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Latent Profile Analysis and Influencing Factors of Medication-Related Burden in Multidrug-Resistant Tuberculosis Patients in Chengdu, China

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Objective: The treatment of multidrug-resistant tuberculosis (MDR-TB) is characterized by a prolonged duration and complex medication regimens, often resulting in a substantial medication-related burden that negatively impacts patients' adherence and quality of life. However, research on the heterogeneity of medication-related burden among MDR-TB patients and its influencing factors remains limited. This study aimed to identify latent profiles of medication-related burden among MDR-TB patients and examine differences in burden characteristics across these profiles, thereby providing evidence for tailored intervention strategies.

Methods: A convenience sampling method was employed to recruit MDR-TB patients diagnosed at a tertiary infectious disease hospital in Chengdu between December 2024 and May 2025. Data were collected using a general information questionnaire, the Living with Medicines Questionnaire (LMQ), and the Health Literacy Management Scale (HeLMS). Latent profile analysis (LPA) was conducted to identify distinct profiles of medication-related burden, and multivariate logistic regression was used to explore associated factors for each profile.

Results: A total of 214 valid responses were analyzed. The LPA identified two distinct profiles of medication-related burden: C1 – "Low-Burden (Attitude & Practice-Dominated)" (44%) and C2 – "High-Burden (Daily Interference-Dominated)" (56%). Absence of side effects, not employing a caregiver, and higher levels of health literacy were positively associated with membership in the C1 group ($P < 0.05$). In contrast, higher educational attainment, longer distance from the treatment center, and prolonged medication duration were negatively associated, increasing the likelihood of being classified in the C2 group ($P < 0.05$).

Conclusion: Medication-related burden among MDR-TB patients exhibits clear heterogeneity. Healthcare professionals should adopt stratified management and personalized interventions based on the identified influencing factors to alleviate the burden of medication in this population.

Keywords: multidrug-resistant tuberculosis, medication-related burden, latent profile analysis

Introduction

Tuberculosis (TB), a chronic infectious disease caused by Mycobacterium tuberculosis, remains the 13th leading cause of death worldwide and poses a serious threat to global public health.[1] Multidrug-resistant tuberculosis (MDR-TB), a subtype of drug-resistant TB, refers to TB strains that are resistant to at least both isoniazid and rifampicin.[2]

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According to the World Health Organization (WHO), approximately 400,000 cases of MDR-TB were reported globally in 2023, with China ranking fourth in the world, accounting for about 29,000 of these cases.[3]

Currently, the preferred treatment strategy for MDR-TB is chemotherapy involving second-line anti-TB drugs. These regimens typically span 9 to 20 months, involving multiple medications with complex protocols.[4–8] A study by Wang et al[9] investigating the economic burden of MDR-TB among 161 patients in Guizhou Province reported an average treatment cost of USD 8266 (approximately RMB 60,000) and a median of USD 7787 (range: 5122–10,090) during the first year of treatment. The prolonged treatment duration and the severe side effects of medications impose significant physical and psychological strain on patients, while also creating substantial economic burden, thereby undermining both medication affordability and adherence.[10,11]

Medication-related burden refers to the difficulties patients experience in acquiring, managing, organizing, and adhering to medication regimens, including the monitoring of treatment and handling of side effects.[12] Mohammed et al,[13] through a systematic review of 34 studies on medication-related burden, proposed a conceptual framework of the lived experience of medicines. Their model emphasized that medication-related burden is a core factor influencing adherence and treatment outcomes. Alleviating this burden is crucial for promoting rational medication behavior and improving therapeutic results. Therefore, early identification and reduction of medication-related burden in MDR-TB patients is essential.

However, most existing studies assess medication-related burden using total scores from standardized scales, overlooking the potential individual heterogeneity among patients. Individuals with similar overall scores may exhibit diverse response patterns across different dimensions of the assessment tools.[14–16] Latent profile analysis (LPA), a person-centered statistical approach, enables the identification of unobserved subgroups within a population based on patterns in continuous variables.[17] This method facilitates the classification of MDR-TB patients according to distinct profiles of medication-related burden, allowing researchers to understand the distribution and characteristics of different subtypes.

Accordingly, this study aims to identify distinct latent profiles of medication-related burden among MDR-TB patients and to explore the factors associated with each profile. The ultimate goal is to provide empirical support for developing more targeted and personalized clinical interventions.

Methods

Design and Participants

This study employed a cross-sectional design using a convenience sampling method. Participants were recruited from December 2024 to May 2025 at a tertiary infectious disease hospital in Chengdu, China. The inclusion criteria were as follows: (1) age $\geq$ 18 years, with normal communication ability and no intellectual or psychiatric disorders; (2) a confirmed diagnosis of multidrug-resistant tuberculosis (MDR-TB), defined according to the World Health Organization (WHO) guidelines as resistance to at least both isoniazid and rifampicin, the two first-line anti-TB drugs;[4] (3) currently undergoing pharmacological treatment for MDR-TB; and (4) willingness to participate and provide written informed consent. Exclusion criteria included: (1) recent exposure to major traumatic events, such as traffic accidents or significant family crises; and (2) participation in other intervention studies. According to Kendall's method for estimating sample size,[18] the minimum required sample size was 5–10 times the number of independent variables. With 26 independent variables and an anticipated 20% invalid response rate, the minimum required sample size was calculated as $5\times26\times(1+20\%) = 156$.

A total of 230 questionnaires were distributed. 16 patients who provided invalid responses (due to obvious response patterns or logical inconsistencies) were excluded prior to data analysis. Ultimately, 214 valid questionnaires were collected, resulting in a valid response rate of 93.04%.

