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Pulmonary tuberculosis among migrants in Shandong, China: Factors associated with treatment delay

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Abstract

Objectives A timely initiation of treatment is crucial to better control tuberculosis(TB).The aim of this study is to describe treatment delay among migrant TB patients and to identify factors associated with treatment delay, so as to provide an evidence for the development and improvement of TB control strategy among migrants in China.

Design A cross-sectional study was conducted in Shandong province of China and a total of 314 confirmed smear positive migrant pulmonary TB patients were enrolled. Descriptive and inferential analyses were performed as appropriate. Univariate logistic regression was used to analyze the association of variables with treatment delay among migrant PTB patients. Multi-logistic regression model was developed to further assess the impact of variables on treatment delay.

Results Of 314 migrant PTB patients, 65.6% experienced treatment delay. The migrant patients whose household income level, whose diagnosis symptom severity, cognition on whether TB was curable or not and knowledge about TB free treatment policy were factors significantly associated with treatment delay.

Conclusions Economic status and cognition on TB cure of migrant PTB patients were key barrier to access TB treatment. Implementing TB-related health education and TB free treatment policy promotion was essential to better control tuberculosis among migrants.

Key Words

Tuberculosis, migrant, treatment delay, cross-sectional study ,China

Strengths and limitations of this study

- This study is one of the first to try to analyze treatment delay among migrant pulmonary TB patients in China.
- A cross-sectional study to examine the treatment delay and its risk factors was conducted in Shandong province of China with a recruitment of 314 confirmed smear positive migrant TB patients.
- Migrant pulmonary TB patients' economic status and cognition on TB cure were key barriers to access timely TB treatment.
- The measurement of treatment delay was self-reported, and reporting bias was unavoidable.

Introduction

China has highest burden of tuberculosis (TB) and it ranks second among the 22 high-burden countries in the world (1). Since 1991, China has implemented Directly Observed Treatment-Short Course (DOTS) strategy and it has universally covered TB patients (2). As a result, the cure rate of active TB cases has reached over 90% (3). However, DOTS for migrant population remains as one of the main challenges in China TB control (4-5).

In 2011, the number of migrants in China has increased to 230 million, and it would increase continuously in the up-coming decades (6). As reported in other studies, TB management among migrants is more difficult than that of local residents due to migrants "migratory" nature, poor financial conditions, low education level and weak awareness of TB, which presents an important barrier for National TB Control Program in China (4-5, 7).

Management of TB patients among migrants which involves early diagnosis and timely initiation of treatment is crucial to reduce transmission, morbidity, mortality and development of drug resistance (8-11). Many studies have reported the length of time from onset of symptoms related to TB to diagnosis of PTB and risk factors for the delay (12-15). However, to the author's knowledgement, few studies have documented the length of time from the time of PTB diagnosis to the start of anti-tuberculosis treatment among migrant PTB patients, and few have reported on risk factors for this delay. Hence treatment delay among migrants is of a high priority among topics for study in China TB control.

The objective of this study is to describe treatment delay among migrant PTB patients in Shandong, China, and to identify factors associated with treatment delay, so as to provide an evidence for the development and

improvement of TB control strategy among migrants in China.

Materials and Methods

Study design

This study was conducted in Shandong Province, which consists of 140 counties (districts) with a total population of nearly 100 million. DOTS strategy for TB was introduced in the 1990s and is now 100% available in all counties (districts) in Shandong province. By the end of 2008, Shandong had about 6.91 million migrants.A total of 12 counties/districts (including Huaiyin District, Lixia District, Dongying District, Guangrao County, Penglai County, Laizhou County, Zouping County, Chengyang District, Jimo County, Luozhuang District, Lanshan District, Gaomi County) were selected as study sites after considering the larger number of migrants in these counties (districts) and the feasibility of the study implementation.

