

# A Cross-Sectional Study on Awareness of Tuberculosis Control Among Post-Treatment Tuberculosis Patients in a City in China

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**Purpose:** This study aimed to investigate awareness of tuberculosis control among post-treatment tuberculosis patients, in order to provide a basis for future preventive and control work in this population.

**Patients and Methods:** A cross-sectional descriptive study was conducted on post-treatment patients with tuberculosis in seven districts of Jinan City between July 2021 and December 2022. A face-to-face or telephone interviews using structured questionnaires for the research subjects were conducted by data collectors. Analyses were carried out first for all subjects, and then separately for male and female subjects.

**Results:** A total of 837 valid questionnaires were collected, of which 495 were males and 342 were females. The awareness rate of the core TB knowledge was 82.46%. The  $\geq 65$  year group in the total group (OR=0.43, 95% CI: (0.28, 0.68)), male (OR=0.47, 95% CI: (0.27, 0.83)) and female group (OR=0.40, 95% CI: (0.19, 0.86)) was lower than that of the control group. Educational level and monthly income are the main factors of TB cognition in total group. People with university or higher education (OR=2.05, 95% CI: (1.38, 3.05)) and with a monthly income of  $\geq 6,000$  (OR=1.89, 95% CI: (1.10, 3.25)) had a higher awareness rate. The group with current residence in the city was more aware than the reference group.

**Conclusion:** In the future, the communication of the main transmission route, suspicious symptoms, and cure of TB needs to be strengthened for the post-treatment TB patients. The elderly, those with secondary school education or below, agricultural workers and low-income people are the groups with weak knowledge of TB, and they are also the groups that need to be focused on health education. The above information should be focused on the above groups of people in order to educate them in a way that is easily acceptable to them.

**Keywords:** pulmonary tuberculosis, awareness rate, completed treatment patients, layered analysis

## Introduction

The Global Tuberculosis Report issued by the World Health Organization (WHO) in 2022<sup>1</sup> showed approximately 10.6 million new cases of tuberculosis worldwide in 2021, including 6.0 million adult males, 3.4 million adult females, and 1.2 million children. Of these, thirty countries with a high-burden TB countries account for 87% of all estimated cases globally. China has the third highest TB burden worldwide with 780,000 estimated TB cases in 2021, accounting for 7.36% of the global. It shows that tuberculosis remains a major infectious disease that seriously endangers public health in China.

In 2014 and 2015, all Member States of WHO and the United Nations (UN) committed to ending the TB epidemic, through their adoption of WHO's End TB Strategy and the UN Sustainable Development Goals (SDGs), a key component of which is

comprehensive patient-centred care and prevention. Previous studies have shown that knowledge of the core knowledge of TB prevention and treatment has a positive impact on the treatment outcome of TB patients,<sup>2</sup> and improving the level of knowledge of the core knowledge of TB prevention and treatment can effectively avoid the occurrence of delayed diagnosis, thus achieving early detection of active TB patients, and targeting the prevention and treatment of TB. Numerous studies have been conducted on the awareness of core knowledge about TB prevention and control in patients with tuberculosis in treatment,<sup>3–5</sup> but few studies have been conducted on patients with tuberculosis who have completed treatment. People with TB who have completed treatment may develop TB again,<sup>6</sup> and the proportion of drug-resistant TB once they have developed TB again is higher than in the new-onset patients.<sup>7</sup> Eighteen percent of patients with relapsed TB are Rifampicin-resistant TB patients, compared with 3.6% of patients with initial treatment.<sup>1</sup> Especially that the multi-drug resistant pulmonary tuberculosis had a long infectious period, had a big difficulty of treatment, and the cure rate was low, the mortality was high. However, despite extensive research on TB awareness during treatment, post-treatment awareness remains under explored, particularly in high-burden countries like China. Therefore, we conducted this study, to investigate the awareness of core information about tuberculosis among post-treatment tuberculosis patients in order to provide a basis for future prevention and control.