Instruments

General Information Questionnaire

A self-developed questionnaire, based on literature review, was used to collect demographic and clinical information, including gender, age, marital status, educational level, distance from the treatment center, employment status, family

averaged income, medical payment, Number of drug-resistant anti-TB agents, medication duration, medication cost (out-of-pocket, per month), comorbidities, side effects, and whether a caregiver was employed — totaling 14 items.

Living with Medicines Questionnaire (LMQ)

The Chinese version of the Living with Medicines Questionnaire (LMQ) was used to assess patients' medication-related burden. The LMQ, developed by Krska et al,[19] evaluates the burden associated with polypharmacy. It contains 39 items across eight dimensions: medication attitude (7 items), practical difficulties (6 items), physician-patient relationship (5 items), medication effectiveness (5 items), interference with daily life (6 items), side effects (4 items), medication behaviors (3 items), and financial burden (3 items). The scale was based on a 5-point scale, with scores ranging from 1 to 5, from complete disagreement to complete agreement, a total score of 39 to 195. Higher scores indicate a greater medication-related burden. Prior to the formal survey, content validity was assessed by five experts, including four clinicians specializing in infectious diseases and one nursing expert, all of whom held senior professional titles. They independently evaluated the relevance and clarity of each item in relation to the research objectives. The overall Content Validity Index (CVI) was calculated as 0.840, indicating acceptable content validity for the instrument in this study context. Subsequently, a pilot test was conducted with 30 patients to evaluate the reliability of the questionnaire. Based on the pilot data, Cronbach's α coefficient for the LMQ was 0.869 in this study, indicating good internal consistency and reliability in measuring medication-related burden among MDR-TB patients.

Health Literacy Management Scale (HeLMS)

Health literacy was measured using the Health Literacy Management Scale (HeLMS), developed by Jordan et al.[20] This instrument includes 24 items across four dimensions: communicative and interactive literacy (9 items), information-seeking ability (9 items), willingness to seek financial support (2 items), and motivation to improve health (4 items). Items are rated on a 5-point Likert scale, ranging from 1 ("almost impossible") to 5 ("no difficulty"). Higher scores reflect higher levels of health literacy. Prior to the formal survey, the content validity of the HeLMS was evaluated by a panel of five experts in the relevant fields. The CVI was calculated as 0.880, indicating acceptable content validity for the instrument within the context of this study. Subsequently, a pilot test was conducted to assess the reliability of the questionnaire. Based on the pilot data, the Cronbach's α coefficient for the HeLMS was found to be 0.832 in this study, indicating acceptable internal consistency and supporting its reliability for use in the target population.

Data Collection and Quality Control

Prior to data collection, trained research staff provided participants with verbal explanations of the study's purpose and procedures. After obtaining written informed consent, participants independently completed the questionnaire by scanning a QR code. For participants unable to complete the questionnaire on their own, research staff read the items aloud and recorded responses based on the participant's answers. All data were double-entered by two independent researchers to ensure accuracy and reliability.

Statistical Analysis

All data were analyzed using SPSS version 26.0 and Mplus version 8.0. Quantitative variables with normal distribution were presented as means ± standard deviations, while categorical variables were described using frequencies and percentages. Latent profile analysis (LPA) was conducted to identify potential subgroups of medication-related burden. Model fit was evaluated using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), adjusted BIC (aBIC), the Lo–Mendell–Rubin adjusted likelihood ratio test (LMRT), Bootstrap Likelihood Ratio Test (BLRT), and entropy values. Lower AIC, BIC, and aBIC values indicated better model fit. An entropy value >0.80 suggested a classification accuracy above 90%. A significant p-value ($P < 0.05$) in LMRT or BLRT indicated that the model with k classes provided a significantly better fit than the model with k−1 classes.[17] After determining the optimal number of latent classes, chi-square tests, Fisher's exact tests, and independent *t*-tests were conducted to assess group differences. Based on univariate analysis and LPA results, multivariate logistic regression was performed to examine the factors influencing medication-related burden. A p-value <0.05 was considered statistically significant.

Results

Sociodemographic Characteristics of Patients with Multidrug-Resistant Tuberculosis (MDR-TB)

Among the 214 patients diagnosed with MDR-TB, 140 (65.4%) were male and 74 (34.6%) were female. Regarding age distribution, 114 patients (53.3%) were aged 18–44 years, 57 (26.6%) were aged 45–59 years, and 43 (20.1%) were aged 60 years and above. Marital status showed that 69 (32.3%) were unmarried, 131 (61.2%) were married, and 14 (6.5%) were divorced or widowed. In terms of educational level, 113 patients (52.8%) had a elementary school and below, 46 (21.5%) had completed junior high school, 24 (11.2%) had a senior high school, and 31 (14.5%) held a bachelor's degree or higher. A total of 61 patients (28.5%) resided within 50 km of the treatment center, while 153 patients (71.5%) lived more than 50 km away. Employment status revealed that only 25 patients (11.7%) were employed, whereas 189 (88.3%) were unemployed. Family averaged income (per month) was reported as less than 1000 CNY in 30 cases (14.0%), 1000–3999 CNY in 99 cases (46.3%), 4000–7999 CNY in 75 cases (35.0%), and 8000 CNY or more in 10 cases (4.7%). Regarding medical payment, 28 patients (13.1%) were covered by employee health insurance, 177 (82.7%) were enrolled in the urban resident medical Insurance, and 9 (4.2%) relied on other insurance. The number of drug-resistant anti-TB agents was as follows: 2 drugs in 56 patients (26.2%), 3 drugs in 83 (38.8%), 4 drugs in 47 (22.0%), 5 drugs in 26 (12.1%), and 6 or more drugs in 2 patients (0.9%). As for the medication duration, 90 patients (42.1%) had been on treatment for 1 year, 78 (36.4%) for 2 years, and 46 (21.5%) for 3 years. Medication cost (out-of-pocket, per month) were less than 1000 CNY in 90 cases (42.1%), 1000–4000 CNY in 78 cases (36.4%), and more than 4000 CNY in 46 cases (21.5%). A total of 58 patients (27.1%) reported side effects, while 156 (72.9%) did not. Comorbidities were present in 38 patients (17.8%), whereas 176 patients (82.2%) had no known comorbidities. Additionally, 137 patients (64.0%) employed a caregiver, while 77 (36.0%) did not.