The participants should meet the following selection criteria: 1) They were smear-positive migrant PTB patients registered in county TB dispensary(CTD) of the 12 sampling sites during the period from August 1st 2007 to July 31st 2008; 2) If the patients were being treated, the treatment time must be over 1 month; 3) If the patients had finished normal treatment, the closure must happen within 6 months. There were 314 patients finally recruited in this study.

Data collection

A cross-sectional study was conducted between August 2nd 2008 and October 17th 2008. All the participants were interviewed face-to-face at local CTD using self-making questionnaire. The interviews were undertaken by trained postgraduates from School of public health of Shandong University and physicians from Shandong Centre for TB Prevention and Control.

Definitions

In this study, "migrants" were non-local residents who had lived or planned to live in a certain area for more than 3 months (16). The "diagnosis symptoms severity" was divided into three categories: mild, moderate and severe. The "mild symptoms" included the initial symptoms of cough, sputum, night sweats, the "moderate symptoms" refered to the initial symptoms of the chest pain, weight loss, fever and the "severe symptoms" included high fever and haemoptysis (12). Treatment time was the period from the diagnosis of PTB to the initiation of treatment. Using the median as the cut-off point, a period of longer than 1 day was defined as a treatment delay.

Data analysis

The data was double entered using EPI Data 6.04, and the two copies were verified. We used SPSS 13.0 for Windows to analyze the data. Descriptive and inferential analyses were performed as appropriate. Univariate logistic regression was used to analyze the association of each variable with treatment delay among migrant PTB patients. Multi-logistic regression model was developed to further assess the impact of variables on treatment delay. The magnitude of the association was measured by the odds ratio (OR) with 95% confidence interval (95%CI). A P-value of <0.05 was considered statistically significant.

Ethical consideration

The Ethical Committee of School of Public Health of Shandong University approved this study. All participants provided written informed consents to participate in the study. The investigation was conducted after obtaining the informed consents of all participants .

Results

Of the 314 respondents, 63.4% were male. The age of the participants

ranged from 15 to 70 years, with a mean age of 31.8 years, and 53.8% are from 15 to 29, 31.5% from 30 to 44, 14.7% are 45 years old and above. About 18.8% were with primary education or illiterate, 40.1% with junior education and 41.1% with senior education and above. With regards to marital status, 44.6% of the respondents were single (never-married), while 51.9% were married, 3.5% divorced or widowed. 88.2% of the respondents are from rural areas, and 11.8% from urban areas. 64.6% of the patients did not have any kind of health insurance (Table 1).

Table 1 Socio-demographic characteristics of the participants

Characteristic	Patients No.	%
Gender		
Male	199	63.4
Female	115	36.6
Age(in years)		
15~29	169	53.8
30~44	99	31.5
≥45	46	14.7
Educational level		
Primary school and below	59	18.8
Junior school	126	40.1
Senior school and above	129	41.1
Marital Status		
Single	140	44.6
Married	163	51.9
Divorced/ bereft of spouse	11	3.5
Household origin		
Rural	277	88.2
Urban	37	11.8
Health insurance status		
yes	111	35.4
no	203	64.6

During the study period, 65.6% of the subjects experienced treatment delay. The treatment delay was compared among different subgroups using univariate logistic regression analysis. We found that migrant patients who were younger ($P<0.05$), who were single ($P<0.05$), whose household income level were lower($P<0.01$),who had a debt ($P<0.01$), who were from guarantee household ($P<0.05$),who were not companied by families ($P<0.01$),whose diagnosis symptoms were mild ($P<0.01$), who thought TB was incurable($P<0.01$) and who didn't know TB free treatment policy ($P<0.01$) were more likely to experience treatment delay (Table 2).