## Materials and Methods

### Study Design and Participants

This cross-sectional survey was designed to assess awareness of tuberculosis control and current health status of TB patients who have completed treatment. Whole population sampling was used in this study. A whole group of patients with active TB who were registered and managed in seven districts of Jinan City during the period from 1 July 2021 to 31 December 2022 were included in the study, and those who were over 18 years of age, mentally normal, able to communicate normally with the investigator and gave informed consent were included in the study as subjects. The investigators were from the district CDCs, they were trained on the purposes of this study and contents of the questionnaire. They conducted face-to-face or telephone interviews using structured questionnaires for the research subjects and entered the questionnaires into the online intelligent questionnaire survey system. During the data collection process, the researchers conducted rigorous monitoring to prevent selection bias.

Questionnaire A pre-survey of 50 people was conducted before the start of the survey to, and obtained the Cronbach's alpha coefficient of 0.817, indicating that the questionnaire had good reliability. The questionnaire consisted of two parts: In the first part, the general information of the subjects (gender, date of birth, education level, current residence, occupation, monthly income) and their current state of health were collected; in the second part of the questionnaire assessed their knowledge of core information about TB prevention and control. It included five items on "the main transmission route of TB", "common suspicious symptoms of TB", "what to do if TB is suspected", "Which hospitals offer discounted treatments and tests", and "whether TB can be cured". Each item is awarded 1 point for correct answers, 0 points for incorrect answers, and 5 points out of 5. The awareness rate of a single item (%) = the number of people who answered a given item correctly/the number of people surveyed  $\times$  100%; the awareness rate of core knowledge (%) = [the sum of correctly answered core knowledge items/(number of people surveyed  $\times$  5)]  $\times$  100%; and the overall core knowledge awareness rate (%) = [the sum of passing grades with awareness of core knowledge/(number of people surveyed  $\times$  5)]  $\times$  100%. Those who correctly answer more than 80% of the items, that is, those who score  $\geq 4$  points, were considered aware of TB.

Statistical Analysis All statistical analyses were performed using SPSS version 26. Descriptive analyses used the mean, standard deviation (SD), median, interquartile range (IQR) for continuous variables and percentages for categorical data. The study participants were stratified into two groups based on knowledge score, the aware of TB group and unaware of TB group. Univariate logistic regression was used to analyze the influencing factors, with a test level of  $\alpha = 0.05$ . Analyses were carried out first for all subjects, and then separately for male and female subjects. Graphs were plotted using SPSS version 26.

## Results

### Basic Information of the Participants

Initially, a total of 837 valid questionnaires were collected. The age range of the participants was 18–93 years with a median and interquartile range of 43 (32, 61) years old. More than a third (39.8%) of the participants (34.9% of the

males and 46.7% of the females) were educated up to university or higher, more than 40% (39.2% of the males and 46.8% of the females) were domestic or non-employed, the vast majority (93%) lived in urban areas, and more than a third (33.5% of the males and 36.5% of the females) had a monthly income of between 4,000 and 5,999 RMB (Table 1).

## Awareness of Core Knowledge About Tuberculosis

Among the 837 TB patients who had completed treatment, the awareness rate of the core knowledge about TB was 82.46%, and of the five individual knowledge items, the awareness rate of “The main transmission route of TB” was the lowest at 74.43%, and the awareness rate of “In which hospital to get a discount on treatment” was the highest at 89.37% (Table 2).

The 837 participants were divided into two groups based on their total knowledge score (scaled from 0 to 5), with a score of 4 or greater indicating awareness of TB and a score of less than 4 indicating unawareness of TB. For all groups (total, male and female), the group aged  $\geq 65$  years was less aware than the reference group. For the total and male groups, the group with university or higher education was more aware than the reference group. For the total and female groups, the group with a monthly income of  $\geq 6000$  was more aware than the reference group. For the total group, the group with current residence in the urban was more aware than the reference group. For the female group only, the group with a monthly income of 4,000–5,999 was more aware than the reference group, and the group with high school/middle school education was more aware than the reference group. (Table 3 and Figure 1).

