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The role of tuberculosis control institutes in delivering tuberculosis information to domestic migrants in China: A multi-level analysis of a nationwide cros-sectional survey

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ABSTRACT

Objectives: The aim of this study was to understand how tuberculosis (TB) control institutes raise awareness of TB among domestic migrants in China, specifically whether migrants have received TB information and how they received it.
Methods: This multi-level analysis included both county-level data and individual-level data covering 31 provinces in mainland China. Multi-level logistic models were used to explore the factors associated with receiving TB information.
Results: This analysis included 205 990 migrants from 31 provinces and municipalities. Only 77 460 (37.60%) migrants reportedly received any TB information in mainland China. The center for disease control and prevention (CDC), the center for tuberculosis control (CTC), and the center for prevention and treatment of chronic diseases (CPTCD) were the most likely to provide TB information for migrants in comparison to other types of TB control institutes, such as general hospitals, specialized hospitals, and community healthcare centers. The odds ratios were calculated as: 1.563 (95% confidence interval (CI) 1.246–1.959) for CDCs, 1.385 (95% CI 1.063–1.804) for CTCs, and 1.723 (95% CI 1.424–2.085) for CPTCDs.
Conclusions: China has not achieved universal coverage of TB awareness. TB awareness levels are higher in regions with CDC, CTC, and CPTCD institutes. Domestic migrants who have moved to western areas are more likely to have received TB information.

Introduction

Globally, tuberculosis (TB) is the leading cause of mortality and morbidity among infectious diseases. An estimated 10 million new TB cases and 1.3 million TB-related deaths occurred in 2017. Most of these cases were in low- and middle-income countries. China, India, and Indonesia alone, accounted for 44% of global cases in 2017 (World Health Organization, 2019).

Basic awareness is one of the most important aspects of TB control, as it can have a marked effect on minimizing the spread of the disease and its impact. However, recent evidence has shown that TB awareness within certain communities is still low, despite the high disease burden in low- and middle-income countries (Hossain et al., 2015; Buregyeya et al., 2016; Gelaw, 2016). Surveys in India and China found that approximately 15% of the population had never heard of TB (Lu et al., 2009) and about 50% of respondents lacked knowledge about the symptoms, transmission routes, prevention, and treatment policies (Thapa et al., 2015). This paucity of awareness impedes timely diagnosis and treatment, and increases the risk of spreading the disease (Putera et al., 2015).

Frequent movement between regions has also impacted TB transmission rates greatly. Both international and domestic migrants have been identified as key populations for TB control (Aldridge et al., 2014; Campbell et al., 2015). Domestic migrants in China regularly move from rural areas to host cities for work

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without permanent residency (*Hukou*) (Huinink et al., 2014). Large studies have shown that these migrants are more vulnerable to TB infection than local people and have become a contributor to TB epidemics (Tavares et al., 2017). Again, reasons for this are reportedly due to a lack of TB awareness when compared with local residents (Pengpid et al., 2016; Nkulu et al., 2010). This suggests that the delivery of TB information among migrant populations needs to be a public health priority in China, and likely in other developing nations.

To combat the TB epidemic, governments worldwide have promoted healthcare reforms (Atun et al., 2010). Many countries are currently exploring the best way to deliver health services for TB control. The traditional model has been overseen almost exclusively by public health organizations. However, these approaches vary from country to country. In the USA, the Centers for Disease Control and Prevention Division of TB Elimination oversees TB control (American Thoracic Society, 2005), while in Russia, public dispensaries are the predominant model for TB control (Coker et al., 2003).

In recent years, many countries have proposed the integration of the private health sector for TB control, especially in high disease burden countries such as India (Dewan et al., 2006), Vietnam (Huong et al., 2005), Bangladesh, Kenya, Indonesia, Burma, Philippines, and South Africa (Atun et al., 2010). This has caused extensive debates (Nagaraja and Menezes, 2014; Pai et al., 2014a, 2014b), with some researchers urging countries to strengthen their public healthcare systems with support from their national health department (American Thoracic Society, 2005). Others have argued that public health systems lack the motivation and flexibility to respond to local needs and will not achieve adequate improvements in health outcomes (Weil, 2000). Instead, they must promote the engagement of the private health sector to address TB control (Lal et al., 2011; Balasubramanian et al., 2006).

