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ORIGINAL RESEARCH

Factors Associated with Non-Adherence to Treatment Among Migrants with MDR-TB in Wuhan, China: A Cross-Sectional Study

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Background: Multidrug resistant tuberculosis (MDR-TB) has attracted increasing attention in achieving the global goal of tuberculosis (TB) control. China has the second largest TB burden worldwide and has been experiencing large-scale domestic migration. This study aims to explore the effect of migrants on non-adherence to MDR-TB treatment.

Materials and Methods: A cross-sectional study was carried out in Wuhan, China. The exposure cases were migrants who were not locally registered in the residence registration system. The control cases were local residents. Non-adherence cases were patients who were lost follow-up or refused treatment. Chi-square and *t*-test were used to compare variables between migrants and local residents. Logistic regression models using enter method were used to determine the relationship between migration and non-adherence to treatment. Moderation and medication effects on the association between migrant status and non-adherence were also explored.

Results: We studied 73 migrants and 219 local residents. The migrants, who did not to adhere to treatment (55, 75.3%), was far higher than that of local residents (89, 40.6%). Migrants with MDR-TB had 10.38-times higher difficulty in adhering to treatment (adjusted OR = 10.38, 95% CI 4.62–25.28) than local residents. This additional likelihood was moderated by age and treatment registration group. Migration had an indirect association with non-adherence to treatment via social medial insurance (adjusted OR = 1.05, 95% CI 1.01–1.13).

Conclusion: There a significant increased likelihood of non-adherence to treatment among migrants with MDR-TB, highlighting the importance of improving treatment adherence in this population. Migration prevented migrants from gaining access to social medical insurance and indirectly reduced their likelihood of adherence to treatment.

Keywords: MDR-TB, migrant, treatment adherence, medical insurance, out-of-pocket

Introduction

Tuberculosis (TB) is one of the three most fatal infectious diseases worldwide and a major health threat especially in low- and middle-income countries.[1,2] The World Health Organization (WHO) and the United Nations (UN) are working together to achieve the goal of ending the TB epidemic by 2030; however, this goal is challenged by the increasing burden of multidrug resistant tuberculosis (MDR-TB).[3–5]

MDR-TB has a stronger transmission capacity (almost all contaminated people will be MDR-TB cases) and longer treatment course than TB.[6,7] From 2009 to 2016, the number of patients with MDR-TB has an annual increase of more than 20% worldwide.[8] In 2017, MDR-TB accounted for 82% of new drug-resistant cases globally, as reported by WHO.[9] "Non-adherence" refers to the phenomenon where patients do not follow medical professionals' advice or instructions regarding their treatment plans or medical recommendations.[10] Failure to adhere to treatment will not only reduce the success rate of the treatment for patients with MDR-TB but also increase the risk of the spread of the disease. Enhancing treatment adherence is one of the significant public measures to control MDR-TB.

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Migration poses challenges for patients with MDR-TB to adhere to treatment. In low TB burden countries, migrants from high burden countries account for a large proportion of new cases, and are a key population for treatment and preventive interventions.[11,12] A cohort study from the UK indicated that the successful treatment rate among migrants with MDR-TB was 72.3%, which was significantly lower than the 90% among local residents.[13] A study in Japan showed that 12% of migrants were lost to follow-up or transferred, which was significantly higher than 8.2% of local residents.[14] In high TB burden countries, as with many infectious diseases, domestic migration of infected individuals may facilitate the spread of TB. Through importation of cases to new locations and increased contact between infectious and susceptible persons, thus promoting TB transmission and emergence of new epidemiological hotspots.[15] A previous study found that 84% of extensively drug-resistant tuberculosis (XDR-TB) transmission province may be linked to cross-district migration in KwaZulu-Natal, South Africa.[16] Understanding patterns of internal migration among MDR-TB patients is also critical for preventing MDR-TB spread. A study in Pakistan showed that internal migrants may delay TB diagnosis and treatment.[17]

Recent research argued that poor access to health insurance, undocumented status, age, gender, education and social risk factors, such as social support, social deprivation, vulnerable housing, mental health concerns or other comorbidities, are barriers to healthcare among migrants and may affect treatment adherence.[18–20] Among them, it is important to consider the impact of, migration factors on out-of-pocket expenses (OOPs) for the patient populations. OOPs encompass costs that individuals personally incur for healthcare services not covered or reimbursed by insurance or other forms of medical security. Research has revealed that the proportion of OOPs for all patients in China is 28.8%, indicating that the effective compensation ratio (ECR) of medical security is approximately 70%.[21] However, for patients diagnosed with MDR-TB, the proportion of OOPs is notably higher at 40%, resulting in a lower ECR of 60%.[22] Migrants who are diagnosed with DR-TB may encounter additional hurdles in navigating the medical security system, leading to higher OOPs and a lower ECR compared to non-immigrant patients.