**Table 1** Characteristics of 837 Tuberculosis Patients Who Had Completed Treatment

Characteristics	Male, N=495 (%)	Female, N=342 (%)	All, N=837
Age group			
15–35 year	157 (31.7)	135 (39.5)	292 (34.9)
36–55 year	140 (28.3)	119 (34.8)	259 (30.9)
56–65 year	90 (18.2)	37 (10.8)	127 (15.2)
$\geq 65$ year	108 (21.8)	51 (14.9)	159 (19.0)
Educational level			
Junior High School or lower	159 (32.1)	90 (24.3)	249 (29.8)
High School/Middle School	163 (32.9)	92 (26.9)	255 (30.5)
University level or higher	173 (34.9)	160 (46.7)	333 (39.8)
Occupation			
Domestic and unemployed	194 (39.2)	160 (46.8)	354 (42.3)
Farmers	79 (16.0)	36 (10.5)	115 (13.7)
Workers	69 (13.9)	42 (12.3)	111 (13.3)
Managers and employees	57 (11.5)	41 (12.0)	98 (11.7)
Pensioners	60 (12.1)	27 (7.9)	87 (10.4)
Others	36 (7.2)	36 (10.5)	72 (8.6)
Current Residence			
Urban	456 (92.1)	322 (94.2)	778 (93.0)
Rural area	39 (7.9)	20 (5.8)	59 (7.0)
Monthly Income (RMB)			
Less than 2000	108 (21.8)	74 (21.6)	182 (21.7)
2000–3999	116 (23.4)	91 (26.6)	207 (24.7)
4000–5999	166 (33.5)	125 (36.5)	291 (34.8)
More than 6000	105 (21.2)	52 (15.2)	157 (18.8)

**Table 2** Awareness of the Core Knowledge Among 837 Tuberculosis Patients Who Had Completed Treatment

Items	Male			Female			All			$\chi^2$	P value
	Correct Responses	Incorrect Responses	Correctness Rate (%)	Correct Responses	Incorrect Responses	Correctness Rate (%)	Correct Responses	Incorrect Responses	Correctness rate (%)		
The main transmission route of TB	368	127	74.3	255	87	74.6	623	214	74.43	0.01	0.94
Common suspected symptoms of TB	404	91	81.6	297	45	86.8	701	136	83.75	4.06	0.04
What to do if you suspect TB	423	72	85.5	307	35	89.8	730	107	87.22	3.37	0.7
Which hospitals offer discounted treatments and tests	436	59	88.1	312	30	91.2	748	89	89.37	2.11	0.15
Whether TB can be cured with regular treatment	378	117	76.4	271	71	79.2	649	188	77.54	0.96	0.32
General core knowledge	2009	466	81.7	1442	268	84.3	3451	734	82.46	6.06	0.30

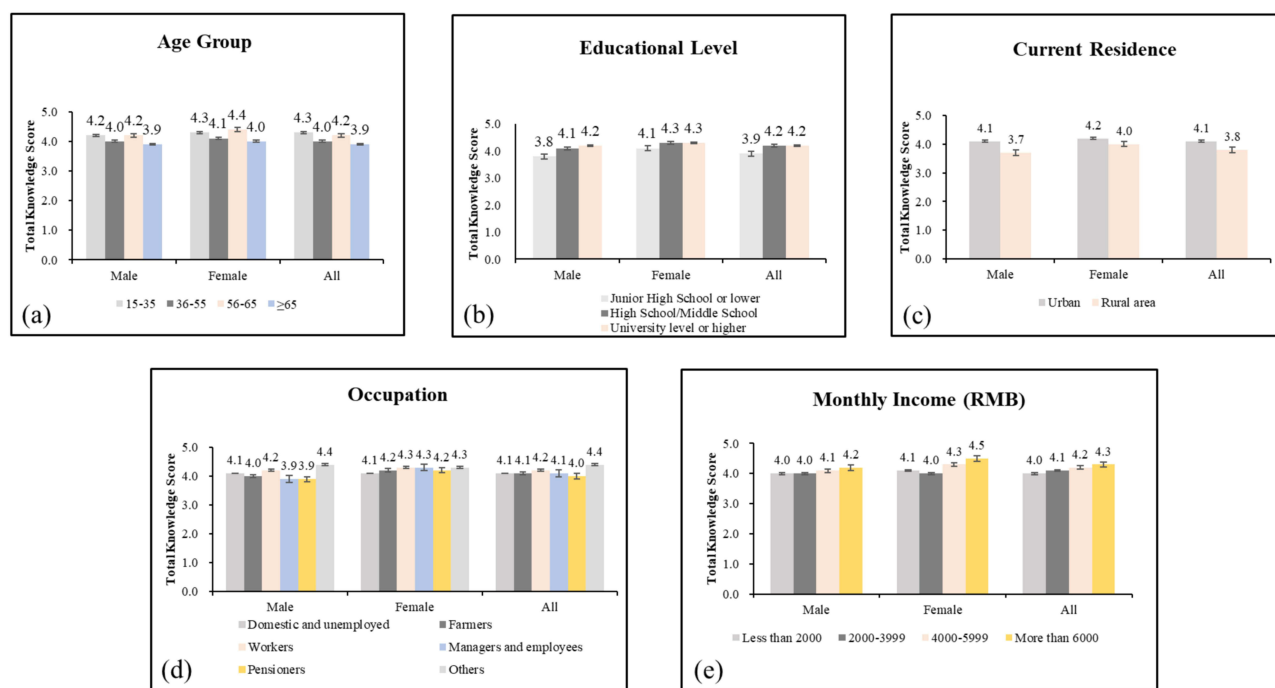
**Table 3** Univariate Binary Logistic Regression Analysis of Awareness of TB Among 837 Tuberculosis Patients Who Had Completed Treatment

