Factors Associated with Non-Adherence for Prescribed Treatment in 201 Patients with Multidrug-Resistant and Rifampicin-Resistant Tuberculosis in Anhui Province, China

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Background: This study aimed to investigate the factors associated with non-adherence of prescribed treatment in patients with multidrug-resistant and rifampicin-resistant tuberculosis (MDR/RR-TB) in Anhui Province, China.

Material/Methods: A cross-sectional survey was conducted in each designated hospital between March 2020 and May 2021. A structured questionnaire was designed to collect categorical characteristics and the historical data of the study participants. Non-adherence was determined from patient medical records and face-to-face interviews using the questionnaire at each designated hospital for MDR/RR-TB.

Results: A total of 201 patients with confirmed sputum cultures positive for MDR/RR-TB were enrolled, 27.4% of whom were non-adherent to MDR/RR-TB treatment. In Anhui, MDR patients had a high incidence of adverse events, of which gastrointestinal reactions accounted for the majority. Absence of other chronic diseases (odds ratio (OR) 0.401; 95% confidence interval (CI) 0.203-0.791) and having no drug discontinuation (OR 0.040; 95% CI 0.018-0.091) were protective predictors of adherence. Patients with MDR/RR-TB with secondary education level and above and monthly family income of $309.4 USD or higher were more likely to follow the guidelines. Those who received anti-tuberculosis treatment and those who lived in suburban areas were less likely to adhere to the treatment. Binary-logistic regression indicated that the risk factor of non-adherence was drug discontinuation.

Conclusions: Low education level, place of residence, poor financial conditions, presence of other chronic diseases, discontinuation of medication, and frequency of anti-tuberculosis treatments were influential factors of adherence to MDR/RR-TB treatment.

Keywords: Antitubercular Agents • Medication Adherence • Patient Compliance • Risk Factors

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Background

Tuberculosis is a major public health problem worldwide, especially in Asia and Africa, regions that account for the highest mortality among the communicable diseases worldwide. There, mortality from tuberculosis exceeds that of HIV/AIDS and accounted for 1.5 million deaths in 2018 [1]. China is one of the 8 countries from these regions and accounts for two-thirds of the global total of tuberculosis cases [1]. In 2013, of the 0.48 million new cases of multi-drug resistant rifampicin-resistant tuberculosis (MDR/RR-TB) worldwide, 0.21 million related deaths occurred [2]. In 2019, the global tuberculosis incidence rate was 130/100 000, and China ranked third among 30 countries, with a high burden of new cases (8.4% of new cases globally). It was estimated that about 3.3% of new cases and 18% of patients who were treated were resistant to rifampin. The countries with the highest estimated number of patients with rifampin resistance to tuberculosis are India (124 000, 27% globally), China (65 000, 14% globally), and Russia (39 000, 8% globally). Nevertheless, the diagnosis and successful treatment of MDR/RR-TB occurred were where the underperformance was greatest. Each of the 16 cities in Anhui Province, China, has set up a designated hospital for MDR/RR-TB, which is responsible for the detection, treatment, and management of patients. The center for disease control and prevention (CDC) of each city cooperates with the designated hospitals to supervise patients’ standardized treatment and ensure treatment adherence. Adherence to MDR/RR-TB treatment is the most vital requirement for efficient tuberculosis control [3]. Therefore, research on the influencing factors of tuberculosis treatment adherence is essential for discovering potential influencing factors and intervening to improve the cure rate and survival rate of patients. In recent years, Anhui Province has gradually promoted the control of MDR/RR-TB. Initially, the Global Fund MDR tuberculosis prevention and treatment program was implemented in Fuyang and Anqing in 2012, and by 2016, province-wide coverage of MDR tuberculosis treatment and management was achieved (the treatment requirements for RR-TB are the same as those for MDR-TB). In 2017, the program management of standardized treatment of patients with MDR/RR-TB was given an impetus across the province, but the number of patients in treatment and the success rate of treatment were still undesirable.