China is one of the high TB burden countries. Domestic migration in China is more pronounced because of its uneven economic development. The number of internal migrants within China is growing rapidly. According to the seventh population census in China in 2020, migrants account for 24.5% (about 376 million) of the total population. The focus of this study is on the impact of migrants with MDR-TB on non-adherence, which refers to domestic migration in China. Previous Chinese studies showed that the proportion of TB cases cured among migrants was 37.0%, which was lower than that of local residents with TB (90.6%).[23] Migrant status has been identified as one of most influential risk factors for non-adherence to treatment for TB and MDR-TB.[24–26] Other factors that could increase the risk of non-adherence to treatment among migrants are as follows: divorce or bereft of spouse, weak incentives for treatment adherence, self-supervision and lack of knowledge about TB treatment and longer travel time to the nearest community health centers.[26,27] Nevertheless, some important issues need to be addressed. Firstly, previous Chinese studies mainly relied on questionnaires or interviews, and all data were self-reported by the patients, so selection bias and recall bias were unavoidable. Secondly, while existing analyses of MDR-TB patient data have provided insights into geographical patterns and the role of social welfare systems, the Chinese studies has predominantly centered on other determinants of health outcomes and did not adequately examine the potential influence of migration status. We understand that in recent years, some countries and regions such as South Africa and Pakistan have carried out relevant research.[16,17] However, there are still differences in social, economic and medical resource environments between different regions. The current evidence base lacks sufficient data specifically exploring how migrative factors like patient mobility and possible differences in medical care opportunities may affect non-adherence to treatment for those living with MDR-TB.

Using data from Wuhan Pulmonary Hospital (the only authorized institution in Wuhan, China), we selected migrants and local residents diagnosed with MDR-TB. This study aims to answer two questions: firstly, is there a significant increased likelihood of non-adherence to treatment among migrants in China? If so, secondly, what is the possible moderators or mediators by which migrants lead to non-adherence to treatment?

Materials and Methods

Study Setting

Wuhan is a large city with a high urbanization level and a relatively developed economic level in China; the city's healthcare resources rank in the middle and upper reaches of the country. Ranking first in Central China, the city has

a permanent population of 13.649 million, including 4.3 million migrants, accounting for 31.5% of the population. In Wuhan, all suspected cases of MDR-TB need to be transferred to Wuhan Pulmonary Hospital, where all patients with confirmed diagnosis of MDR-TB will receive treatment following the clinical guideline.

This study investigated the impact of domestic migrants with MDR-TB on non-adherence in Wuhan, China. A migrant in this study refers to individuals who have relocated internally within China from one province/region to another, maintaining Chinese citizenship rather than crossing international borders. The study population included migrants without local household registration and local residents. Local residents more easily obtained employees' basic medical insurance or residents' basic medical insurance through their employers or community services, providing over 50% reimbursement of actual inpatient costs according to insurance rules. Employees' basic medical insurance has not established a financing scheme for general outpatient care. The reimbursement cap line of outpatient care in residents' basic medical insurance was set at 400 Chinese yuan (CNY) for total visits in a year. Migrants as a mobile population relied on employers to purchase employees' basic medical insurance or purchase residents' basic medical insurance in their place of origin. Migrants could not purchase residents' basic medical insurance without residence registration in Wuhan. Migrants needed to pay 10% upfront before reimbursement, with 10–20% lower reimbursement ratios compared to local policies due to cross-regional medical services. Meanwhile, local MDR-TB patients received government subsidies for outpatient MDR-TB treatment. However, this subsidy did not cover hospitalization costs, treatment of complications, comorbidities or other medications. The maximum subsidy amount was 50,000 CNY. Migrant patients did not qualify for this subsidy policy.