China is one of the developing countries at a crucial crossroad in terms of healthcare system evolution and is currently exploring different TB control models (Wei et al., 2014; Jiang et al., 2012). In order to implement any future approaches that can effectively mitigate, and hopefully eliminate TB, there is a pressing need to better understand different TB control models and how they deliver TB information. This research explored the current model of TB information delivery in China. An analysis of the coverage of TB awareness was performed and a multi-level logistic model developed to compare the effects of different models in delivering TB information to domestic migrants.

Methods

Models of TB control institutes

In China, dispensaries for TB treatment, known as centers for tuberculosis control (CTCs), were first established in the 1980s (Li et al., 2016). In 1998, China introduced the National Center for Disease Control and Prevention (CDC) model (Peng et al., 2003). By 2010, most dispensaries in China had become part of the CDC (Long et al., 2016). However, CTCs still exist in certain provinces, cities, and counties. In addition to the CTCs and CDCs, there are centers for the prevention and treatment of chronic diseases (CPTCDs), which are also responsible for the prevention and treatment of TB and other chronic diseases. More recently, China has also engaged general and specialized hospitals and community healthcare centers to help tackle TB control. These four types of organization, the CDCs, CTCs, CPTCDs, and designated hospitals, have differences in responsibilities and priorities that may affect public health outcomes in regards to TB control (Wang et al., 2009; Wei et al., 2013, 2014).

Delivery of TB information

TB information in China is one of the free basic public health services delivered nationwide with funds from central government (Zhao et al., 2011). TB awareness initiatives for the whole of China are designed by the National CDC; they have also developed specific content to target migrant populations. The migrant population TB information includes: (1) basic knowledge on TB transmission and prevention; (2) local health policies; and (3) the importance of adhering to and the need for continuous treatment. Although the types of TB control institute differ in China, they are all responsible for delivering TB information. According to the National Guidelines on Tuberculosis Control Plan and Implementation, TB control institutes should deliver TB information in a range of ways, including the dissemination of pamphlets, books, journals, posters, videos, social media (WeChat), and CD-ROMS, face-to-face consultations, internet consultations (live chat), and lectures (Center for Disease Control and Prevention, 2008).

Study design

This study included 31 provinces and municipalities in mainland China. This multi-level analysis collected both county-level and individual-level data.

Individual level

Data sources. Individual-level data were sourced from the 2015 National Internal Migrant Dynamic Monitoring Survey (NIMDMS), commissioned by the National Health Commission of China (NHC) in May 2015. The survey used a stratified, multi-stage, probability proportionate to size (PPS) sampling method. Samples were first stratified by the 31 provinces and municipalities; 433 cities were then selected. The inclusion of provincial capitals, cities specifically designated in the state plan, and cities designated for the promotion of equality of basic public services was mandatory. The remaining cities were selected randomly. PPS sampling methods were used to select streets in each city. Communities were further selected from each street or district according to the

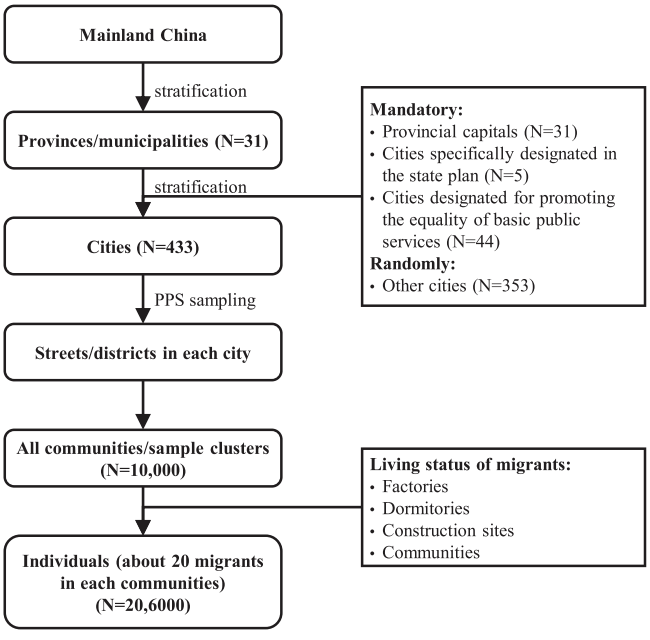

Figure 1. Flow diagram for the sampling method of the 2015 National Internal Migrant Dynamic Monitoring Survey (NIMDMS).