Latent Profile Analysis of Medication-Related Burden Among MDR-TB Patients

Latent profile analysis (LPA) was conducted to explore patterns of perceived medication-related burden among MDR-TB patients using eight dimensions from the Medication-related Burden Questionnaire as observed indicators. Models ranging from one to five latent classes were compared (see Table 1). The Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted BIC (aBIC) values decreased progressively with the number of classes, with the greatest drop observed between the one-class and two-class models. The two-class model also demonstrated the highest entropy value (0.928), indicating good classification accuracy. Additionally, both the Lo–Mendell–Rubin (LMR) test and Bootstrap Likelihood Ratio Test (BLRT) were statistically significant ($P < 0.001$), suggesting that the two-class model provided a significantly better fit than the one-class model. Based on model fit indices and theoretical interpretability, the two-class solution was determined to be the optimal model.

Table 1 Fit Indices for Latent Profile Models of Medication-Related Burden in MDR-TB Patients (n = 214)

Model	AIC	BIC	aBIC	Entropy	*P* value		Latent Profile Probability
					LMRT	BLRT	
1	3763.300	3817.156	3766.456	–	–	–	1
2	2948.902	3033.052	2953.833	0.928	<0.001	<0.001	0.44/0.56
3	2768.166	2882.609	2774.872	0.893	0.1718	0.1765	0.30/ 0.35/0.35
4	2666.761	2811.498	2675.241	0.897	0.2990	0.3040	0.28/0.34/0.10/0.28
5	2611.915	2786.946	2622.170	0.890	0.2092	0.2141	0.17/ 0.17/ 0.25/0.10/0.31

Notes: *P* value represented in the LMRT and BLRT tests reflect the significance of model improvement. $P < 0.05$ indicated a statistically significant fit improvement. Only Model 2 showed significant improvement over Model 1.

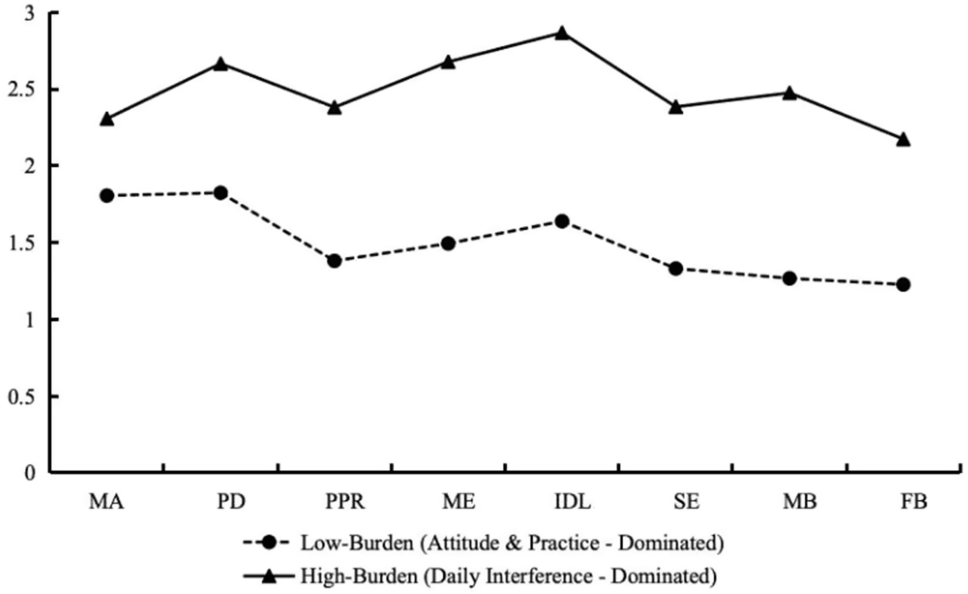

Figure 1 Mean Scores Across the Eight Dimensions of Medication Related Burden for Two Latent Classes of MDR-TB Patients.
Abbreviations: MA, medication attitude; PD, practical difficulties; PPR, physician-patient relationship; ME, medication effectiveness; IDL, interference with daily life; SE, side effects; MB, medication behaviors; FB, financial burden.

Naming of Latent Profiles of Medication-Related Burden in MDR-TB Patients

The mean scores across the eight dimensions for the two latent classes are presented in Figure 1. In Class 1 (C1, 44%, n = 95), patients exhibited relatively lower levels of medication burden, with stable mean scores across different dimensions. However, the burden related to "medication attitudes" and "practical difficulties" was comparatively higher. Therefore, this profile was labeled as C1: Low-Burden (Attitude & Practice-Dominated). In contrast, Class 2 (C2, 56%, n = 119) showed generally higher levels of medication burden, with slight variations among the dimensions. The burden related to "interference with daily life" was the highest. Thus, this profile was designated as C2: High-Burden (Daily Interference-Dominated).

