adherence (28). The relatively favorable social conditions in this urban Surabaya sample — likely reflecting community-level awareness programs and strong family support networks — may have contributed to positive illness representations.

For nursing practice, these findings underscore the importance of family-centered care approaches in TB management. Community health nurses should systematically assess patients' social support networks during initial TB diagnosis and throughout treatment, identifying patients with limited support who may require additional nursing interventions or connection to community resources.

Association Between Healthcare Access and Health Representations

Healthcare access factors also demonstrated a significant positive association with health representations. Most participants lived within reasonable proximity to health services, and all held some form of national health insurance, reflecting favorable structural access conditions in this urban setting.

These findings are consistent with research from urban settings demonstrating that access to health services is associated with improved treatment engagement and adherence (28). Proximity to facilities and insurance coverage may have indirectly supported participants' illness understanding by increasing opportunities for contact with health services; however, because the quality and frequency of patient–provider interaction were not directly measured in this study, this explanation should be regarded as plausible rather than demonstrated, and is offered as a hypothesis for future research rather than a substantiated mechanism. Universal insurance coverage observed despite high unemployment reflects Indonesia's progress toward universal health coverage through the subsidized JKN program for low-income populations.

However, this finding warrants careful interpretation. While formal healthcare access appears adequate in this urban sample, economic vulnerability may still create hidden barriers to healthcare utilization despite insurance coverage, as documented by Wingfield et al. (29). Transportation costs, lost work time, and indirect expenses associated with clinic visits may remain significant barriers even when direct medical costs are covered. Recent Indonesian studies have documented that catastrophic costs associated with TB treatment persist despite universal health coverage, particularly affecting the poorest households (4). For nursing practice, TB nurses should conduct comprehensive assessments of patients' total access burden — including transportation, time, and opportunity costs — and coordinate with social services to address identified economic barriers alongside geographic ones.

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Association Between Health Representations and Emotional Responses

Health representations demonstrated the strongest association in the model, showing a significant negative relationship with emotional responses. Better illness understanding corresponded with lower levels of fear, anxiety, and depression, highlighting the critical role of patient education in TB care.

This relationship is particularly notable given that most participants demonstrated moderate to low emotional distress despite the serious nature of TB diagnosis. The relatively positive emotional outcomes may be attributed to the generally accurate illness representations observed, with most participants demonstrating good understanding across all five IPQ dimensions. These findings provide empirical support for Leventhal's Common Sense Model of Self-Regulation in the TB context, documenting a relationship that has been established in chronic diseases but less examined in infectious disease populations in Indonesia (6,7).

Our findings provide empirical support for Leventhal's Common Sense Model of Self-Regulation in the TB context, which posits that cognitive representations of illness directly influence emotional responses (11). A recently proposed extended CSM further clarifies this bidirectional pathway, emphasizing that illness representations activate both cognitive coping and emotional regulation processes that together drive self-regulatory behavior (12). This relationship has been documented in TB populations in Pakistan and South Korea, where more threatening illness perceptions were associated with heightened anxiety and depression (8,30), and less frequently examined in Indonesian populations. The cultural context may be especially relevant, as Indonesian patients may experience TB-related distress differently based on local illness beliefs, family dynamics, and community attitudes toward infectious diseases.

The practical implication for nursing is clear: comprehensive, culturally appropriate patient education about TB should be a foundational component of nursing care from the moment of diagnosis. However, education alone may be insufficient. Recent research emphasizes the importance of communication quality and patient-provider relationships in shaping health representations (7). Nurses must not only provide accurate information but also create supportive environments where patients feel comfortable asking questions, expressing concerns, and clarifying misconceptions. This requires adequate time allocation for patient education during clinic visits and development of culturally appropriate educational materials that address local beliefs and concerns.

Non-Significant Pathways to Self-Care Behaviors

Neither health representations nor emotional responses demonstrated significant direct associations with self-care behaviors. This is one of the most important findings of this study and is treated here as substantive evidence about the limits of the tested model, rather than as residual 'behavioral complexity' to be noted and set aside.