Table 2 Univariate analysis of the risk factors for treatment delay**(T-delay)** among migrant PTB patients

Variables	T-delay		No T-delay		OR	95%CI	*P*
	n	%	n	%			
Sex							0.38
Male	127	63.8	72	36.2	1.0	--	
Female	79	68.7	36	31.3	1.24	0.76-2.03	
Age(in years)							**0.01**
15~29	124	73.4	45	26.6	1.0	--	
30~44	56	56.6	43	43.4	0.47	0.28-0.80	
≥45	26	56.5	20	43.5	0.47	0.24-0.93	
Educational level							0.26
Primary school and below	35	59.3	24	40.7	1.0	--	
Junior school	89	70.6	37	29.4	1.65	0.87-3.15	
Senior school and above	82	63.6	47	36.4	1.20	0.64-2.25	
Marital Status							**0.04**
Single	102	72.9	38	27.1	1.0	--	
Married	96	58.9	67	41.1	0.53	0.33-0.87	
Divorced/ bereft of spouse	8	72.7	3	27.3	0.99	0.25-3.94	
Household origin							0.64
Rural	183	66.1	94	33.9	1.0	--	

Urban	23	62.2	14	37.8	0.84	0.42-1.72	
Household income level							**0.00**
Lowest group	60	75.0	20	25.0	1.0		
Lower group	54	76.1	17	23.9	1.06	0.50-2.23	
Higher group	58	63.0	34	37.0	0.57	0.29-1.10	
Highest group	34	47.9	37	52.1	0.31	0.15-0.61	
Debt status							**0.00**
No	135	60.3	89	39.7	1.0		
≤10000 Yuan(RMB)	44	77.2	13	22.8	2.23	1.14-4.38	
＞10000Yuan(RMB)	27	81.8	6	18.2	2.97	1.18-7.48	
Guaranteeing household**							**0.03**
Yes	16	94.1	1	5.9	1.0		
No	190	64.0	107	36.0	0.11	0.02-0.85	
Working hours per day							0.65
≤8	134	64.7	73	35.3	1.0		
＞8	72	67.3	35	32.7	1.12	0.68-1.84	
Working days per week							0.22
≤5	93	69.4	41	30.6	1.0		
＞5	113	62.8	67	37.2	0.74	0.46-1.20	
Companied by families or not							**0.00**
No	126	78.3	35	21.7	1.0		
Yes	80	52.3	73	47.7	0.30	0.19-0.50	
Health insurance status							0.97
Yes	73	65.8	38	34.2	1.0		
No	133	65.5	70	34.5	0.99	0.61-1.61	
Distance to local CTD (Kms)							0.56
0-	51	68.0	24	32.0	1.0		
5-	48	67.6	23	32.4	0.98	0.49-1.97	
10-	73	67.0	36	33.0	0.95	0.51-1.79	
20-	34	57.6	25	42.4	0.64	0.32-1.30	
Diagnosis symptom severity							**0.001**
mild	21	42.9	28	57.1	1.0		
moderate	122	67.0	60	33.0	2.71	1.42-5.17	
severe	63	75.9	20	24.1	4.20	1.97-8.96	
Cognition on whether TB is curable or not							**0.009**

Yes	182	63.2	106	36.8	1.0		
No	24	92.3	2	7.7	6.99	1.62-30.16	
Knowledge about TB free treatment policy							**0.001**
Yes	139	59.9	93	40.1	1.0		
No	67	81.7	15	18.3	2.99	1.61-5.55	

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)**;**:Guaranteeing household:** the low-income household subsidized by bureau of civil affairs.

The output of multivariate logistic regression model showed that patients' household income level, diagnosis symptom severity, cognition on whether TB was curable or not and knowledge about TB free treatment policy were factors significantly associated with treatment delay. None of the others entered the model (Table 3).