Univariate Analysis of Latent Profiles of Medication-Related Burden in MDR-TB Patients

Univariate analysis revealed statistically significant differences between the two latent classes in terms of educational level (χ^2 = 11.591, P = 0.009), distance from the treatment center (χ^2 = 9.142, P = 0.002), medication duration (χ^2 = 45.793, P < 0.001), side effects (χ^2 = 23.760, P < 0.001), comorbidities (χ^2 = 8.027, P = 0.005), employment of a caregiver (χ^2 = 10.483, P = 0.001), and health literacy score (t = 5.576, P < 0.001). Detailed results of the univariate comparisons are presented in Table 2.

Multivariate Analysis of Latent Profiles of Medication-Related Burden in MDR-TB Patients

Taking the two latent classes of medication-related burden (C1 and C2) as the dependent variable and using C1 Low-Burden (Attitude & Practice-Dominated) as the reference group, a multivariate logistic regression analysis was performed, incorporating variables that showed statistical significance in the univariate analysis. Variable coding was as follows: Education level: Elementary school or below = 1, Junior high = 2, Senior high = 3, Bachelor's degree or above = 4; Distance from treatment center: ≤50 km = 1, >50 km = 2; Medication duration: 1 year = 1, 2 years = 2, 3 years = 3; Side effects: Yes = 1, No = 2; Employment of caregiver: Yes = 1, No = 2; Health literacy score: Entered as continuous variable. The results of the logistic regression analysis, summarized in Table 3, indicated that patients who

Table 2 Univariate Analysis of Latent Classes of Medication-Related Burden Among MDR-TB Patients

Variables	Categories	Profiles		χ^2/t	*P*
		C1 Low-Burden (n = 95)	C2 High-Burden (n= 119)		
Gender	Male	68 (71.6%)	72 (60.5%)	2.864	0.091
	Female	27 (28.4%)	47 (30.5%)		
Age	18-44	44 (46.3%)	70 (58.8%)	3.463	0.177
	45-59	30 (31.6%)	27 (22.7%)		
	≥60	21 (22.1%)	22 (18.5%)		
Marital status	Unmarried	30 (31.6%)	39 (32.8%)	0.556	0.757
	Married	60 (63.2%)	71 (59.7%)		
	Divorced/ widowed	5 (5.3%)	9 (7.6%)		
Educational level	Elementary school and below	60 (63.2%)	53 (44.5%)	11.591	0.009
	Junior high school	19 (20.0%)	27 (22.7%)		
	Senior high school	10 (10.5%)	14 (11.8%)		
	Bachelor's degree or higher	6 (6.3%)	25 (21.0%)		
Distance from treatment center	≤50 km	37 (38.9%)	24 (20.2%)	9.142	0.002
	> 50 km	58 (61.1%)	95 (79.8%)		
Employment status	Employed	12 (12.6%)	13 (10.9%)	0.149	0.699
	Unemployed	83 (87.4%)	106 (89.1%)		
Family averaged income (per month)	<1000	10 (10.5%)	20 (16.8%)	4.784	0.188
	1000–3999	42 (44.2%)	57 (47.9%)		
	4000–7999	40 (42.1%)	35 (29.4%)		
	≥8000	3 (3.2%)	7 (5.9%)		
Medical payment	Employee health insurance	12 (12.6%)	16 (13.4%)	0.099	1.000
	Urban resident medical Insurance	79 (83.2%)	98 (82.4%)		
	Other insurance	4 (4.2%)	5 (4.2%)		
The number of drug-resistant anti-TB agents	2	22 (23.2%)	34 (28.6%)	7.732	0.082
	3	43 (45.3%)	40 (33.6%)		
	4	21 (22.1%)	26 (21.8%)		
	5	7 (7.4%)	19 (16.0%)		
	≥6	2 (2.1%)	0 (0.0%)		
Medication duration (year)	1	64 (67.4%)	26 (21.8%)	45.793	<0.001
	2	22 (23.2%)	59 (47.1%)		
	3	9 (9.5%)	37 (31.1%)		
Medication cost (out-of-pocket, per month)	<1000	5 (5.3%)	9 (7.6%)	0.508	0.776
	1000-4000	70 (73.7%)	87 (73.1%)		
	>4000	20 (21.1%)	23 (19.3%)		
Side effects	Yes	10 (10.5%)	48 (40.3%)	23.760	<0.001
	No	85 (89.5%)	71 (59.7%)		
Comorbidities	Yes	9 (9.5%)	29 (24.4%)	8.027	0.005
	No	86 (90.5%)	90 (75.6%)		
Employment of caregiver	Yes	50 (52.6%)	88 (73.9%)	10.483	0.001
	No	45 (47.4%)	31 (26.1%)		
Health literacy	/	3.19 ±.49	2.85 ±.39	5.576	<0.001

had no side effects (OR = 0.331, $P = 0.046$), did not employ a caregiver (OR = 0.238, $P < 0.001$), and had higher health literacy scores (OR = 0.391, $P = 0.046$) were more likely to be classified into the C1 Low-Burden (Attitude & Practice-Dominated). In contrast, patients with higher education levels (OR = 4.969, $P = 0.015$), those living farther from the treatment center (OR = 3.358, $P = 0.007$), and those with a medication duration of 2 years (OR = 7.292, $P < 0.001$) or 3 years (OR = 0.007, $P < 0.001$) were more likely to be in the C2 High-Burden (Daily Interference-Dominated).