Study Design and Participants

We conducted a cross-sectional study using data from the information system of Wuhan Pulmonary Hospital. This information system consists of clinical system, medical insurance system, and public health system. From the clinical system, we obtained patient ICD-10 Codes, demographic characteristics (age, gender, marriage, occupation), migrant status, and treatment registration groups. From the medical insurance system, we retrieved type of social medical insurance, OOPs due to outpatient/inpatient care. The OOPs of patients without social medical insurance directly comes from the patient's self-payment in the clinical system. The public health system serves as the core system for tuberculosis management in China. The hospitals in charge of tuberculosis management in each region have their own application authority. Wuhan Pulmonary Hospital is responsible for conducting quarterly follow-ups for registered tuberculosis patients. Based on the treatment outcome information registered in the public health system (including treatment completion, recovery, undergoing treatment, loss to follow-up, death, adverse reactions, lack of effective treatment regimen, and others), we determined non-adherence to treatment.

Data were collected between January 2016 to December 2019. Eligible patients were those diagnosed with MDR-TB based on ICD-10 Codes (A15.0, A15.1). Moreover, the treatment outcome for patients was treatment completion, recovery, and loss of follow-up. We excluded patients who did not actively terminate treatment due to death, adverse reactions, and lack of effective scheme (judged by the final recorded treatment results) as this may be caused by factors other than non-adherence. Patients who were still undergoing treatment were also excluded, as they had not completed the full treatment course, making it impossible to assess adherence. The exposure cases were migrants who were not locally registered in the residence registration system. The control cases were local residents. Finally, 292 cases were selected.

Variables

Outcome and Measure

Non-adherence to treatment (yes or no). Adherent cases were those who recovered from MDR-TB and completed the required treatment or were receiving treatment following the clinical guideline. The remaining patients with MDR-TB were non-adherence cases and usually consisted of people lost to follow-up or refused treatment.

Covariates

We investigated socio-demographic characteristics including age (age was coded into the age groups: "18–34", "35–64" and "65+"), gender (male vs female), marital status (married, single or others), and occupation status (employed, retired or unemployed).

We also evaluated disease characteristics (measured by registration group: new, relapse, vs retreatment excluding relapse), medical security factors (measured by the type of basic medical insurance: residents' basic medical insurance, employees' basic medical insurance, vs without medical insurance), and OOPs due to outpatient/inpatient care (These variables were subjected to a natural log transformation to normalize their distribution). Based on studies that explored the determinants of medical adherence among patients with TB/MDR-TB, these covariates were reported to be significantly related to treatment adherence.[28,29]

Statistical Analysis

Continuous variables were reported as mean (standard deviation, SD) and tested by *t*-test. Categorical variables were presented as number (percentage) and tested by Chi-square test.

To examine the association between migrant status and non-adherence to treatment, we fitted the data by logistic regression, with non-adherence to treatment (yes or no) as the outcome and migration (yes or no) as the key predictor. We reported the results as unadjusted/adjusted odd ratio (OR) and its 95% confidence interval (95% CI). Logistic models were established using a hierarchical approach. Model 1 provided the unadjusted result. Model 2 controlled the socio-demographic factors including age, gender, marital status and occupation status. Model 3 additionally controlled disease characteristic. Model 4 additionally controlled medical security factor and economic cost. The hierarchical results from logistic regression implied the existence of interactions between migrant status and covariates. We searched for the possible moderators by testing the interaction between immigration status and other covariates. We generated interaction items by cross-multiplying each covariate with the migrant status variable and included them in model 4. We generated adjusted ORs and 95% CIs for the association between migrant status and non-adherence according to levels of the covariates. This allows us to examine whether the association between migrant status and non-adherence differs according to levels of the covariates.

To explore the possible mechanism by which migrant status affect non-adherence to treatment, we further estimated their indirect association by using the mediation model. As potential mediators, we selected three variables from logistic regression Model 4: social medical insurance, OOPs due to outpatient care, and treatment registration group. These three variables can be changed to some extent through policies or interventions, and were significantly associated with non-adherence in Model 4, meeting the selection criteria for mediators. We used the Sobel test to analyze whether these three variables mediated the statistical relationship between migrant status and non-adherence in a meaningful way.

All statistical analyses were performed using R software (version 4.0.4). Statistical significance was defined as $P < 0.05$.