PPS sampling method. Approximately 200 000 participants were recruited for the survey, with 20 domestic migrants selected from each of 10 000 communities (Figure 1). The NIMDMS survey data (http://www.chinaldrk.org.cn/wjw/) were made available to researchers, who applied and gained authorization from the NHC (Migrant Population Service Center, 2015). Authorization for the use of the data was given in December 2016.

Study participants. Domestic migrants in this study were defined and recruited as participants if they: (1) were living in the host city for at least 1 month prior to the investigation; (2) were not an officially registered resident (*Hukou*) in their host place; (3) were aged 15 years or older. The survey excluded participants who were temporarily migrating for study, tourism, medical care, and/or training.

Measurements. Domestic migrants completed a standard questionnaire concerning demographic information, migration experience, social insurance, and TB awareness. (1) Demographic information: participants were asked about their current address, sex, age, ethnicity, educational level, and marital status. Job status was investigated by asking whether the participant had a paid job of more than 1 h in the host city, and the number of hours worked in the past week. Participants were also asked their average monthly family income and expenditure over the past year. (2) Migration experience: participants were asked about the scale, number of years, and reason for migration, and permanent living intention was assessed by asking if they intended to live in their host city for 5 or more years. (3) Social insurance status was assessed by asking whether the participants had the new common rural cooperation medical insurance, which is popular among migrants. (4) TB awareness: participants were asked if they had received TB information in their host city in the past year, and if so, how they had received it.

County level

Details of the types of TB control institutes in all counties within the 31 provinces in mainland China were collected from the tuberculosis website of the National CDC (http://www.chinatb.org/jfwl/) (Center for Disease Control and Prevention, 2015a). Data