Table 3 Multivariate Logistic Regression Analysis of Latent Classes of Medication-Related Burden Among MDR-TB Patients

Variable		C2 High-Burden (Daily Interference-Dominated) Group					
		B	*SE*	Waldχ^2	*P*	OR	OR (95% CI)
Education level (take Elementary school and below as reference)	Junior high school	0.340	0.479	0.504	0.478	1.405	0.549–3.593
	Senior high school	0.358	0.574	0.388	0.533	1.430	0.464–4.407
	Bachelor's degree or above	1.603	0.657	5.963	0.015	4.969	1.372–17.993
Distance from treatment center (take ≤50 km as reference)	> 50 km	1.211	0.450	7.251	0.007	3.358	1.39–8.11
Medication duration (year) (take 1 year as reference)	2	1.987	0.422	22.132	<0.001	7.292	3.187–16.685
	3	2.117	0.521	16.502	<0.001	8.302	2.99–23.051
Side effects (take Yes as reference)	No	−1.105	0.554	3.971	0.046	0.331	0.112–0.982
Comorbidities (take Yes as reference)	No	−0.940	0.590	2.537	0.111	0.391	0.123–1.242
Employment of caregiver (take Yes as reference)	No	−1.434	0.402	12.711	<0.001	0.238	0.108–0.524
Health literacy	/	−0.940	0.472	3.975	0.046	0.391	0.155–0.984

Discussion

This study employed latent profile analysis (LPA) to identify distinct subgroups of patients with multidrug-resistant tuberculosis (MDR-TB) based on their perceived medication-related burden. Compared to traditional methods that rely solely on total scale scores to assess medication-related burden, LPA offers the advantage of detecting subpopulations whose scores may not meet standard thresholds yet still require targeted interventions. This approach enables the development of tailored strategies for different patient profiles.

Latent Profiles of Medication-Related Burden in Patients with MDR-TB

Based on the combined indicators used in LPA, the optimal model identified two latent profiles: Low-Burden (Attitude & Practice-Dominated) (C1) and High-Burden (Daily Interference-Dominated) (C2). The C1 group accounted for 44% of the sample and was characterized by relatively low overall medication-related burden. However, patients in this group experienced psychological concerns such as fear of forgetting to take medications or worries about long-term side effects, which could negatively influence their medication attitudes and behaviors, thereby generating medication burden. Ausi et al[15] conducted a qualitative study on 36 MDR-TB patients and found that long-term pharmacotherapy often led to anxiety about organ damage and excessive preoccupation with medication routines, resulting in what they termed "associative symptoms".[21,22] In addition, some patients experienced agitation or distress before medication intake—so-called "behavioral symptoms"[23,24]—which further contributed to their sense of burden. These findings highlight the importance of proactive medication education by healthcare providers. Helping patients accurately understand the purpose, safety, and importance of medication may reduce unwarranted concerns and enhance adherence. The C2 group made up 56% of the sample and showed a significantly higher medication-related burden, primarily characterized by interference in daily life—such as restrictions on mobility, changes in dietary habits, and reduced social interactions. Prior studies have shown that medication burden substantially diminishes the quality of life among patients with MDR-TB.[7] This finding is consistent with Moen et al,[25] who interviewed 59 elderly patients taking five or more medications daily and found that polypharmacy severely disrupted daily life, particularly social functioning and interpersonal relationships. Furthermore, Boye et al[26] reported that although clinical outcomes improved following interventions in patients with chronic illnesses, those who experienced a high initial medication burden showed smaller gains. This underlines the necessity of timely intervention for patients in the high-burden group. In addition to medication management support, healthcare professionals should consider implementing remote healthcare services,[27] designing personalized nutrition plans,[28] and establishing TB care support systems[4] to mitigate the impact of medication burden on patients' daily lives. These measures could help relieve psychological stress and loneliness, foster better adaptation to long-term treatment, and improve both quality of life and adherence.

Characteristics of Latent Medication-Related Burden Profiles in MDR-TB Patients

This study further explored the characteristics of patients within each latent profile. Patients in the C1 group were more likely to have higher health literacy, no side effects, and no hired caregivers. Health literacy—the ability to obtain, process, and understand health information to make appropriate decisions[29]—enables patients to better manage their condition. A higher level of health literacy facilitates comprehension of complex treatment regimens, fosters a more positive attitude toward MDR-TB therapy, and reduces perceived medication-related burden.[30] Numerous studies have demonstrated that side effects are a major independent predictor of medication burden.[23,31,32] These side effects not only cause physical discomfort but also lead to psychological stress, thereby exacerbating the overall burden.[33] In our study, patients without side effects reported significantly lower medication burden, indicating the critical role of side effect management in burden reduction. Therapeutic drug monitoring (TDM)[34] should be enhanced to detect and address side effects early, while also providing clear communication about expected treatment outcomes. Patient feedback should be integrated into medication adjustments to improve adherence and reduce treatment burden. Economic pressure is another contributor to medication burden, especially in MDR-TB patients. Out-of-pocket expenses can severely impact treatment adherence and quality of life for both patients and their families.[35,36] Our findings showed that patients without hired caregivers were more likely to be in the low-burden group (C1), possibly because hiring caregivers imposes additional financial strain. This suggests that caregiver-associated costs indirectly increase the overall medication burden. Thus, future health policy and service interventions should prioritize financial and caregiving support. Providing home-based care through community health services or offering government subsidies for caregiving expenses[36–39] could alleviate family burden and reduce patient medication burden, leading to improved adherence and quality of life.