Treatment adherence in patients with MDR/RR-TB is correlated with various factors, including insufficient awareness of MDR/RR-TB [3], the occurrence and management of adverse reactions to anti-tuberculosis drugs, implementation of treatment guidelines [4], family economic status, and management of supervised medication administration. Compared with the treatment effect in patients with tuberculosis who are drug sensitive, the treatment effect in patients with MDR/RR-TB is much worse [5]. This may be because MDR/RR-TB requires a long treatment duration, which requires continuous treatment for 18 to 20 months [6], there are many kinds of therapeutic drugs, which are difficult to obtain [7,8], there is a high incidence of adverse reactions [9-11], and most families cannot afford drugs owing to the high cost of outpatient examination and hospitalization [9,10,12-14]. Fang et al investigated the adherence to tuberculosis treatment in Anhui Province [15] and identified several related factors, including marital status, annual income, medical personnel supervision, and patient knowledge about anti-tuberculosis treatment. However, they recruited the drug-sensitive tuberculosis population [15], whereas we selected patients with drug-resistant tuberculosis to describe the non-adherence to MDR/RR-TB treatment.

Although MDR/RR-TB has been included in the scope of the National Reimbursement for Major Diseases, there are still many drugs that are scarce, expensive, and cannot be reimbursed within the range of medical insurance, greatly reducing the treatment adherence of patients with MDR/RR-TB. The result is the spread and prevalence of MDR/RR-TB, which causes great harm to the society. Since 2016, one municipal medical institution was designated as an MDR/RR-TB hospital in each prefecture-level city and was made responsible for the diagnosis and inpatient and outpatient follow-up treatment of MDR/RR-TB in the city. Each city’s CDC tuberculosis control staff are responsible for the supervision and management of patients with MDR/RR-TB in their jurisdiction.

Therefore, this study aimed to investigate the factors associated with non-adherence for prescribed treatment in patients with MDR/RR-TB in Anhui Province, China.

Material and Methods

Study Participants

This study was conducted in Anhui Province from March 2020 to May 2021. As the eighth largest province in China, Anhui consists of 16 municipalities and 104 counties (districts) with a total population of more than 60 million (Figure 1). A stratified sampling method was used based on the geographical distribution of Anhui Province. The province was divided into 3 zones, namely southern, central, and northern, with enormous interzonal variation. Representative cities were selected by the per capita gross domestic product (GDP), and 25 patients with MDR/RR-TB were selected in each city by simple random sampling. A total of 8 municipalities (including Anqing, Tongling, Maanshan, Hefei, Huainan, Bengbu, Fuyang, and HuaiBei) were selected as study sites after considering the registration and management of MDR/RR-TB patients and the level of GDP per capita in each municipality. The survey was conducted on patients with MDR/RR-TB who registered...
chronologically at the designated hospitals for MDR/RR-TB in each municipality from January 1, 2017, onward. This survey ensured that no cases of death outcomes were included. This study recruited 201 patients and continued its investigations after the treatment period of the patients was over. The diagnosis of resistance in these patients was detected by the supervision of the treatment carried out.

Study Methods

A structured questionnaire was designed, and the in-depth interviews were conducted by trained investigators. All participants were interviewed face-to-face at the local designated hospital by using the self-designed survey tool, which included demographic and socio-economic information of the participants, MDR/RR-TB-related medical seeking behavior, history of unhealthy behaviors and disease, and the knowledge of MDR/RR-TB. Information related to patient treatment was entered into the China Tuberculosis Information Management System in accordance with the requirements of the China CDC. The structured questionnaire was designed based on the consultation of experienced doctors and extensive relevant literature review.

The rate of incorporation of patients with MDR/RR-TB into treatment and the rate of successful treatment were recorded as the relevant indicators in this study.

Relevant Definitions

Regular medication intake referred both to adhering to the doctor’s chemotherapy regimen, obeying the management of the supervisor, taking medication regularly for a long period of time, not changing the treatment plan at will, and stopping, changing, increasing, or decreasing medication according to prescription only during the treatment process.
Regular check-up was considered as adherence if the patients attended follow-up check-ups on schedule.