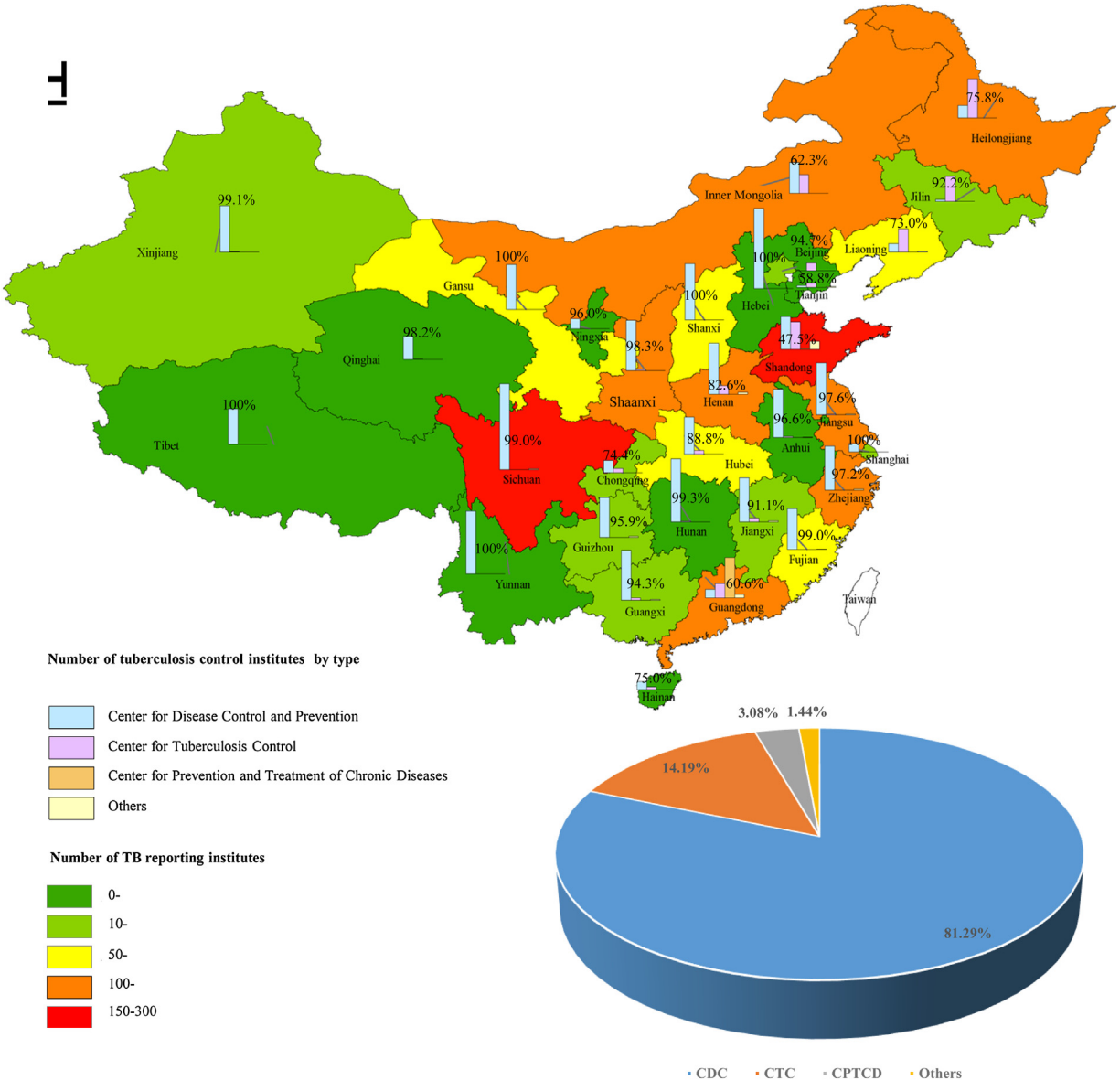

Figure 2. Distribution of TB control institutes in China.

were also obtained from all institutes that reported TB within their county in 2015 from the National Scientific Data Sharing Platform for Population and Health (Center for Disease Control and Prevention, 2015b). There were 3121 TB control institutes and 69 568 TB reporting institutes. The majority of TB control institutes (81.3%) were CDCs, followed by CTCs (14.2%), and then CPTCDs (3.1%). General and specialized hospitals and community healthcare centers amounted to 1.4% (Figure 2).

Data linkage

The individual-level data and county-level data were linked by the county name and were unified across all datasets.

Statistical analysis

Individual characteristics were described using the mean and standard deviation (SD) for normally distributed quantitative variables, and the median and interquartile range (IQR, Q1–Q3) for quantitative variables with a skewed distribution. The frequency and percentage were utilized to describe the categorical variables.

The primary outcome of this study was whether the migrants had received TB information in the past year and how they had received it. Considering the hierarchical structure of the data, multi-level logistic regression was conducted in order to explore the factors associated with TB awareness. The cluster effect was found at the county level when an empty model was performed. The intra-class correlation coefficient was 0.44 (95% confidence interval (CI) 0.42–0.46, $p < 0.001$). The univariable model was first conducted to identify potential confounders. Variables with a p-value <0.10 in the univariable analysis were included in the multivariable model. Variables were determined to be statistically significant if they had a p-value <0.05. The data analysis was performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). ArcGIS Software was used to present the types of TB control institute and the numbers of institutes reporting TB.

Results

Characteristics of domestic migrants

The NIMDMS recruited a total of 206 000 migrants. Ten migrants were excluded (0.005%) because they did not report whether they had received TB information in their host city. The total analysis included 205 990 migrants. The average age was 35.2 years, 53.1% were male, and 92.1% were of Han ethnicity. The majority had a middle or high school education (72.2%), 21.1% were married, and 82.3% were employed, working an average of 56 (IQR 40–63) hours per week. The average migrant had been away from their original residential place for 7.2 (IQR 3.6–13.2) years. Almost half of them (49.9%) had migrated to another province and 30.3% had migrated to another city in their province of birth. The majority (80.4%) had moved to their host city for a job and expressed their intention to live permanently in the host city (57.3%) (Table 1).