Table 3 Final model of the risk factors for treatment delay(**T-delay)** among migrant PTB patients

Variables	**OR** $_{adj}$	95%**CI**	***P***
Age(in years)			
≥45	**1.0**		
15~29	1.56	0.55-4.42	0.40
30~44	1.03	0.43-2.48	0. 95
Marital Status			
Single	**1.0**		
Married	1.37	0.56-3.34	0.49
Divorced/ bereft of spouse	0.97	0.14-6.70	0.97
Household income level			
Highest group	**1.0**		
Lowest group	3.79	1.55-9.29	**0.00**
Lower group	2.37	0.96-5.81	0.06
Higher group	1.42	0.66-3.07	0.37
Debt status			
No	**1.0**		

≤10000 Yuan(RMB)	1.91	0.84-4.32	0.12
＞10000Yuan(RMB)	2.23	0.76-6.52	0.14
Guaranteeing household			
Yes	**1.0**		
No	0.14	0.02-1.24	0.08
Companied by families or not			
No	**1.0**		
Yes	0.21	0.11-0.43	**0.00**
Diagnosis symptom severity			
mild	**1.0**		
moderate	7.00	2.91-16.84	**0.00**
severe	13.35	4.87-36.63	**0.00**
Cognition on whether TB is curable or not			
No	**1.0**		
Yes	0.04	0.01-0.23	**0.00**
Knowledge about TB free treatment policy			
No	**1.0**		
Yes	0.22	0.10-0.50	**0.00**

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)**;**:Guaranteeing household:** the low-income household subsidized by bureau of civil affairs.

Discussion

Providing timely treatment after diagnosis is a key intervention to prevent the spread of TB among migrants. Therefore, to identify risk factors for treatment delay among migrant PTB patients is of high significance. The median treatment delay in our study was 1 day, which was similar to the reported median (1 day) among permanent residents conducted in Ghana (17) and Ethiopia (18), and the median(1 day) of the study conducted in the same province among permanent residents(19), but it was a little longer than 0 day reported among migrants in Changning District,Shanghai City(13).

Similar to the findings of other studies, this study also indicated that

economic status of migrant PTB patients was a key barrier to access TB treatment (20-22). The policy implemented by Chinese government to provide free treatment for TB patients had covered migrants. The free policy, to a certain extent, had reduced financial burden of patients. However, there were also some items being not included in the free package, such as transport costs occurring in the care-seeking process and additional treatment for side effects. Those high out-of-pocket medical expenditures would probably affect migrant PTB patients' to seek timely TB treatment after diagnosis. Therefore, TB control programme for migrants should address economic factors to maximize its efficiency by expanding the free package or making pro-poverty policies to extend the range of reimbursement for TB-related health services for the poor among migrant PTB patients.

As compared with migrant patients companied by families, patients living along were more vulnerable to have treatment delay. Some previous studies found that lack of social support was a positively-associated risk factor of TB-related health seeking behavior (23-24). As the most important source of social support for migrant TB patients, family members played an important role in encouraging them to seek timely treatment after diagnosis.

We found that migrant PTB patients with mild and moderate diagnosis symptoms were more easily to experience treatment delay than severe diagnosis symptoms ones. An explanation for such phenomenon might be patients' deficient knowledge on TB symptoms and thus many patients would delay to seek treatment after diagnosis based on their subjective cognition on mild diagnosis symptoms, then treatment delay would easily appear.

A clear association was observed between treatment delay and patients

cognition on TB cure. The patients thought TB was incurable would be more likely to experience treatment delay than those who thought TB was curable. We also found that the patients had not known TB free treatment policy were more easily to experience treatment delay. As *National TB Control Program Implementation Guide in China (2008)* proposed that to improve TB-related cognitive level among PTB patients was a crucial measure to control TB in China(25). The findings should therefore give an impetus to carry out TB-related health education and also free treatment policy promotion among migrant PTB patients.

This study had potential limitations. One limitation was that the selection of migrant PTB patients might be biased. The target population of this study were those who registered in local CTD, but the cases who were undetected or had no registration in local CTD or had left the sample counties(districts) during the period of the survey were not included, thus affected to some extent the representativeness of our result. Another limitation was that the measure of treatment delay was self-reported, and recall bias was unavoidable.