Interruption of therapy was defined as patients who interrupted their treatment for 2 consecutive months or more without the doctor’s permission during the period, or patients who did not follow primary care management and did not come to the hospital for 2 consecutive months or more to recheck and pick up their medication. Those patients who had discontinued but did not reach 2 months of treatment could not be defined as interruption of therapy.

Good adherence was defined as taking medicines regularly, doing check-ups on a regular basis, and having no interruption in the time of the survey. Patients who did not fulfill 1 of the above conditions over 2 months were judged to be non-adherent. The examination of sputum Mycobacterium tuberculosis, sputum smear examination, sputum culture turned negative, and computer tomography (CT) were applied to observe the improvement of the absorption of lung lesions.

Body mass index (BMI) was calculated by taking a person’s weight in kg divided by their height in m², or BMI=kg/m² [16]. In this study, a BMI less than 18.4 was defined as underweight and above 24.0 was considered obese. A BMI in the range of 18.5 to 23.9 was considered normal.

Data Analysis

The data was captured using Epidata 3.1 and exported to SPSS 23.0 (IBM Corp, Armonk, NY, USA) for statistical analysis. Quantitative data was described by $\bar{x} \pm $standard deviation, and qualitative data was expressed as rates or percentages. The chi-square test was used to analyze the association of each variable with adherence to MDR/RR-TB treatment. A binary-logistic regression model was used to further assess the impact of variables on adherence. The odds ratio (OR) with 95% confidence interval (CI) was used to measure the magnitude of association. A P value of <0.05 was considered statistically significant.

Results

General Information

A total of 201 patients were recruited during the study period. The male to female ratio was 2.9:1. The age of the respondents ranged from 34 to 67 years, with a mean age of 50.5±16.4 years. The mean height of the patients was 169±7.0 cm, and the mean weight was 60.8±10.7 kg. Concerning patients’ work, 22.7% were working on farms, 21.1% were unemployed, 18.0% were migrant workers. Almost all patients (97.5%) had health insurance. The percentage of respondents who lived in urban areas was 45.8%, while 37.8% lived in the countryside. Nearly 60% of the patients had 2 to 3 family members.

Knowledge of MDR/RR-TB

Patients who knew all of the 9 items about MDR/RR-TB on the survey were defined as having a good mastery and high rate knowledge; not knowing all answers was regarded as a low awareness rate. The questions in Table 1 were open and multi-selective, not dichotomous choices. Consequently, the percentage of those who knew all of the 9 items about MDR/RR-TB was 16.9%. The awareness rate of MDR/RR for each article is shown in Table 1.

Status of Treatment

A total of 72.6% of the patients had good treatment compliance; 90.5% had received anti-tuberculous treatment more than once. The total cost of this MDR/RR-TB hospitalization was a minimum of $154.7 USD and a maximum of $27 846, with a

| Table 1. Patient awareness of multidrug-resistant tuberculosis and rifampicin-resistant tuberculosis. |
|-------------------------------------------------------------|
| **Awareness rate (%)**                                      |
| Could MDR/RR-TB be cured?                                  | 76.0 |
| Is MDR/RR-TB more severe and difficult to cure than ordinary tuberculosis? | 92.5 |
| If MDR/RR-TB infects others, will they also become MDR/RR-TB once they fall ill? | 64.8 |
| Do the drugs to treat MDR/RR-TB have any adverse effects on humans? | 79.4 |
| Can I reduce the dose or type of medication at will?        | 89.0 |
| Can I stop treatment when I feel that my symptoms have subsided? | 82.2 |
| Should I stop smoking and drinking if I have MDR/RR-TB?     | 94.5 |
| Is MDR/RR-TB hereditary?                                   | 92.0 |
| Which institution should I go to for medical service of MDR/RR-TB? | 59.0 |
Table 2. Univariate analysis of the risk factors for non-adherence to multidrug-resistant tuberculosis and rifampicin-resistant tuberculosis treatment.