ALL, N=837					
Variables	Awareness of TB			OR (95% CI)	P value
	Unawareness	Awareness	Awareness rate (%)		
Age group					
15–35 year	52	240	82.2	Reference	
36–55 year	57	202	78.0	0.77(0.51,1.17)	0.218
56–65 year	22	105	82.7	1.03(0.60–1.79)	0.905
≥65 year	53	106	66.7	0.43(0.28,0.68)	<0.001
Educational level					
Junior High School or lower	73	176	70.7	Reference	
High School/Middle School	55	200	78.4	1.51(1.01,2.26)	0.046
University level or higher	56	277	83.2	2.05(1.38,3.05)	<0.001
Occupation					
Domestic and unemployed	27	88	76.5	Reference	
Farmers	75	279	78.8	1.14(0.69,1.88)	0.605
Workers	18	93	83.8	1.59(0.81,3.01)	0.174
Managers and employees	23	75	76.5	1.00(0.53,1.39)	0.999
Pensioners	29	58	66.7	0.61(0.33,1.14)	0.123
Others	12	60	83.3	1.53(0.72,3.26)	0.267
Current Residence					
Rural area	20	39	66.1	Reference	
Urban	164	614	78.9	1.92(1.09,3.38)	0.024
Monthly Income (RMB)					
Less than 2000	48	134	73.63	Reference	
2000–3999	55	152	73.43	0.99(0.63,1.55)	0.965
4000–5999	56	235	80.76	1.50(0.97,2.33)	0.069
More than 6000	25	132	84.08	1.89(1.10,3.25)	0.021
MALE, N=495					
Variables	Awareness of TB			OR (95% CI)	P值
	Unawareness	Awareness	Awareness rate (%)		
Age group					
15–35 year	31	162	80.3	Reference	
36–55 year	36	104	74.3	0.71(0.41,1.23)	0.220
56–65 year	16	74	82.2	1.14(0.58,2.22)	0.705
≥65 year	37	71	65.7	0.47(0.27,0.83)	0.008
Educational level					
Junior High School or lower	49	110	69.2	Reference	
High School/Middle School	42	121	74.2	1.28(0.79,2.09)	0.315
University level or higher	29	144	83.2	2.21(1.31,3.73)	0.003

(Continued)

Table 3 (Continued).