TB awareness status of migrants in mainland China

Out of the 206 000 migrants surveyed, only 77 460 (37.6%) said they had received TB information in mainland China. Posters (92.3%), videos (87.2%), and social media (WeChat) (68.0%) were the most common forms of delivering TB information. The frequency was higher in counties where TB awareness was led by the CDC and CPTCD. Only 27.1% of migrants said they had received TB information through face-to-face consultation; this was the most popular method for those institutions categorized as 'other', such as designated hospitals (Table 2).

Table 1
Socio-demographic characteristics: description of participants in the 2015 National Internal Migrant Dynamic Monitoring Survey (NIMDMS) and description of county-level variables.

Variables		Number	%
Individual-level			
Demographic characteristics			
Age (mean, SD)		35.16	10.6
Sex			
Male		109 301	53.1
Female		96 689	46.9
Ethnicity			
Han		189 805	92.1
Other		16 185	7.9
Education level			
Primary or below		31 336	15.2
Middle/high school		148 780	72.2
College or above		25 874	12.6
Marital status			
Single/divorced/widowed		162 469	78.9
Married		43 521	21.1
Job			
Yes		169 544	82.3
No		36 443	17.7
Number of hours worked in the past week (median, Q1–Q3)		56	40–63
Monthly family income over the past year (median, Q1–Q3)		5000	3700–7000
Monthly family expenditure over the past year (median, Q1–Q3)		3000	2000–4000
Migration characteristics			
Years of migration (median, Q1–Q3)		7.2	3.6–13.2
Scale of migration			
International		26	<0.1
Inter-province		102 755	49.9
Inter-city		62 504	30.3
Inter-county		40 705	19.8
Reason for migrating			
Work		165 700	80.4
Family		20 438	9.9
Other (business, training, relocating, and others)		19 849	9.7
Permanent living (>5 years) intention in destination city			
Unsure		61 664	29.9
No		26 218	12.7
Yes		118 105	57.3
Social insurance characteristics			
Health records in destination city			
No and never heard		58 432	28.4
Have heard of, but currently do not have		53 796	26.1
Unknown		33 828	16.4
Yes		59 934	29.1
Have rural cooperative medical care insurance			
Yes		136 209	67.7
No		63 357	31.5
Unclear		1731	0.9
County-level			
Regions			
Central		33 996	16.5
Western		66 998	32.5
Northeast		14 000	6.8
Eastern		90 996	44.2
Types of TB control institutes			
Public health system	CDC	155 755	76.6
	CTC	31 199	15.4
	CPTCD	8399	4.1
Other[a]		7917	3.9
Number of TB reporting institutes (median, Q1–Q3)		21	15–28

SD, standard deviation; Q1, first quartile; Q3, third quartile; CDC, center for disease control and prevention; CTC, center for tuberculosis control; CPTCD, center for prevention and treatment of chronic diseases; TB, tuberculosis.

[a] Other: general hospitals, specialized hospitals, and community healthcare centers.

Table 2
Sources of TB information among migrants.

Sources of TB information	CDC	CTC	CPTCD	Other[a]	Total	Chi-square	*p*-Value
Posters	53 553 (92.3%)	11 008 (92.6%)	2682 (91.5%)	2899 (92.9%)	70 142 (92.3%)	5.97	0.113
Videos	50 831 (87.6%)	10 202 (85.8%)	2570 (87.7%)	2636 (84.5%)	66 239 (87.2%)	48.73	<0.001
Social media (WeChat)	39 793 (68.6%)	7836 (65.9%)	2073 (70.7%)	1988 (63.7%)	51 690 (68.0%)	68.27	<0.001
Books, journals, or CD ROMS	34 029 (58.6%)	6752 (56.8%)	1782 (60.8%)	1915 (61.4%)	44 478 (58.5%)	31.61	<0.001
Public health consultation activities	31 606 (54.5%)	6605 (55.6%)	1587 (54.1%)	1621 (52.0%)	41 419 (54.5%)	13.67	0.003
Internet consultations (live chat)	31 987 (55.1%)	6450 (54.3%)	1814 (61.9%)	1742 (54.3%)	41 993 (55.3%)	57.72	<0.01
Lectures	24 051 (43.4%)	6169 (51.9%)	1231 (42.0%)	1462 (51.9%)	32 913 (43.3%)	457.39	<0.001
Face-to-face consultations	23 025 (27.4%)	4704 (26.7%)	986 (21.9%)	1324 (29.8%)	30 039 (27.1%)	54.19	<0.001