Conclusions

In this study, 65.6% of the participants experienced treatment delay. The study indicates that treatment delay was associated with economic status of migrant patients, which implicated for policymakers that pro-poverty policies should be made to extend the range of reimbursement for TB-related health services for the poor among migrant PTB. We also found that TB patient poor cognition on TB cure might have negative impact on treatment delay. It suggests for policy makers to carry out extensive TB-related health education among migrant TB patients. Furthermore, we also found that factors including diagnosis symptom severity and whether companied by

families or not were associated with treatment delay, which would be helpful for policymakers to make target policies.

Competing interests

The authors declare there are no competing interests.

Contributorship statement

CZ, LX and HG conceived the idea, CZ and HG implemented the field study. JC and XW participated in the statistical analysis and interpretation of the results. CZ wrote the manuscript. All authors read and approved the final manuscript.

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Data sharing

Extra data is available by emailing CZ.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2，5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4，5
Objectives	3	State specific objectives, including any prespecified hypotheses	4，5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Pulmonary tuberculosis among migrants in Shandong, China: Factors associated with treatment delay

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Abstract

Objective A timely initiation of treatment is crucial to better control tuberculosis (TB).The aim of this study is to describe treatment delay among migrant TB patients and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Design A cross-sectional study was conducted in Shandong province of China. A total of 314 confirmed smear positive migrant pulmonary TB patients were included. Univariate logistic regression was used to analyze the association of variables with treatment delay among migrant TB patients. Multi-logistic regression model was developed to further assess the effect of variables on treatment delay.

Results Of 314 migrant TB patients, 65.6% experienced treatment delay (> 1day). Household income level, diagnosis symptom severity, understanding of whether TB is curable or not and knowledge about the free TB treatment policy are factors significantly associated with treatment delay.

Conclusions Economic status and knowledge about TB are key barriers to accessing TB treatment. An integrated policy of carrying out TB-related health education and publicizing the free TB treatment policy among migrants is needed. Health insurance schemes for migrants should be modified to make them transferrable and pro-poor.

Key Words

Tuberculosis, migrant, treatment delay, cross-sectional study, China

Strengths and limitations of this study

- This study is one of the first to try to analyze treatment delay among migrant pulmonary TB patients in China.
- A cross-sectional study to examine the treatment delay and its risk factors was conducted in Shandong province of China with a recruitment of 314 confirmed smear positive migrant TB patients.
- Economic status and knowledge about TB are key barriers to accessing timely TB treatment among migrants.
- The measurement of treatment delay was self-reported, and reporting bias was unavoidable.

Introduction

China has one of the highest burdens of tuberculosis (TB) worldwide and it ranks second among the 22 high-burden countries in the world (1). Since 1991, China has implemented the Directly Observed Treatment-Short Course (DOTS) strategy and has provided universal coverage for TB patients (2). As a result, the cure rate of active TB cases has reached over 90% (3). However, the implementation of DOTS for the migrant population remains one of the main challenges in China for controlling TB (4-5).

As of 2012, the migrant population in China has reached 236 million, and is expected to increase continuously in the up-coming decades (6). As reported in other studies, TB case management among migrants is more difficult than among local residents due to their "migratory" nature, poor financial conditions, low education level and minimal awareness of TB (4-5, 7). The challenge of administering to the migrant population presents an important barrier for National TB Control Program in China. Early detection of cases and timely treatment of TB are essential for effective TB control (8-11). Delays occurring in any part of the health-seeking process would increase the probability of TB transmission and eventually result in a higher disease burden (12). Studies of delays have been conducted in many countries, most of which explain the delays in terms of patient delay, diagnosis delay and treatment delay (13-14).