Results

Table 1 shows the information of 292 patients, including 73 migrants and 219 local residents. Among migrants, more than half were 18–64 years old (56, 76.7%), male (55, 75.3%), married (51, 69.9%), retired or unemployed (55, 75.3%), newly diagnosed cases (53, 72.6%) and non-adherent to treatment (55, 75.3%). About 15.1% (11/73) lacked social medical insurance. The mean OOPs among migrants were 6.62 ± 7.34 for outpatient care and 9.71 ± 12.93 for inpatient care. Among local residents, more than half were 18–64 years old (180, 82.2%), male (154, 70.3%), married (139, 63.5%), retired or unemployed (154, 70.3%), newly diagnosed cases (144, 65.8%) and non-adherent to treatment (89, 40.6%). About 1.8% (4/219) lacked social medical insurance. The mean OOPs were 4.69 ± 9.53 for outpatient care and 5.35 ± 6.82 for inpatient care. According to the results of Chi-square test and *t*-test, several factors were significantly different between migrants and local residents; these factors included treatment registration group, social medical insurance, OOPs due to inpatient care and non-adherence to treatment. The proportion of newly diagnosed cases was higher among migrants than locals ($\chi2 = 6.10$, $P = 0.0473$). The OOPs due to inpatient care of migrants was higher than that of local residents ($t = 2.82$, $P = 0.006$). The proportion of migrants without social medical insurance was higher than

Table 1 Basic Description

Variables	Migrants (N = 73)	Local Residents (N = 219)	Statistics	p
Age				
18–34	22 (30.1)	47 (21.5)	$\chi2 = 4.52$	0.1044
35–64	34 (46.6)	133 (60.7)		
≥ 65	17 (23.3)	39 (17.8)		
Gender				
Male	55 (75.3)	154 (70.3)	$\chi2 = 0.45$	0.5002
Female	18 (24.7)	65 (29.7)		
Marital status [a]				
Married	51 (69.9)	139 (63.5)	$\chi2 = 4.34$	0.1143
Single	13 (17.8)	29 (13.2)		
Others	9 (12.3)	51 (23.3)		
Occupation status				
Employed	18 (24.7)	65 (29.7)	$\chi2 = 0.45$	0.5002
Retired or unemployed	55 (75.3)	154 (70.3)		
Treatment registration group				
New	53 (72.6)	144 (65.8)	$\chi2 = 6.10$	**0.0473**
Relapse	15 (20.5)	34 (15.5)		
Retreatment excluding relapse	5 (6.8)	41 (18.7)		
Social medical insurance				
Employees' basic medical insurance	27 (37)	86 (39.3)	$\chi2 = 19.93$	**< 0.0001**
Residents' basic medical insurance	35 (47.9)	129 (58.9)		
Without medical insurance	11 (15.1)	4 (1.8)		
OOPs due to outpatient care[b]	6.62 (7.34)	4.69 (9.53)	t = 1.80	0.0739
OOPs due to inpatient care[b]	9.71 (12.63)	5.35 (6.82)	t = 2.82	**0.0060**
Non-adherence to treatment				
Yes	55 (75.3)	89 (40.6)	$\chi2 = 25.01$	**< 0.0001**
No	18 (24.7)	130 (59.4)		

Notes: Data are presented as number (percent) unless other specifies. [a]The "other" in marital status include death of a spouse and divorces. [b]Continuous variable; means ± standard deviations are presented. The results displayed in bold text indicate statistical significance in the statistical analysis.

that of local residents ($\chi2 = 19.93$, $P< 0.0001$). Moreover, the migrants, who did not to adhere to treatment, was far higher than that of local residents ($\chi2 = 25.01$, $P < 0.0001$).

Table 2 shows the association between migrant status and non-adherence to treatment. We conducted a logistic regression analysis, gradually adjusting for potential confounding factors including socio-demographic factors, disease characteristic, medical security factor and the economic costs. In Models 1 to 4, migrant status remained a significant independent risk factor for non-adherence ($P < 0.05$) after adjusting for confounders. After controlling for all confounders, migrants had 10.38-times likelihood of failing to adhere to treatment than local residents (adjusted OR = 10.38, 95% CI 4.62–25.28; Table 2, model 4). This suggests migrant status independently influence treatment adherence for MDR-TB above and beyond other measured covariates.