TB, tuberculosis; CDC, center for disease control and prevention; CTC, center for tuberculosis control; CPTCD, center for prevention and treatment of chronic diseases.
[a] Other: general hospitals, specialized hospitals and community healthcare centers.

Factors associated with TB awareness status of migrants in mainland China

TB awareness levels were higher in regions with a CDC, CTC, and CPTCD. The adjusted odds ratios (aOR) were calculated to be 1.563 (95% CI 1.246–1.959) for CDCs, 1.385 (95% CI 1.063–1.804) for CTCs, and 1.723 (95% CI 1.424–2.085) for CPTCDs. Regions where there were more institutes that had reported cases of TB via the TB reporting system had lower TB awareness levels among migrants (aOR 0.982, 95% CI 0.979–0.985). TB awareness levels were higher in the western (aOR 3.359, 95% CI 2.912–3.873) and central regions of China (aOR 1.675, 95% CI 1.411–1.988) (see Table 3). The group least likely to receive TB information were of Han ethnicity, with a low education, who worked long hours, had a low monthly income, with no permanent living intention in the host city, with no health records in the host city, and who were unsure whether they had medical insurance (see Table 3).

Discussion

In China, migrants are at increased risk of TB transmission due to their lack of TB awareness. The NIMDMS survey revealed low levels of TB awareness among migrants (37.6%). TB awareness levels were found to be higher in regions with CDC, CTC, and CPTCD institutes. The results of this research are similar to those of another study conducted in China, which reported that only 46.3% of migrants had received TB information (Li and Jiang, 2010). This is despite the fact that the Chinese government proposed in the 13th Five-year Plan that "more than 85% of the public will master the core knowledge of TB control and treatment" (General Office of the State Council, 2017). Current low levels of TB awareness are yet to reach such heights (Chen et al., 2016).

Since TB prevalence is higher among migrants than the general public, TB control institutes need to continue to target these populations. The present research reaffirmed that TB awareness among migrants has not yet reached the majority of this population who were surveyed in the NIMDMS. It is suggested that more efforts are focused on delivering TB information among the migrant populations by targeting their mobile characteristics. Cellular communication in particular appears to be the most effective way to target them (Borsari et al., 2018; Rath et al., 2018; Vu et al., 2016). While the percentages calculated in the present research and in the research conducted by others (37.6% and 46.3%) may appear alarming for TB control, caution is advised, as further research is needed to assess the scale and speed of TB awareness over time.

Public health institutes, such as the CDCs, CTCs, and CPTCDs, provided the most TB information. This is because these institutes are organized to prevent and control public diseases, and are primarily focused on public health. In these institutes, face-to-face consultations, internet consultations, and lectures are held more frequently for the public, particularly the most at-risk populations. They also favor up-to-date techniques for delivering TB information like social media (WeChat). The reason why designated hospitals may provide less TB information is because this is not their main priority and is an addition to their already heavy workload. However, the present research suggests that hospitals may provide the most detailed TB information. Designated hospitals tended to provide face-to-face consultations, books, journals, and disks. Face-to-face consultations in particular are advantageous, as they enable providers to assess whether the information has been accurately understood.

The Chinese government is working to promote the reform of the TB control systems and strengthen collaboration between the public health systems using designated hospitals. Numerous cities have taken measures to cooperate in TB prevention and the medical care of TB patients. Yangjiang, a city in Guangdong Province, has piloted a 'public health hospital' to promote TB prevention and treatment (Yangjiang Government, 2018). Although we know that the public health systems have advantages in delivering TB information, further studies are still needed to assess the performance of the various types of institute in both TB prevention and treatment. There is an urgent need to comprehensively evaluate the performance of TB control systems to better utilize the strengths of each institute.