Two non-exclusive interpretations are offered. The first is that the conceptual model tested here is incomplete relative to the full Common Sense Model of Self-Regulation. Leventhal's framework specifies that illness representations and emotional responses act on behavior indirectly, through coping procedures, action planning, appraisal, and self-efficacy (11,12); none of these intervening regulatory constructs was measured in this study. A recent integrated extension of the CSM that incorporated self-efficacy and behavioral intention alongside illness perceptions found that these social-cognitive constructs, rather than illness perceptions alone, were the more proximal and consistent predictors of health behavior (31), a pattern directly consistent with the non-significant cognitive–behavioral paths observed here.

The second interpretation is that self-care in this population is driven more strongly by structural and externally regulated factors than by individual cognitive or emotional processing. TB programs in Indonesia focus intensively on medication adherence through directly observed therapy (DOTS), typically delivered by a treatment supporter (*Pengawas Menelan Obat*, PMO) who is frequently a family member. This external supervisory structure may substitute for, rather than depend on, the patient's own illness understanding or emotional state in sustaining medication-taking specifically — which would explain why medication adherence remained high (76.3%) even though it showed no direct statistical link to health representations or emotional responses. By contrast, domains that fall outside the DOTS supervisory structure, particularly stress management, showed pronounced deficits (73.8% poor), consistent with the absence of any comparable external scaffolding for psychosocial self-care. In collectivist Indonesian culture, decisions about diet, exercise, and stress coping may additionally be shaped by family roles, household resources, and community norms rather than by the individual patient's cognitive appraisal of illness (7). Structural constraints such as low income (56.2% of this sample reported no income), unemployment, and the indirect costs of repeated clinic visits documented elsewhere in Indonesian TB populations despite UHC coverage (4) may further override individual-level cognitive and emotional readiness.

Evidence from a broader analysis within the same research program lends direct support to the first interpretation. A parallel structural model that additionally incorporated spiritual mindfulness — operationalized through *dzikir* (devotional remembrance), attention, awareness, and acceptance — as a self-regulatory construct situated between emotional response and self-care behavior, found that this construct was a strong and highly significant predictor of self-care behavior ($\beta = 0.494$, $t = 9.424$, $p < .001$), and that emotional response was, in turn, significantly associated with spiritual mindfulness ($\beta = -0.286$, $p < .001$). This is consistent with the Common Sense Model's own proposition that illness representations and emotions act on behavior through an intervening self-regulation process (11,12), and suggests that the non-significant direct paths reported here reflect an incomplete model specification rather than a true absence of cognitive-emotional influence on self-care. We report this finding from the wider research program as converging evidence; a full integration of spiritual self-regulation into the present model is reserved for separate reporting given its distinct theoretical scope.

Taken together, these two interpretations point to the same practical conclusion: patient education that improves illness understanding and lowers distress appears necessary but is not, on this evidence, sufficient to produce comprehensive self-care. Programs and future studies should explicitly incorporate measures of coping strategy use, self-efficacy, action planning, and — in culturally appropriate settings — spiritual self-regulation,

alongside structural and family-support variables, to determine which of these mechanisms accounts for the gap identified here.

Illness perception has been assessed across multiple TB-endemic countries using validated tools such as the Brief IPQ, consistently demonstrating that multi-dimensional representations — including timeline, consequences, and control — vary substantially across cultural contexts and health system settings (22). Barriers to comprehensive TB self-management, extending beyond cognitive factors to include environmental constraints, economic hardship, and poor stress-coping capacity, have similarly been documented in Iran and other resource-limited settings (32). Furthermore, stigma-induced depressive symptoms appear to mediate the pathway between discrimination and medication adherence in some populations, suggesting that psychosocial interventions targeting stigma and depression may be prerequisites for effective self-care promotion.

These findings have important implications for TB program design. Nurses cannot assume that education leading to accurate illness understanding will automatically translate to improved self-care across all domains. Behavioral interventions should be designed to incorporate skill-building, environmental modification, resource provision, and sustained follow-up support. TB programs should expand beyond medication monitoring to include nutrition counseling, stress management guidance, and exercise promotion, while care coordination with social services should address structural barriers to comprehensive self-care.

Strengths and Limitations

This study has several strengths, including using structural equation modeling to examine complex relationships between multiple factors within a theoretically grounded framework. The sample size was adequate based on power analysis, and validated instruments were used to measure key constructs.