Interestingly, this study found that patients with higher education levels were more likely to fall into the high-burden group (C2), a finding that seems counterintuitive. However, Wang et al[40] reported similar results in a cross-sectional survey of 430 elderly patients with chronic diseases—those with lower education levels reported greater burden. In the context of MDR-TB, which is a communicable disease requiring long-term, complex pharmacotherapy, patients with higher education may be more aware of the challenges and risks involved. As a result, they may set higher expectations for treatment, leading to greater perceived burden. Therefore, clinical care for highly educated patients should include individualized counseling and psychological support to help them build realistic treatment expectations.

Additionally, longer duration of medication use was associated with a higher likelihood of being in the high-burden group (C2), identifying treatment duration as an independent risk factor. An observational study of 474 elderly patients with comorbidities found that those with longer treatment histories experienced significantly greater burden ($t=2.710$, $P=0.007$).[41] Prolonged treatment can lead to diminished treatment confidence, decreased adherence, cumulative toxicity, and higher costs.[42] The recent introduction of all-oral, short-course regimens for drug-resistant TB represents a promising breakthrough, shortening treatment to as little as 6 months.[43] However, systemic barriers still limit the widespread implementation of these regimens, especially for critically ill patients (eg, TB meningitis), children, and pregnant women. We recommend comprehensive case management for these populations throughout the treatment cycle,[44] including pre-treatment assessment, real-time monitoring, and post-treatment follow-up. Such strategies can help optimize therapeutic outcomes, reduce medication burden, and enhance patient experience.

Finally, patients living ≥50 km away from treatment centers were more likely to fall into the high-burden group. This is consistent with qualitative findings by Krska et al,[13] who reported that long travel distances increase both the financial and time costs of accessing care, potentially reducing continuity of treatment. Research has shown that providing telemedicine services, such as video consultations and smart pillbox monitoring, can effectively overcome these geographical challenges. This can help reduce the economic burden on patients, improve medication adherence, and alleviate the overall medication burden.[45] Based on these findings, we recommend the following actions for future implementation: 1) Establish a tiered healthcare system, decentralizing some services to primary healthcare institutions; 2) Develop a mobile health-based intelligent management system for remote monitoring and medication reminders; 3) Explore a "centralized distribution + community supervision" model for medication supply to reduce patients' medication burden.

Strengths and Limitations

This study employed an individual-centered statistical approach and identified latent profiles of medication burden among MDR-TB patients through Latent Profile Analysis (LPA). It explored the influencing factors of different categories, revealing the heterogeneity of medication burden among various patient groups and providing a basis for more targeted and personalized interventions. However, there are several limitations to this study. First, the research was conducted in a single tertiary hospital in Sichuan Province, China, which limits the geographic representativeness of the sample. Future research should include large-scale, multi-center studies to broaden the sample size and enhance the generalizability of the findings. Additionally, this study was cross-sectional and did not capture the temporal changes in medication burden. It is insufficient to establish causal relationships between variables. Longitudinal studies are needed to verify the hypotheses in this study and provide evidence to support the development of personalized interventions for medication burden in MDR-TB patients. Finally, when excluding invalid response questionnaires, we did not employ advanced methods such as the Rasch model to systematically assess the validity of response patterns or potential response biases. Future studies could apply the Rasch model to further investigate the underlying mechanisms of invalid responses and improve the rigor of data quality evaluation.

Conclusions

The findings of this study indicate that there is heterogeneity in the medication-related burden among MDR-TB patients. Latent Profile Analysis revealed two latent profiles of medication-related burden: a Low-Burden (Attitude & Practice-Dominated) (C1) and a High-Burden (Daily Interference-Dominated) (C2). Furthermore, the study found that factors such as education level, distance from the treatment center, medication duration, side effects, whether a caregiver is employed, and health literacy levels can predict the latent profiles of medication-related burden in MDR-TB patients. Healthcare professionals should identify the medication-related burden category of MDR-TB patients early and implement targeted interventions based on these factors to alleviate patients' medication burden and improve treatment success rates and quality of life.

Abbreviations

TB, tuberculosis; MDR-TB, multidrug-resistant tuberculosis; LPA, Latent profile analysis; LMQ, Living with Medicines Questionnaire; HeLMS, Health Literacy Management Scale; AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; LMRT, Lo–Mendell–Rubin adjusted likelihood ratio test; BLRT, Bootstrap Likelihood Ratio Test.

Data Sharing Statement

The data and materials that support the findings of this study are available from Miss Xiaoyi Yang upon reasonable request.

Ethical Approval Statement

This study was approved by the Medical Ethics Committee of Public Health Clinical Centre of Chengdu (NO YJ-K2024 -32-01). This study was conducted in accordance with the declaration of Helsinki. All participants provided written informed consent prior to data collection.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas, took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published, have agreed on the journal to which the article has been submitted and agree to be accountable for all aspects of the work.