The regional incidence of TB is one of the specific challenges facing TB control in China, as highlighted by our research. Western regions have a higher TB prevalence among the general population as well as migrants compared with other regions in China (Guo and Huang, 2016; Mijiti et al., 2016; Wang et al., 2014). Yet, it was found that migrants living in the western region were three times more likely to have received TB information than those in the eastern region, and that those in the central regions were twice as likely to have received information as those in the eastern region. These results could be attributed to the migration flows from less developed western regions to more developed eastern regions. In China, by 2011, more than 70% of all migrants were said to have migrated into eastern regions like Guangdong, Jiangsu, Zhejiang, and Shanghai (National Health and Family Planning Commission of the People's Republic of China, 2017). Most of the migrants to the eastern regions were inter-provincial migrants, while those who migrated to the western regions were intra-provincial migrants. The former may have poorer integration into the host cities than the latter, and they were less likely to receive TB information in the host region. Another possible explanation is that the TB control institutes in the western regions attached more importance to TB awareness among migrants than those in the eastern regions due to the higher prevalence rates. This indicates that the eastern regions need to provide more TB information to their migrant populations.

This study has some limitations. First, the study was conducted in China and the results should not be generalized to other regions; however, it does provide clues in regards to evaluating the performance of TB control systems elsewhere. Second, the surveys

Table 3
Factors associated with TB awareness among migrants in China.