| Variables                 | Adherence (number [composition ratio %]) | Non-adherence | $\chi^2$ | $P$ value |
|---------------------------|-------------------------------------------|---------------|----------|-----------|
| **Sex**                   |                                           |               |          |           |
| Male                      | 108 (72.5)                                | 41 (27.5)     | 0.007    | 0.934     |
| Female                    | 38 (73.1)                                 | 14 (26.9)     |          |           |
| **Age**                   |                                           |               |          |           |
| 15-39                     | 40 (72.7)                                 | 15 (27.3)     | 0.004    | 0.998     |
| 40-59                     | 63 (72.4)                                 | 24 (27.6)     |          |           |
| 60 or above               | 43 (72.9)                                 | 16 (27.1)     |          |           |
| **Region**                |                                           |               |          |           |
| South of Anhui            | 55 (71.4)                                 | 22 (28.6)     | 2.357    | 0.308     |
| Center of Anhui           | 28 (65.1)                                 | 15 (34.9)     |          |           |
| North of Anhui            | 63 (77.8)                                 | 18 (22.2)     |          |           |
| **Body mass index**       |                                           |               | 4.693    | 0.096     |
| Underweight               | 23 (60.5)                                 | 15 (39.5)     |          |           |
| Normal                    | 97 (77.6)                                 | 28 (22.4)     |          |           |
| Obese                     | 26 (68.4)                                 | 12 (31.6)     |          |           |
| **Marital status**        |                                           |               | 4.984    | 0.083     |
| Unmarried                 | 24 (88.9)                                 | 3 (11.1)      |          |           |
| Married                   | 103 (71.5)                                | 41 (28.5)     |          |           |
| Divorced or widowed       | 19 (63.3)                                 | 11 (36.7)     |          |           |
| **Education level**       |                                           |               | 12.898   | 0.002     |
| Primary and below         | 34 (57.6)                                 | 25 (42.4)     |          |           |
| Middle and high           | 86 (75.4)                                 | 28 (24.6)     |          |           |
| Junior college and above  | 26 (92.9)                                 | 2 (7.1)       |          |           |
| **Place of residence**    |                                           |               | 11.220   | 0.004     |
| City                      | 77 (83.7)                                 | 15 (16.3)     |          |           |
| County                    | 19 (57.6)                                 | 14 (42.4)     |          |           |
| Countryside               | 50 (65.8)                                 | 26 (34.2)     |          |           |
| **Monthly household income (USD)** |                             |               | 18.401   | <0.001    |
| 316 and below             | 43 (55.8)                                 | 34 (44.2)     |          |           |
| 316-790                   | 67 (80.7)                                 | 16 (19.3)     |          |           |
| Over 790                  | 36 (87.8)                                 | 5 (12.2)      |          |           |
| **Whether to borrow**     |                                           |               | 2.158    | 0.142     |
| Yes                       | 45 (66.2)                                 | 23 (33.8)     |          |           |
| No                        | 101 (75.9)                                | 32 (24.1)     |          |           |

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Table 2 continued. Univariate analysis of the risk factors for non-adherence to multidrug-resistant tuberculosis and rifampicin-resistant tuberculosis treatment.