The association between migration and non-adherence to treatment was moderated by age and treatment registration group but not by gender, marriage, occupation, type of social medical insurance and OOPs due to outpatient/inpatient care (Table 3). Compared with migrants aged 35–64 years, those aged 18–34 years had a 7.54-times likelihood of non-adherence to treatment (adjusted OR = 7.54, 95% CI 1.25–51.42). Moreover, the likelihood of non-adherence to treatment decreased by 95% among migrants who were relapse compared with migrants who were newly diagnosed (adjusted OR = 0.05, 95% CI 0.01–0.30).

Beside the direct association between migration and non-adherence to treatment in Table 2, migration had an indirect association with non-adherence to treatment via social medial insurance (adjusted OR = 1.05, 95% CI 1.01–1.13) but not via

Table 2 Association Between Migrant Status and Non-Adherence to Treatment

Variables	Model 1	Model 2	Model 3	Model 4
Migrant (= yes)	**4.48 (2.51–8.25)**	**9.78 (4.85–21.12)**	**8.67 (4.26–18.73)**	**10.38 (4.62–25.28)**
Age				
35–64		Reference	Reference	Reference
18–34		**0.21 (0.08–0.51)**	**0.21 (0.08–0.51)**	**0.22 (0.08–0.57)**
≥ 65		1.49 (0.66–3.39)	1.51 (0.66–3.49)	2.12 (0.84–5.47)
Gender				
Male		Reference	Reference	Reference
Female		0.59 (0.30–1.16)	0.54 (0.27–1.08)	0.51 (0.24–1.04)
Marital status [a]				
Married		Reference	Reference	Reference
Single		2.27 (0.82–6.42)	1.99 (0.72–5.70)	1.67 (0.53–5.31)
Others		**26.84 (10.18–87.36)**	**25.28 (9.58–82.27)**	**18.73 (6.62–63.43)**
Occupation status				
Retired or unemployed		Reference	Reference	Reference
Employed		0.63 (0.31–1.23)	0.63 (0.31–1.26)	0.97 (0.38–2.48)
Treatment registration group				
New			Reference	Reference
Relapse			1.27 (0.57–2.86)	1.31 (0.57–3.03)
Retreatment excluding relapse			0.43 (0.17–1.05)	**0.37 (0.14–0.93)**
Social medical insurance				
Employees' basic medical insurance				Reference
Residents' basic medical insurance				1.36 (0.57–3.25)
Without medical insurance				**12.06 (2.29–96.54)**
OOPs due to outpatient care [b]				**0.93 (0.88–0.98)**
OOPs due to inpatient care [b]				0.97 (0.93–1.01)

Notes: Data are included in the model as categorical variables unless otherwise stated. [a]The "other" in marital status include death of a spouse and divorces. [b]Data are included in the model as continuous variables. The results displayed in bold text indicate statistical significance in the statistical analysis.

Table 3 Moderating Effect on the Association Between Migrant Status and Non-Adherence to Treatment

Variables	OR (95% CI)
Age	
Migrant (=yes) * Age (= 35–64)	Reference
Migrant (=yes) * Age (= 18–34)	**7.54 (1.25–51.42)**
Migrant (=yes) * Age (≥ 65)	2.12 (0.30–20.49)
Gender	
Migrant (=yes) * Gender (= Male)	Reference
Migrant (=yes) * Gender (= Female)	1.08 (0.21–5.87)
Marital status	
Migrant (=yes) * Marital status (= Married)	Reference
Migrant (=yes) * Marital status (= Single)	6.62 (0.77–80.64)
Migrant (=yes) * Marital status (= Others)	NA
Occupation status	
Migrant (=yes) * Occupation status (= Retired or unemployed)	Reference
Migrant (=yes) * Occupation status (= Employed)	0.79 (0.17–3.78)
Treatment registration group	
Migrant (=yes) * Treatment registration group (= New)	Reference
Migrant (=yes) * Treatment registration group (= Relapse)	**0.05 (0.01–0.30)**
Migrant (=yes) * Treatment registration group (= Retreatment excluding relapse)	0.84 (0.03–29.67)

(*Continued*)

Table 3 (Continued).