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References

1. Janssen S, Murphy M, Upton C, et al. Tuberculosis: an update for the clinician. *Respirol*. 2025;30:196–205. doi:10.1111/resp.14887
2. Salari N, Kanjoori AH, Hosseinian-Far A, et al. Global prevalence of drug-resistant tuberculosis: a systematic review and meta-analysis. *Infect Dis Poverty*. 2023;12:57. doi:10.1186/s40249-023-01107-x
3. Goletti D, Meintjes G, Andrade BB, et al. Insights from the 2024 WHO global tuberculosis report - more comprehensive Action, Innovation, and Investments required for achieving WHO End TB goals. *Int J Infect Dis*. 2025;150:107325. doi:10.1016/j.ijid.2024.107325
4. World Health Organization. *WHO Consolidated Guidelines on Tuberculosis: Module 4: Treatment - Drug-Resistant Tuberculosis Treatment, 2022 Update*. Geneva: World Health Organization; 2022.
5. Ahmad N, Ahuja SD, Akkerman OW; Collaborative Group for the Meta-Analysis of Individual Patient Data in MDR-TB treatment–2017, et al. Treatment correlates of successful outcomes in pulmonary multidrug-resistant tuberculosis: an individual patient data meta-analysis. *Lancet*. 2018;392:821–834. doi:10.1016/S0140-6736(18)31644-1
6. Kushemererwa O, Nuwagira E, Kiptoo J, et al. Adverse drug reactions and associated factors in multidrug-resistant tuberculosis: a retrospective review of patient medical records at mbarara regional referral hospital, Uganda. *SAGE Open Med*. 2023;11:20503121231171350. doi:10.1177/20503121231171350
7. Abubakar M, Ullah M, Shaheen MA, et al. Why do patients with DR-TB do not complete their treatment? Findings of a qualitative study from Pakistan. *BMJ Open Respir Res*. 2024;11:e002186. doi:10.1136/bmjresp-2023-002186
8. Ahmad N, Javaid A, Basit A, et al. Management and treatment outcomes of MDR-TB: results from a setting with high rates of drug resistance. *Int J Tuberc Lung Dis*. 2015;19:1109–14, i–ii. doi:10.5588/ijtld.15.0167
9. Wang Y, McNeil EB, Huang Z, et al. Household financial burden among multidrug-resistant tuberculosis patients in Guizhou province, China: a cross-sectional study. *Medicine*. 2020;99:e21023. doi:10.1097/MD.0000000000021023
10. Wahid A, Ghafoor A, Khan AW, et al. Comparative effectiveness of individualized longer and standardized shorter regimens in the treatment of multidrug resistant tuberculosis in a high burden country. *Front Pharmacol*. 2022;13:973713. doi:10.3389/fphar.2022.973713
11. Du Y, Qiu C, Chen X, et al. Treatment outcome of a shorter regimen containing clofazimine for multidrug-resistant tuberculosis: a randomized control trial in China. *Clin Infect Dis*. 2020;71:1047–1054. doi:10.1093/cid/ciz915
12. Given BA, Given CW, Sikorskii A, et al. Medication burden of treatment using oral cancer medications. *Asia Pac J Oncol Nurs*. 2017;4:275–282. doi:10.4103/apjon.apjon_7_17
13. Mohammed MA, Moles RJ, Chen TF. Medication-related burden and patients' lived experience with medicine: a systematic review and metasynthesis of qualitative studies. *BMJ Open*. 2016;6:e010035. doi:10.1136/bmjopen-2015-010035
14. Hedima EW, Ohieku JD, David EA, et al. Evaluation of viral suppression and medication-related burden among HIV-infected adults in a secondary care facility. *Explor Res Clin Soc Pharm*. 2024;15:100473. doi:10.1016/j.rcsop.2024.100473
15. Ausi Y, Yunivita V, Santoso P, et al. A mixed-method study of medication-related burden among multi-drug resistant tuberculosis patients in West Java, Indonesia. *Clinicoecon Outcomes Res*. 2024;16:707–719. doi:10.2147/CEOR.S473768
16. Sacco K, LM West, LM Grech, et al. Assessing medication-related burden of community-dwelling individuals with chronic conditions in a small island state. *Chronic Illn*. 2025;21:145–156. doi:10.1177/17423953231205918
17. Li B, Shu D, Pang S, et al. Primary caregiver-reported family resilience in children with cancer in central China: a latent profile analysis. *BMC Nurs*. 2025;24:1248. doi:10.1186/s12912-025-03444-8
18. Anderson OD. Kendall's advanced theory of statistics, volume 1: distribution theory. *J Royal Stat Soc*. 1988;37:487–488. doi:10.2307/2348788
19. Krska J, Morecroft CW, Rowe PH, et al. Measuring the impact of long-term medicines use from the patient perspective. *Int J Clin Pharm*. 2014;36:675–678. doi:10.1007/s11096-014-9970-5
20. Jordan JE, Buchbinder R, Osborne RH. Conceptualising health literacy from the patient perspective. *Patient Educ Couns*. 2010;79:36–42. doi:10.1016/j.pec.2009.10.001
21. Amaral JM, Brito MJM, Kakehasi AM. High frequency of methotrexate intolerance in longstanding rheumatoid arthritis: using the methotrexate intolerance severity score (MISS). *Adv Rheumatol*. 2020;60:43. doi:10.1186/s42358-020-00145-5
22. Farida Y, Widayanti AW, Andayani TM, et al. Medication-related burden and experience with medications in indonesian older adults with chronic diseases: a mixed-method study. *J Prev Med Public Health*. 2025;58:188–198. doi:10.3961/jpmph.24.374
23. Liu D, Qiu L, Han L, et al. Prevalence and influencing factors of medication-related burden among patients with late-life depression in typical city of eastern China: a cross-sectional study. *BMC Public Health*. 2024;24:3521. doi:10.1186/s12889-024-20939-2.)
24. Bulatović M, Heijstek MW, Verkaaik M, et al. High prevalence of methotrexate intolerance in juvenile idiopathic arthritis: development and validation of a methotrexate intolerance severity score. *Arthritis Rheum*. 2011;63:2007–2013. doi:10.1002/art.30367
25. Moen J, Bohm A, Tillenius T, et al. "I don't know how many of these [medicines] are necessary". - a focus group study among elderly users of multiple medicines. *Patient Educ Couns*. 2009;74:135–141. doi:10.1016/j.pec.2008.08.019
26. Boye KS, Mody R, Lage MJ, et al. Chronic medication burden and complexity for US patients with type 2 diabetes treated with glucose-lowering agents. *Diabetes Ther*. 2020;11:1513–1525. doi:10.1007/s13300-020-00838-6