Factors		Receiving TB information in the past year					
		Number	Percentage (%)[b]	Univariable analysis		Multivariable analysis[c]	
				cOR (95% CI)	*p*-Value	aOR (95% CI)	*p*-Value
Individual-level variables							
Age		–	–	1 (0.999–1.001)	0.399	–	–
Sex							
Male		41 364	37.8	1.028 (1.008–1.049)	0.006	0.985 (0.962–1.008)	0.207
Female		36 096	37.3	Reference		Reference	
Ethnicity							
Han		70 217	37.0	1.048 (1.007–1.091)	0.022	0.924 (0.882–0.969)	0.001
Other		7243	44.8	Reference		Reference	
Education level							
Primary or below		11 506	36.7	0.709 (0.682–0.738)	<0.001	0.739 (0.704–0.776)	<0.001
Middle/high school		55 308	37.2	0.811 (0.787–0.837)	<0.001	0.849 (0.818–0.881)	<0.001
College and above		10 646	41.1	Reference		Reference	
Marital status							
Single/divorced/widowed		60 544	38.9	1.013 (0.988–1.038)	0.312	–	–
Married		16 916	37.3	Reference			
Job							
Yes		64 784	38.2	1.230 (1.197–1.265)	<0.001	–	–
No		12 675	34.8	Reference			
Number of hours worked in the past week		–	–	0.998 (0.998–0.999)	<0.001	0.999 (0.998–1.000)	0.027
Monthly family income over the past year (RMB) (median, Q1–Q3)		–	–				
≤5000		41 515	37.6	0.813 (0.776–0.851)	<0.001	0.863 (0.812–0.918)	<0.001
5000–		18 185	37.1	0.845 (0.805–0.887)	<0.001	0.872 (0.822–0.925)	<0.001
8000–		13 523	37.9	0.900 (0.857–0.946)	<0.001	0.928 (0.877–0.981)	0.009
12 500–		4237	39.5	Reference		Reference	
Monthly family expenditure over the past year (median, Q1–Q3)							
≤1000		5772	36.2	0.926 (0.884–0.969)	0.001	1.118 (1.052–1.188)	0
1000–		32 565	37.4	0.916 (0.888–0.944)	<0.001	1.061 (1.015–1.108)	0.009
3000–		26 587	37.6	0.936 (0.908–0.965)	<0.001	1.038 (0.998–1.080)	0.062
5000–		12 536	38.8	Reference		Reference	
Years of migration		–	–	1.004 (1.002–1.005)	<0.001	1.001 (1.000–1.003)	0.152
Scale of migration							
International		11	42.3	0.614 (0.254–1.485)	0.2792	–	–
Inter-province		35 787	34.8	0.643 (0.266–1.556)	0.3276	–	–
Inter-city		25 091	40.1	1.516 (0.626–3.668)	0.3564	–	–
Inter-county		16 571	40.7	Reference			
Reason for migrating							
Working		61 890	37.4	0.926 (0.855–1.002)	0.055	0.975 (0.870–1.093)	0.661
Families		7560	37.0	0.840 (0.773–0.913)	<0.001	0.978 (0.864–1.106)	0.72
Other		8009	40.3	Reference		Reference	
Permanent living (>5 years) intention in destination city							
No		9211	35.1	0.815 (0.789–0.842)	<0.001	0.855 (0.823–0.887)	<0.001
Unsure		21 280	34.5	0.816 (0.797–0.835)	<0.001	0.856 (0.833–0.879)	<0.001
Yes		46 968	39.8	Reference		Reference	
Health records in destination city							
No and never heard		15 715	26.9	0.483 (0.468–0.499)	<0.001	0.490 (0.473–0.509)	<0.001
Have heard of, but currently do not have		21 531	40.0	0.755 (0.733–0.778)	<0.001	0.753 (0.728–0.779)	<0.001
Unknown		10 076	29.8	0.552 (0.533–0.571)	<0.001	0.559 (0.537–0.582)	<0.001
Yes		30 138	50.3	Reference		Reference	
Have rural cooperative medical care insurance							
No		25 077	39.6	1.108 (1.083–1.134)	<0.001	1.023 (0.995–1.052)	0.106
Unclear		483	27.9	0.782 (0.696–0.878)	<0.001	0.866 (0.764–0.981)	0.024
Yes		50 090	36.8	Reference		Reference	
County-level variables							
Regions							
Central		12 707	37.4	2.207 (1.947–2.502)	<0.001	1.675 (1.411–1.988)	0.004
Western		32 479	48.5	3.374 (2.995–3.802)	<0.001	3.359 (2.912–3.873)	<0.001
Northeast		5323	38.0	1.121 (0.965–1.302)	0.135	0.935 (0.761–1.150)	0.591
Eastern		26 951	29.6	Reference		Reference	
Number of TB reporting institutes		–	–	0.988 (0.986–0.990)	<.0001	0.982 (0.979–0.985)	<0.0001
Types of TB control institutes*							
Public health system	CDC	58 048	37.3	1.889 (1.573–2.270)	<.0001	1.563 (1.246–1.959)	<0.0001
	CTC	11 890	38.1	1.939 (1.578–2.384)	<.0001	1.385 (1.063–1.804)	0.016
	CPTCD	2932	34.9	0.758 (0.667–0.861)	<.0001	1.723 (1.424–2.085)	<0.0001
Other[a]		2413	34.3	Reference		Reference	

TB, tuberculosis; cOR, crude odds ratio; CI, confidence interval; aOR, adjusted odds ratio; Q1, first quartile; Q3, third quartile; CDC, center for disease control and prevention; CTC, center for tuberculosis control; CPTCD, center for prevention and treatment of chronic diseases.

* $p < 0.05$.

[a] Other: general hospitals, specialized hospitals, and community healthcare centers.

[b] Percentages of receiving TB education regarding TB prevention and treatment in the past year in each subgroup (row percentages).

[c] Multilevel bivariate analysis with random intercepts.

were self-reported, which could lead to bias. Third, the research only assessed whether participants had received TB information, not their understanding and level of TB knowledge. Further studies are needed to assess the quality of TB information delivered by TB control institutes.

In conclusion, China has not achieved universal coverage of TB awareness. TB awareness levels are higher in regions with CDC, CTC, and CPTCD institutes. Domestic migrants who have moved to western areas are more likely to have received TB information.

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Ethical approval

This was an analysis using second-hand data. Ethical approval is not applicable.

Conflict of interest

None.

Author contributions

XZ and LL contributed to the conception and design of the study. LL contributed to data acquisition. XZ, LZ, HZW, LC, FJZ, CG, and JLY contributed to data analysis and interpretation of results. XZ drafted the article; the other authors contributed to revisions of the manuscript. All authors approved the final version to be submitted.

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