Variables	OR (95% CI)
Social medical insurance	
Migrant (=yes) * Social medical insurance (= Employees' basic medical insurance)	Reference
Migrant (=yes) * Social medical insurance (= Residents' basic medical insurance)	2.72 (0.58–13.60)
Migrant (=yes) * Social medical insurance (= Without medical insurance)	NA
OOPs due to outpatient care	
Migrant (=yes) * OOPs due to outpatient care	1.06 (0.95–1.19)
OOPs due to inpatient care	
Migrant (=yes) * OOPs due to inpatient care	0.96 (0.90–1.03)

Notes: Data were presented as ORs and their 95% CIs, extracted from Model 4 in Table 2, but adding the interactive item between migrant and considered variable. [a]The "other" in marital status include death of a spouse and divorces. [b]Data are included in the model as continuous variables. The results displayed in bold text indicate statistical significance in the statistical analysis.

Table 4 Indirect Association Between Migrant Status and Non-Adherence to Treatment

Indirect Pathway	OR (95% CI)
Migrant ~ Social medical insurance (= Without medical insurance) ~ Non-adherence to treatment	**1.05 (1.01–1.13)**
Migrant ~ OOPs due to outpatient care ~ Non-adherence to treatment	0.98 (0.95–1.01)
Migrant ~ Treatment registration group (= Retreatment excluding relapse) ~ Non-adherence to treatment	1.02 (1.00–1.04)

Notes: Data were presented as ORs and their 95% CIs, extracted from mediation models. Only the indirect association via social medical insurance, OOPs due to outpatient care, or treatment registration group were explored, as they are changeable and also significantly associated with non-adherence to treatment (shown in Table 2). The results displayed in bold text indicate statistical significance in the statistical analysis.

OOPs (adjusted OR = 0.98, 95% CI 0.95–1.01) and treatment registration group (adjusted OR = 1.02, 95% CI 1.00–1.04) (Table 4).

Discussion

Using data from the only designated hospital for MDR-TB in Wuhan, we investigated the association between migration status and non-adherence to treatment and identified the possible moderators or mediators of this non-adherence. Migrants had 10.38-times likelihood of non-adherence to treatment than local residents, and this additional likelihood was moderated by age and treatment registration group. Migration status had a low coverage of social medical insurance, which indirectly reduced the likelihood of treatment adherence.

The treatment adherence of migrants with MDR-TB was worse than that of local residents, consistent with previous reports. For example, some studies in China indicated that non-adherence to treatment was common among migrants with TB.[24,27] Possible explanations for the poor treatment adherence of migrants were reported. For instance, migrants had difficulty adhering to treatment because of their low income[30] and high medical costs.[31,32] Targeted financial assistance programs may be needed to help offset high medical costs for migrants.[33] This could take the form of insurance subsidies or direct aid to lower out-of-pocket costs for treatment and monitoring. Simultaneously, the high mobility of migrants affected their adherence to treatment.[34] Mobile health and digital tools show promise for improving adherence among highly mobile populations.[15] Apps, telehealth, electronic reminders and monitoring may help compensate for lack of in-person social support networks during treatment. Multi-sectoral coordination across health departments and providers in migrant source and destination areas could facilitate continuity of treatment and management across jurisdictions. In Addition, public discrimination against tuberculosis still exists in China.[35] This social isolation caused by such discrimination affects their adherence to medical advice and willingness to participate in treatment. Community health worker programs placed in migrant communities may aid directly observed therapy, social support, education and navigation of healthcare services to boost adherence.

More specifically, age of 18–34 years had a negative impact on treatment adherence among migrants possibly. The 2015 Chinese data showed that the average age of migrants in China was 29.8 years old, with over half (126 million migrants, 51.1%) being under 35 years old.[36] As the majority of migrants in China were young, their higher mobility for work may pose challenges to healthcare access and management of infectious diseases. A study among migrants in Taiwan found that migrants with the highest TB incidence were young people,[37] which may increase the possibility of non-adherence to treatment. A study in China showed that the upward trend of young-age migrant patients with infectious diseases remain a threat to the future intervention and prevention of infectious diseases.[38] A key factor contributing to this issue is that migrants often have difficulty accessing equivalent social and healthcare rights as local urban workers when they relocate for employment opportunities.[39] As they move between locations seeking improved livelihoods, migrants face challenges in obtaining public health protections and welfare benefits comparable to local residents at their destination.[39] This underscores the need for strengthened public health protections and welfare support for migrants, especially young migrant workers.