| Variables                        | Adherence (number [composition ratio%]) | Non-adherence | $\chi^2$ | P value |
|----------------------------------|-----------------------------------------|---------------|----------|---------|
|                                  | Adherence                               | Non-adherence |          |         |
| Poor family                      |                                          |               | 1.283    | 0.257   |
| Yes                              | 29 (65.9)                               | 15 (34.1)     |          |         |
| No                               | 117 (74.5)                              | 40 (25.5)     |          |         |
| History of smoking              |                                          |               | 0.001    | 0.972   |
| Yes                              | 58 (72.5)                               | 22 (27.5)     |          |         |
| No                               | 88 (72.7)                               | 33 (27.3)     |          |         |
| History of drinking             |                                          |               | 0.583    | 0.445   |
| Yes                              | 48 (76.2)                               | 15 (23.8)     |          |         |
| No                               | 98 (71.0)                               | 40 (29.0)     |          |         |
| Diabetes                         |                                          |               | 1.968    | 0.161   |
| Yes                              | 20 (62.5)                               | 12 (37.5)     |          |         |
| No                               | 126 (74.6)                              | 43 (25.4)     |          |         |
| Other chronic diseases           |                                          |               | 7.174    | 0.007   |
| Yes                              | 29 (58.0)                               | 21 (42.0)     |          |         |
| No                               | 117 (77.5)                              | 34 (22.5)     |          |         |
| Awareness ratio                  |                                          |               | 0.945    | 0.331   |
| Good                             | 27 (79.4)                               | 7 (20.6)      |          |         |
| Not good                         | 119 (71.3)                              | 48 (28.7)     |          |         |
| Adverse reactions                |                                          |               | 1.710    | 0.191   |
| Yes                              | 89 (69.5)                               | 39 (30.5)     |          |         |
| No                               | 57 (78.1)                               | 16 (21.9)     |          |         |
| Medication discontinuation       |                                          |               | 80.089   | <0.001  |
| Yes                              | 13 (25.0)                               | 39 (75.0)     |          |         |
| No                               | 133 (89.3)                              | 16 (10.7)     |          |         |
| Frequency of anti-tuberculosis treatments |                      |               | 18.049   | <0.001  |
| 0                                | 17 (89.5)                               | 2 (10.5)      |          |         |
| 1                                | 58 (87.9)                               | 8 (12.1)      |          |         |
| 2                                | 33 (61.1)                               | 21 (38.9)     |          |         |
| Over 2                           | 38 (61.3)                               | 24 (38.7)     |          |         |
median of $1574. Of the adverse reactions that occurred in 63.7% of patients with MDR/RR-TB, most were gastrointestinal reactions. Of the patients who experienced adverse reactions, 67.8% were given efficient treatment.

### Analysis of Treatment Adherence and Its Influencing Factors

Adherence was compared among different subgroups using the chi-square test. It was found that education level, place of residence, household monthly income, presence of other chronic diseases, discontinuation of medication, and the frequency of anti-tuberculosis treatments were factors influencing adherence of patients with MDR/RR-TB (Table 2).

The variables with significant differences in Table 2 were extracted and the ORs and 95% CIs were calculated separately for them (Table 3).

Binary-logistic regression analysis revealed that drug discontinuation was a barrier to adherence to MDR/RR-TB treatment (Table 4).

### Discussion

Providing efficient treatment is a key step in stopping the spread of MDR/RR-TB. However, treatment that lasts for 18 to 20 months makes it difficult for patients to maintain adherence. In our study, 72.6% of the patients adhered to the MDR/RR-TB treatment. A previous report defined adherence and the differences in the way drug-sensitive and drug-resistant tuberculosis patients are managed in registries, treatment cycles and methods, and national policies; poor adherence was defined as a missed dose of medication [15]. The study revealed that factors such as marital status, annual income, tuberculosis knowledge, and medical staff visits affect drug-sensitive patients [15]. However, our study showed that low education level, place of residence, poor financial conditions, presence of other chronic diseases, discontinuation of medication, and frequency of anti-tuberculosis treatments were major influential factors of adherence to MDR/RR-TB treatment. Therefore, there are differences in the study population and

### Table 3. Univariate analysis of influencing factors for multidrug-resistant tuberculosis and rifampicin-resistant tuberculosis non-adherence and odds ratio value with 95% CI of each variable.