Occupation					
Domestic and unemployed	20	59	74.7	Reference	
Farmers	42	152	78.4	1.23(0.67,2.26)	0.512
Workers	12	57	82.6	1.61(0.72,3.59)	0.245
Managers and employees	19	38	66.7	0.68(0.32,1.43)	0.309
Pensioners	22	38	63.3	0.59(0.28,1.22)	0.151
Others	5	31	86.1	2.10(0.72,6.14)	0.175
Current Residence					
Rural area	13	26	66.7	Reference	
Urban	107	349	76.5	1.63(0.81,3.28)	0.171
Monthly Income (RMB)					
Less than 2000	28	80	74.1	Reference	
2000–3999	30	86	74.1	1.00(0.55,1.83)	0.991
4000–5999	39	127	76.5	1.14(0.65,2.00)	0.647
More than 6000	23	82	78.1	1.25(0.66,2.35)	0.492
FEMALE, N=342					
Variables	Awareness of TB			OR (95% CI)	P值
	Unawareness	Awareness	Awareness rate (%)		
Age group					
15–35 year	21	114	84.4	Reference	
36–55 year	21	98	82.4	0.86(0.44,1.67)	0.655
56–65 year	6	31	83.8	0.95(0.35,2.56)	0.922
≥65 year	16	35	68.6	0.40(0.19,0.86)	0.018
Educational level					
Junior High School or lower	24	66	73.3	Reference	
High School/Middle School	13	79	85.9	2.21(1.04,4.68)	0.038
University level or higher	27	133	83.1	1.79(0.96,3.34)	0.067
Occupation					
Domestic and unemployed	7	29	80.6	Reference	
Farmers	33	127	79.4	0.93(0.37,2.31)	0.874
Workers	6	36	85.7	1.45(0.44,4.79)	0.544
Managers and employees	4	37	90.2	2.23(0.60,8.37)	0.233
Pensioners	7	20	74.1	0.69(0.21,2.28)	0.541
Others	7	29	80.6	1.00(0.31,3.21)	1.00
Current Residence					
Rural area	7	13	65.0%	Reference	
Urban	57	265	82.3%	2.50(0.96,6.55)	0.062
Monthly Income (RMB)					
Less than 2000	20	54	73.0%	Reference	
2000–3999	25	66	72.5%	0.98(0.49,1.95)	0.949
4000–5999	17	108	86.4%	2.35(1.14,4.86)	0.021
More than 6000	2	50	96.2%	9.26(2.06,41.65)	0.004



**Figure 1** A bar graph depicting the awareness scores of TB among 837 tuberculosis patients who had completed treatment divided according to (a) age group, (b) educational level, (c) current residence, (d) occupation and (e) monthly income.

## Discussion

Tuberculosis is a chronic infectious disease that seriously endangers public health, and in 2014, the World Health Organization proposed the “End TB Strategy (2016–2035)”,<sup>8</sup> with the goal of reducing TB 95% TB deaths and 90% TB cases between 2015 and 2035. In order to achieve this goal, early detection of TB patients is important. Previous studies have shown that the detection of tuberculosis patients in China mainly relies on the passive detection method of symptomatic treatment, which suggests us the public need more knowledge of tuberculosis that they can voluntarily go to the designated tuberculosis hospital when they have suspicious symptoms. This strategy relies on the assumption that the population is aware that a persistent cough or contact with a TB patient is an indication to seek formal health care.

The results of this study showed that the awareness rate of core tuberculosis prevention and treatment information of post-treatment tuberculosis patients in Jinan was 82.46%, which was lower than Beijing in 2021 (87.53%) and higher than 2023 in Beijing (70.42%) before starting treatment of pulmonary tuberculosis patients with positive pathogens.<sup>3</sup> The results suggest that patients who have been suspected of TB may have a better understanding of tuberculosis-related knowledge in order to seek diagnosis and treatment, so their core knowledge awareness rate is higher.

Further analysis of the single knowledge of the five core information shows that the awareness of “what to do if TB is suspected” and “where to go for screening and treatment to benefit from preferential reduction and exemption policies” exceeded the target of 85% required by the National Health Commission,<sup>9</sup> which is considered to be related to the fact that this population has received anti-tuberculosis treatment in designated tuberculosis hospitals and has enjoyed relevant preferential reduction and exemption policies. The knowledge of “the main transmission route of pulmonary tuberculosis”, “common suspicious symptoms of TB” and “whether TB can be cured” did not reach 85%, and the above three pieces of information were closely related to the detection and treatment management of pulmonary tuberculosis patients. While only 50.65% of patients knew these three pieces of information. These results suggest that even after a course of anti-TB therapy, the participant’s knowledge of the core information about tuberculosis transmission routes, suspicious symptoms of tuberculosis, and whether tuberculosis can be cured is still unsatisfactory, and lack of knowledge can easily lead to delay in related attitudes and behaviors.<sup>10</sup> If a person with active tuberculosis is unaware that tuberculosis is transmitted through the respiratory tract, would easily lead to the spread of tuberculosis. Coughing, sneezing, or talking