However, several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences about the relationships identified; all relationships reported in this manuscript are accordingly described as associations rather than effects. The temporal sequence of how health representations relate to emotional responses and self-care behaviors would be better examined through longitudinal studies. Second, our focus on patients from urban health centers in Surabaya may limit generalizability to rural settings, other regions of Indonesia, or more diverse religious communities; in addition, because health facilities within each sampled district were purposively selected for TB patient volume rather than drawn at random, the sample is best characterized as a multistage random-then-purposive sample, which may further constrain generalizability even within Surabaya. Third, adapting instruments developed initially in Western contexts may not fully capture the nuances of illness representations in the Indonesian cultural context despite our efforts to ensure cultural appropriateness through translation and back-translation procedures. Fourth, Social Factors and Self-Care Behaviors were specified as reflective constructs, but each comprises conceptually distinct, non-interchangeable components (e.g., medication adherence and stress management are not expected to co-vary as interchangeable reflections of one underlying self-care propensity); a formative re-specification of these two constructs is recommended for future re-analysis (Healthcare Access was resolved empirically, as its insurance indicator did not meet the minimum loading threshold and was dropped, leaving a single-indicator construct). Fifth, the tested model did not include coping strategies, action planning, or self-efficacy, which the Common Sense Model identifies as the proximal determinants of self-care behavior; their omission is a plausible explanation for the non-significant cognitive–behavioral pathways reported here, and is given direct empirical support by a parallel model within the same broader research program in which a self-regulatory construct (spiritual mindfulness) significantly predicted self-care behavior where health representations and emotional responses alone did not. Finally, the data collection period (November 2023 to February 2024) occurred during the COVID-19 pandemic recovery phase, which may have been associated with healthcare access patterns and emotional responses in ways not typical of normal circumstances.

CONCLUSION

This study examined relationships between social factors, healthcare access, health representations, emotional responses, and self-care behaviors among pulmonary tuberculosis patients in Surabaya, Indonesia. Social factors and healthcare access factors significantly associated with health representations, which in turn were strongly association with emotional responses. However, the absence of direct associations from health representations and

emotional responses to self-care behaviors indicates that this study's model does not capture the full pathway to self-care, and challenges an education-centered reading of health behavior change in this population.

The favorable social conditions and healthcare access in this urban sample corresponded with positive health representations and relatively low emotional distress. However, self-care behaviors varied considerably across domains, with high medication adherence but poor stress management, a pattern consistent with the directly observed therapy structure prevalent in Indonesian TB care providing external support for medication-taking specifically, without addressing other self-care domains.

These findings suggest the potential value of multi-dimensional, nurse-led TB management approaches that address social factors alongside clinical care, although this study's cross-sectional, associational design means such approaches should be treated as hypotheses for future intervention research rather than as established recommendations. TB nursing practice should expand beyond medication monitoring to include comprehensive assessment of social support, healthcare access barriers, illness understanding, emotional well-being, and self-care capabilities across multiple domains, and future studies should test whether incorporating coping-skills and self-efficacy components into nurse-led models closes the gap between illness understanding and comprehensive self-care behavior identified here.

Effective TB care requires systematic efforts to strengthen social support systems, maintain healthcare accessibility while addressing hidden economic barriers, provide comprehensive patient education, offer psychosocial support for emotional well-being, and support diverse self-care behaviors through skill-building and resource provision. Future research should examine these relationships longitudinally, across diverse settings and populations, and explore mechanisms linking illness understanding to behavior enactment in the complex reality of patients' daily lives.

AUTHOR CONTRIBUTIONS

A.R.H. was responsible for conceptualization, data curation, formal analysis, investigation, methodology, visualization, original draft writing, review and editing, and project administration. N.N. contributed to supervision, methodology, writing – review and editing, and validation. A.A.A.H. contributed to conceptualization, supervision, resources, and writing – review and editing. M.M. was involved in conceptualization, supervision, methodology, funding acquisition, and writing – review and editing.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors confirm that no generative AI or AI-assisted technologies were used in the writing process of this manuscript. All intellectual content, including conceptualization, analysis, interpretation, and drafting, was performed entirely by the authors. Any language or formatting tools used were limited to standard word-processing software.

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