27. Olowoyo KS, Esan DT, Adeyanju BT, et al. Telemedicine as a tool to prevent multi-drug resistant tuberculosis in poor resource settings: lessons from Nigeria. *J Clin Tuberc Other Mycobact Dis*. 2024;35:100423. doi:10.1016/j.jctube.2024.100423
28. Wagnew F, Gray D, Tsheten T, et al. Effectiveness of nutritional support to improve treatment adherence in patients with tuberculosis: a systematic review. *Nutr Rev*. 2024;82:1216–1225. doi:10.1093/nutrit/nuad120
29. Jeitani C, Van den Broucke S, Leemans C. Interventions addressing health literacy in cancer care: a systematic review of reviews. *Int J Environ Res Public Health*. 2025;22:212. doi:10.3390/ijerph22020212.)
30. A-K L, Y-Y L, Su J, et al. Self-efficacy and self-management mediate the association of health literacy and quality of life among patients with TB in Tibet, China: a cross-sectional study. *Int Health*. 2023;15:585–600. doi:10.1093/inthealth/ihad040
31. Valadares RMC, Carvalho WDS, Miranda SSD. Association of adverse drug reaction to anti-tuberculosis medication with quality of life in patients in a tertiary referral hospital. *Rev Soc Bras Med Trop*. 2019;53:e20190207. doi:10.1590/0037-8682-0207-2019
32. Abood NA, Kadhim DJ, Hussein RJ. Medication-related burden among Iraqi patients with ulcerative colitis: a cross-sectional study. *J Med Life*. 2024;17:800–805. doi:10.25122/jml-2023-0342
33. Gaida R, Davids AS, Sewpaul R. Adverse event reporting practices in drug-resistant tuberculosis facilities across South Africa. *S Afr J Infect Dis*. 2023;38:564. doi:10.4102/sajid.v38i1.564
34. Kim HY, Ulbricht E, Ahn YK, et al. Therapeutic drug monitoring practice in patients with active tuberculosis: assessment of opportunities. *Eur Respir J*. 2021;57:2002349. doi:10.1183/13993003.02349-2020
35. Akalu TY, Clements AC, Wolde HF, et al. Economic burden of multidrug-resistant tuberculosis on patients and households: a global systematic review and meta-analysis. *Sci Rep*. 2023;13:22361. doi:10.1038/s41598-023-47094-9
36. Assefa DG, Dememew ZG, Zeleke ED, et al. Financial burden of tuberculosis diagnosis and treatment for patients in Ethiopia: a systematic review and meta-analysis. *BMC Public Health*. 2024;24:260. doi:10.1186/s12889-024-17713-9
37. Deshmukh RD, Dhande DJ, Sachdeva KS, et al. Social support a key factor for adherence to multidrug-resistant tuberculosis treatment. *Indian J Tuberc*. 2018;65:41–47. doi:10.1016/j.ijtb.2017.05.003
38. Octaviani P, Ikawati Z, Yasin NM, et al. Interventions to improve adherence to medication on multidrug-resistant tuberculosis patients: a scoping review. *Med J Malaysia*. 2024;79:212–221.
39. Watthananukul T, Liabsuetrakul T, Pungrassami P, et al. Effect of Global Fund financial support for patients with multidrug-resistant tuberculosis. *Int J Tuberc Lung Dis*. 2020;24:686–693. doi:10.5588/ijtld.19.0353
40. Wang Y, Li X, Jia D, et al. Exploring polypharmacy burden among elderly patients with chronic diseases in Chinese community: a cross-sectional study. *BMC Geriatr*. 2021;21:308. doi:10.1186/s12877-021-02247-1
41. Zhiyu W, Xianyu L, Fengmei X. Polypharmacy burden and the associated factors among inpatients with elderly comorbidity. *Chin J Pract Nurs*. 2022;38:906–910. doi:10.3760/cma.j.cn211501-20211103-03037
42. Mphothulo N, Hlangu S, Furin J, et al. Navigating DR-TB Treatment care: a qualitative exploration of barriers and facilitators to retention in care among people with history of early disengagement from drug-resistant tuberculosis treatment in Johannesburg, South Africa. *BMC Health Serv Res*. 2025;25:122. doi:10.1186/s12913-025-12265-z
43. Evans D, Hirasen K, Ramushu C, et al. Patient and provider costs of the new BPaL regimen for drug-resistant tuberculosis treatment in South Africa: a cost-effectiveness analysis. *PLoS One*. 2024;19:e0309034. doi:10.1371/journal.pone.0309034
44. Chen J, Ruan Y, Wang K, et al. Development and application of a multidrug-resistant tuberculosis case management system - Yunnan Province, China, 2017-2020. *China CDC Wkly*. 2022;4:855–861. doi:10.46234/ccdcw2022.177
45. Manyazewal T, Woldeamanuel Y, Getinet T, et al. Patient-reported usability and satisfaction with electronic medication event reminder and monitor device for tuberculosis: a multicentre, randomised controlled trial. *EClinicalMedicine*. 2023;56:101820. doi:10.1016/j.eclinm.2022.101820