| Variables                        | Odds ratio | 95% confidence interval |
|----------------------------------|------------|-------------------------|
| Other chronic diseases           |            |                         |
| Yes                              | 0.401      | 0.203-0.791             |
| No                               |            |                         |
| Medication discontinued          |            |                         |
| Yes                              |            |                         |
| No                               | 0.040      | 0.018-0.091             |
| Education level                  |            |                         |
| Primary and below                | 1.0        |                         |
| Middle and high                  | 0.443      | 0.227-0.865             |
| Junior college and above         | 0.105      | 0.023-0.482             |
| Place of residence               |            |                         |
| City                             |            |                         |
| County                           | 3.782      | 1.562-9.161             |
| Countryside                      | 2.669      | 1.288-5.530             |
| Monthly household income (USD)   |            |                         |
| 316 and below                    | 1.0        |                         |
| 316-790                          | 0.302      | 0.149-0.612             |
| Over 790                         | 0.176      | 0.062-0.496             |
| Frequency of anti-TB treatments  |            |                         |
| 0                                | 1.0        |                         |
| 1                                | 1.172      | 0.227-6.050             |
| 2                                | 5.409      | 1.132-25.844            |
| Over 2                           | 5.368      | 1.137-25.337            |

### Table 4. Multi-factor logistic regression analysis of factors affecting patients’ adherence to multidrug-resistant tuberculosis and rifampicin-resistant tuberculosis treatment.

| Variables            | \( \beta \) | Wald \( \chi^2 \) | \( P \) | \( \text{Exp} (B) \) | 95.0% CI lower | 95.0% CI upper |
|----------------------|-------------|-----------------|--------|-----------------|---------------|--------------|
| Constant             | 3.435       | 6.267           | 0.012  |                 |               |              |
| Drug discontinuation |             |                 |        |                 |               |              |
| Yes                  | -3.127      | 44.690          | 0.001  | 0.040           | 0.016         | 0.103        |
Findings between the 2 studies. Prior to the standardization of MDR/RR-TB treatment, many patients experienced more than 1 anti-tuberculosis treatment or non-standardized treatment with a failed outcome, possibly because drug sensitivity testing was not performed. These were the main factors found to influence treatment adherence in the results of the univariate analysis of the present study and were partially comparable to the results of similar studies [3,4,7,9-14,17-22]. Due to the low literacy rate, this segment of patients might have a relatively insufficient understanding of physicians’ advice and knowledge of tuberculosis prevention and control; therefore, they might not have a good grasp of the hazards of drug-resistant tuberculosis and the importance of standardized treatment during the consultation. MDR/RR-TB treatment regimens in this study included at least 4 effective anti-tuberculosis drugs, the costs of medication were relatively high, and there were some items not covered by health insurance. The 2-year-long treatment cycle imposed a heavy financial burden on patients. It was therefore difficult for patients who were living in a low-income family to afford the whole cycle of treatment. In 2020, the average annual salary of employed persons in urban private units in Anhui Province was $8134 USD, and salaries in rural areas were significantly lower than this. For some unemployed patients, it caused a greater financial burden. Patients with drug-resistant pulmonary tuberculosis were included in the reimbursement of chronic and special disease medical insurance. The proportion of inpatient treatment reimbursement was relatively high, and the proportion of outpatient treatment reimbursement was not high, and therefore, the economic burden of patients was great. As reported in other study, financial hardship was a major factor affecting treatment adherence in patients with MDR/RR [9,10,12-15]. In the province’s 16 cities, each city had only 1 designated hospital for MDR/RR-TB, usually a municipal general hospital; therefore, it was more challenging for patients with MDR/RR-TB living in counties and rural areas to find medical services than for those living in cities. Consequently, this was 1 possible reason accounting for non-adherence. Patients with comorbidity of other chronic diseases, discontinuation of medication during treatment, and a high frequency of previous anti-tuberculosis treatments were in poor general health, and the state of their diseases were more complex. Thus, they were more prone to be affected by other factors. Compared with the patients with drug-resistant tuberculosis alone who were in anti-tuberculosis treatment for the first time, the above-mentioned patients could obviously not totally adhere to the treatment.

Drug discontinuation is a significant factor affecting adherence, and it is necessary to urge patients to adhere to the course of medication. Drug discontinuation means interruption of treatment, which promotes the growth and reproduction of drug-resistant tuberculosis bacteria. Notably, the impact of drug discontinuation on patient adherence was extremely significant and easily contributed to the prevalence of drug-resistant bacteria.