In China, a number of studies have reported the length of the patient delay among migrant TB patients to last from 10 days (median) in Shandong province (12) to 20 days (median) in Changning District of Shanghai (15) to 43 days (median) in Shijiazhuang city (16). Previous studies have also reported diagnosis delays among migrant TB patients of 5 days (median) in Putuo District of Shanghai (17) to 8 days (median) in Shandong province

(12) to 13 days (median) in Changning District of Shanghai (15). Factors including age, economic status, TB symptoms, health insurance, educational level, working time, the specific health facilities first visited by the TB patients were found to be associated with the patient and diagnosis delays (12, 15-19). However, to the author's knowledge, few studies have documented the length of treatment delay, and few have identified risk factors for treatment delay. Therefore, treatment delay among migrants is of a high priority among topics for study in China TB control.

The objective of this study is to describe treatment delay among migrant TB patients in Shandong, China, and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Materials and Methods

Study design

This study was conducted in Shandong Province, which consists of 140 counties (districts) with a total population of nearly 100 million. By the end of 2008, Shandong had about 6.91 million migrants. The DOTS strategy for TB was introduced in the 1990s and is now available in 100% of counties (districts) in Shandong province. In China, TB cases are usually diagnosed and treated in local TB dispensaries (LTD). However, service providers at other levels, especially the lowest level providers (such as township health centers and clinics) cannot diagnose and treat the TB cases, only to identify suspected TB cases and refer them to the LTD. All diagnosed TB cases (including new and relapsed patients) are required to be registered in the LTD and reported to upper level health authorities.

A total of 12 counties/districts (including Huaiyin District, Lixia District, Dongying District, Guangrao County, Penglai County, Laizhou County,

Zouping County, Chengyang District, Jimo County, Luozhuang District, Lanshan District, Gaomi County) were selected as study sites after considering the larger number of migrants in these counties (districts) and the feasibility of the study implementation. The participants should meet the following selection criteria: 1) They were smear-positive migrant pulmonary TB patients registered in LTD of the 12 sampling sites during the period from August 1 2007 to July 31 2008; 2) If the patients were being treated, the treatment time must be over 1 month; 3) If the patients had finished normal treatment, the end of treatment must happen within 6 months.

Table.1. Economic status and distribution of cases of study sites

Sites	GDP per capita (RMB)*	No. of Participants
Huaiyin	34511	25
Lixia	75148	25
Dongying	48163	25
Guangrao	41125	26
Penglai	54584	34
Laizhou	26936	26
Zouping	47566	25
Chengyang	97426	22
Jimo	39011	27
Luozhuang	34706	26
Lanshan	31111	26
Gaomi	22093	27

*The data of the GDP per capita sourced from *Shandong Statistical Yearbook 2007*.

There were a total of 418 migrant TB patients registered in the 12 sampling sites during the period, 372 of which met the above criteria. Of the 372 eligible cases, 20 individuals were unreachable because they had left the

area, 16 individuals were unresponsive to contact, 11 individuals refused to participate in the study, and 11 individuals did not participate for other reasons. There were 314 patients successfully recruited into the study. Table 1 presents the economic status and distribution of the patients in different sites.

Data collection

A cross-sectional study was conducted between August 2 2008 and October 17 2008. The participants were contacted and recruited by staff of the LTD and were interviewed face-to-face at the LTD of the study site using questionnaires which included socio-demographic characteristics, household income, health insurance status, health service geographic accessibility, knowledge about TB and its related policies, and patient health-seeking experiences from diagnosis to the initiation of treatment.The interviews were undertaken by trained postgraduates from the School of Public Health of Shandong University and physicians from the Shandong Center for TB Prevention and Control.

Definitions

In this study, “migrants” were non-local residents who had already lived or intended to stay in our study areas for at least 3 months (20). The “diagnosis symptoms severity” was divided into three categories: mild, moderate and severe. The “mild symptoms” included the initial symptoms of cough, sputum, and night sweats; the “moderate symptoms” referred to the initial symptoms of chest pain, weight loss, and fever; and the “severe symptoms” included high fever and haemoptysis (12). Treatment time was the period from the diagnosis of TB to the initiation of treatment. Using the median (1 day) as the cut-off point, a period of longer than 1 day was defined as a treatment delay.