Migrants who were relapse had a higher likelihood of adhering to treatment because they had a higher perceived relapse risk, thus realizing the importance of treatment adherence.[40] The associations between non-adherence and socio-demographic characteristics were also explored in some studies; marital status was reported to be associated with adherence to treatment, contradicting our findings.[26] Researchers believed that spouse played an important role in treatment supervision. However, many married migrants lived separately from their spouses, who thus could not effectively exert medical supervision.[29] Living arrangement status was not included in our study and warrants further investigation.

The regression results showed that social medical insurance was significantly associated with non-adherence to treatment among migrants. Social medical insurance was a mediator between migrant status and non-adherence to treatment. That is, migration status prevented migrants from gaining access to social medical insurance, thereby indirectly reducing the likelihood of adherence to treatment. This finding was consistent with previous reports. For example, prior studies suggested that migrants had difficulty in obtaining benefits from health insurance in urban cities of China.[41] China's migrants believed that they were discriminated in social security.[42] On the one hand, migrants without local residence registration cannot obtain residents' basic medical insurance due to the limitations in the registration system in China.[43] On the other hand, migrants cannot obtain employees' basic medical insurance because of work instability and employer discrimination.[44] More equitable access to medical services and welfare benefits, regardless of residency status, is crucial for protecting migrant health and reducing infectious disease burdens in a country of increasing human mobility. Thus, providing universal access to social health insurance for migrants, regardless of residence registration status, would help address a key barrier to adherence identified in this study. China and other countries should improve the relationship between social security and residence registration system, so migrants can live an equal life with local residents.

In addition, OOPs due to outpatient care was not a mediator between migration and treatment adherence. Migrants did not receive treatment or complete treatment following the clinical guideline because of their poor treatment adherence, which resulted in lack of significant difference in OOPs due to outpatient care. This finding might not be explained by the data used in our study.

This study has strengths. Firstly, this is a population-based study. The data of all registered patients with MDR-TB in Wuhan from 2016 to 2019 were collected to achieve the representativeness of the estimated values. Secondly, all data were from the electronic clinical records registered by doctors, so data quality was guaranteed. Thirdly, to explore the mechanism of the effect of migration status on treatment non-adherence, we further estimated their indirect association by using the mediation model.

Nevertheless, the present work has some limitations. Firstly, the study was unable to assess the effect of factors that were not routinely collected and included in the electronic clinical records of Wuhan Pulmonary Hospital. Factors that have a significant impact on treatment adherence, such as education, mental health concerns, other comorbidities and distance from the hospital, were not evaluated due to lack of data.[27,45] Secondly, the study did not assess the information of patients who did not go to Wuhan Pulmonary Hospital, so it may underestimate the non-adherence of patients, especially for age group of 0–18 years. Thirdly, our study adopted a retrospective design and thus did not allow the

investigation of qualitative factors of patients, such as self-motivation, social support and lack of treatment knowledge, which were reported to be key drivers of treatment adherence.[46] Fourthly, this study's single-location design and limited set of socioeconomic parameters evaluated. Future research with larger, multi-site samples could help validate these initial findings and characterize additional contextual factors impacting migrant health outcomes. While the results offer insights useful for local TB management, their broader applicability remains unclear without replicating the analysis in different settings.

Conclusion

This study compared treatment adherence between migrants and local residents with MDR-TB in Wuhan, China. We found that Migrants had a greater likelihood of non-adherence to treatment. The results suggest an association between migration status, age, treatment registration group, lack of medical insurance, and non-adherence that warrants further investigation. As population mobility in China continues to grow, failure to include migrants in residency registration systems and provide medical coverage represents systemic barriers impairing treatment motivation. The public health authorities should strengthen migrant-inclusive policies and health systems strengthening efforts required to achieve the goal of ending TB transmission by 2030.

Data Sharing Statement

The data-set used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

The study design was approved by the ethics institutional review board of Huazhong University of Science and Technology, Wuhan, China (approval number: 20210630-S170). All the methods were carried out in accordance with relevant guidelines and regulations. The need for informed consent was waived by the ethics institutional review board of Huazhong University of Science and Technology because of the retrospective nature of the study. All authors confirm that this research caused no harm (physical or mental) to any participants. The research process complies with the Declaration of Helsinki. The health data was anonymously provided by Wuhan Pulmonary Hospital.

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Disclosure

The authors declare that there were no competing interests.

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