Considering the above factors affecting treatment adherence of patients with MDR/RR-TB, the following approaches have been considered to enhance treatment adherence and control the drug-resistant tuberculosis epidemic.

Firstly, greater importance should be given to the advocacy of tuberculosis-related knowledge [3,12,15,17,19]. While guiding patients, physicians should emphasize the dangers of MDR/RR-TB and the possible consequences of unregulated treatments. Supervising administrators should highlight the infectiousness of drug-resistant tuberculosis during household follow-up visits and supervision of medication administration. Patients should be proactively informed about how to protect their family members from being infected. At the same time, care should be given to the physical and mental health of patients, and adverse reactions occurring during taking anti-tuberculosis drugs should be recorded. Once adverse events happen, timely treatment at the designated hospital should be provided to prevent adverse consequences. For patients who have had multiple anti-tuberculosis treatments, it is even more essential to strengthen communication interventions and psychological counseling, as necessary. As for patients with low literacy, more attention to tailoring methods and approaches for this population is important. Patient mastery of relevant knowledge should be assessed, and for patients who do not master it well, the information must be promoted, emphasized, and communicated several times. Tools such as brochures should be made and distributed in an easy-to-understand way using drawings, flow charts, and slogans for different types of target groups, with concise and easy-to-remember content.

Secondly, efforts to minimize the financial burden of patient treatment by taking advantage of the central financial tuberculosis program, financial subsidies, and related expenditure reductions were provided to drug-resistant patients. Applying to the finance department for more investment and to the health insurance department for further increase in reimbursement ratio and increasing the types of anti-tuberculosis drugs covered by medical insurance reimbursement would be urgently required to improve adherence. Government investment and policy protection were the crucial points to promoting tuberculosis prevention and control [1,13,23,24]. Through multisectoral means, we could expand the free packages to reduce the financial burden for the poor, such as writing off the costs of transport and supplementary nutrition involved in treatment. All of the above might facilitate regular treatment, improve patient adherence, and increase the cure rate.

Thirdly, the strengthening of adverse drug reaction monitoring cannot be ignored. There are various kinds of anti-tuberculosis
drugs that have a high incidence of adverse reactions. The adverse effects were not a risk factor affecting adherence in this study; however, many studies have reported that patients had an interruption of therapy due to adverse effects [9-11,18]. Clinicians and supervisory administrators should strengthen patient awareness of the timely detection of adverse drug reactions, have patients sign a written informed consent for anti-tuberculosis treatment before drug administration, and inform patients in detail of the types of possible adverse reactions that might occur and the clinical manifestations and symptoms. When an adverse reaction occurs, patients must communicate with their doctors as soon as possible. Regular review was also a means of detecting adverse drug reactions. Adverse effects might be mitigated by changes in the way medication is taken; for example, reducing gastrointestinal reactions might be achieved by gradually increasing the dose and adjusting the time of medication or by taking it with juice, yogurt, and other beverages. If the effects are not relieved or serious adverse reactions occur and the patient could not tolerate them, the treatment regimen should be adjusted; however, the principle of drug combination might not be changed. It is of primary importance to ensure early, regular, whole-course, appropriate, and combined drug use.

Generally, MDR/RR-TB is characterized by a long treatment cycle, high cost, and a high rate of adverse events. The adherence of participants in the present study was affected by a range of factors. In the course of routine tuberculosis control, we must enhance awareness of prevention and control and take various measures to decrease non-adherence according to the above-mentioned factors and improve the cure rate to control the tuberculosis epidemic.

This study had some limitations. Firstly, the information collected on the questionnaire was mainly obtained from patients’ subjective recall; therefore, recall bias was inevitable. Secondly, the sample size was relatively small, which may weaken the robustness of the conclusions.

Conclusions

The findings of this study indicated that 27.4% of the participants did not adhere to MDR/RR-TB therapy. The influencing factors for non-adherence include education level, place of residence, monthly household income, presence of other chronic diseases, drug discontinuation, and multiple anti-tuberculosis treatments.

Declaration of Figures’ Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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