loudly without wearing a mask could cause mycobacterium tuberculosis to spread into the surrounding air and infect healthy people. If a person with tuberculosis does not know the general symptoms of tuberculosis and does not seek medical attention when symptoms appear, it would lead to the spread of tuberculosis. This phenomenon has brought great challenges to the prevention and treatment work. If a person with tuberculosis does not know whether it can be cured with regular treatment, he or she could not build confidence in the success of treatment. The patient's compliance with treatment will also be reduced, and irregular treatment can easily lead to treatment failure and drug resistance.<sup>11</sup>

About the qualification of tuberculosis prevention and treatment information among tuberculosis patients, the univariate analysis showed that there were no significant differences in different genders, age groups, ethnicities, occupations, and chronic diseases ( $P \geq 0.05$ ), while there were statistically significant differences between different education levels, current residence types, and monthly income levels, which were consistent with the results of other studies.<sup>12,13</sup> The  $\geq 65$  age group had lower total knowledge awareness rates in the total population, males, and females than the control group. With the increase of age, the awareness rate tends to decline, which may be due to the lack of understanding and mastery of health knowledge among the elderly.<sup>14</sup> However, the awareness rate of core knowledge about TB prevention and control in the total population, male and female populations living in urban areas, the group with a university degree or above, and the group with a monthly income of  $\geq 6000$  was higher than that of the control group. The results showed that the pass rate of core knowledge about TB prevention and control increased with the increase of education level and monthly income,<sup>15,16</sup> and the awareness rate of all people with secondary school education or below was relatively low, which may be related to the relatively small scope of knowledge received by this group, the weak ability and the insufficient attention to health knowledge.<sup>17</sup> At present, the group living in urban areas is higher than the rural group, which suggests that agricultural workers are mainly engaged in manual labor, and the health and nutritional conditions are relatively poor, and the reception of tuberculosis knowledge may be limited.<sup>18</sup>

In summary, there is still a certain gap between the awareness rate of core information on tuberculosis prevention and control in pulmonary tuberculosis patients who have completed treatment and the target and requirement of 85%. Communication in the core message about how TB is transmitted, suspicious symptoms, and cure needs to be strengthened. The elderly, those with secondary school education or below, agricultural workers and low-income people are the groups with weak knowledge of tuberculosis prevention and control, and they are also the groups that need to be focused on in future health education. It is suggested that increasing the publicity of the public about the serious harm of tuberculosis and the prognosis of treatment will help improve the awareness of patients facing up to the early treatment of tuberculosis and standardized treatment, and then improve the compliance and cure rate of patients, which is of great significance for the prevention and treatment of tuberculosis. The above selection of influences is based on the literature review, but we still need to consider the influence of confounding factors such as socio-economic status and access to healthcare.

In addition, there are also some limitations of this research. First, the inherent limitation of cross-sectional study is that it cannot explore the causal relationship. And the information bias of the instrument (interviewee bias, memory bias on the part of the interviewees, and interviewer bias). Second, patients in this study are come from the main urban area of Jinan city, may not fully represent the overall level, it suggests that the awareness rate of core information on tuberculosis in non-main urban area might lower, the scope of relevant science popularization activities should be expanded. Third, we did not perform sensitivity analyses to strengthen the results validity.

## Conclusion

The results of this study suggest that there is still a gap in the knowledge of TB control among post-treatment TB patients, which may lead to the occurrence of disease relapse. Therefore, we should pay more attention to health education and community outreach for post-treatment TB patients, especially vulnerable population identified in the study. And knowledge of TB prevention and treatment among this population should be further improved through preaching by attending physicians during follow-up visits, and peer education, and community outreach in the future.

## Ethical Approval and Consent to Participate

Our study complied with the Declaration of Helsinki. This study was approved by the Ethics Committee of the Center for Sexually Transmitted Diseases and AIDS Prevention and Control, Chinese Center for Disease Control and Prevention (Project number:X230606737). Informed consent for this study was obtained from the study participants by telephone or interview.



## Disclosure

The authors report no conflicts of interest in this work.

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