Data analysis

The data was double entered using EPI Data 6.04 and the two copies were verified. We used SPSS 13.0 for Windows to analyze the data. Gender, age, educational level, marital status, residence and health insurance status were presented as percentages. Univariate logistic regression was used to analyze the association of each variable with treatment delay across different subgroups of migrant TB patients. The identified risk factors (P<0.05) were included into a multivariate logistic regression model to further assess the impact of variables on treatment delay. The magnitude of the association was measured by the odds ratio (OR) with 95% confidence interval (95% CI). A P-value of <0.05 was considered statistically significant.

Ethical consideration

The Ethical Committee of School of Public Health of Shandong University approved this study. All participants signed written informed consents for participation prior to the start of study activities.

Results

Of the 314 respondents, 63.4% were male. The age of the participants ranged from 15 to 70 years, with a mean of 31.8 years, and 53.8% were from 15 to 29 years, 31.5% were from 30 to 44 years, 14.7% were 45 years and above. As for educational level, 18.8% had primary education or below, 40.1% had junior high education and 41.1% had high school education and above. With regards to marital status, 44.6% of the respondents were single (never-married), while 51.9% were married, and 3.5% were divorced or widowed. 88.2% of the respondents were from rural areas and 11.8% were from urban areas. 64.6% of the patients did not have any kind of health insurance plans (Table 2).

Table.2. Socio-demographic characteristics of the participants

Characteristic	No. of Patients	%
Gender		
Male	199	63.4
Female	115	36.6
Age(in years)		
15~29	169	53.8
30~44	99	31.5
≥45	46	14.7
Educational level		
Primary or below	59	18.8
Junior high	126	40.1
High school and above	129	41.1
Marital Status		
Single	140	44.6
Married	163	51.9
Divorced/ bereft of spouse	11	3.5
Residence		
Rural	277	88.2
Urban	37	11.8
Health insurance status		
yes	111	35.4
no	203	64.6

The median of treatment delay was 1 day, with a mean of 2.5 days, ranging from 0 to 90 days. When we examined the treatment delay at the individual level, we found that 65.6% of the subjects experienced treatment delay during the study period. The treatment delay was compared across different subgroups using univariate logistic regression analysis. We found that migrant TB patients who were younger ($P<0.05$), who were single ($P<0.05$), whose household income level were lower ($P<0.01$),who had a debt

($P<0.01$), who were from *Dibao* household (Low-income households identified and subsidized by local bureau of civil affairs—$P<0.05$), who migrated without families ($P<0.01$), whose diagnosis symptoms were mild ($P<0.01$), who thought TB was incurable ($P<0.01$) and who didn't know about the free TB treatment policy ($P<0.01$) were more likely to experience treatment delay (Table 3).

Table.3. Univariate analysis of the risk factors for treatment delay **(T-delay)** among migrant TB patients in Shandong, China

Variables	T-delay		No T-delay		OR	95%CI	*P*
	n	%	n	%			
Gender							0.38
Male	127	63.8	72	36.2	1.0	--	
Female	79	68.7	36	31.3	1.24	0.76-2.03	
Age(in years)							**0.01**
15~29	124	73.4	45	26.6	1.0	--	
30~44	56	56.6	43	43.4	0.47	0.28-0.80	
≥45	26	56.5	20	43.5	0.47	0.24-0.93	
Educational level							0.26
Primary and below	35	59.3	24	40.7	1.0	--	
Junior high	89	70.6	37	29.4	1.65	0.87-3.15	
High school and above	82	63.6	47	36.4	1.20	0.64-2.25	
Marital Status							**0.04**
Single	102	72.9	38	27.1	1.0	--	
Married	96	58.9	67	41.1	0.53	0.33-0.87	
Divorced/ bereft of spouse	8	72.7	3	27.3	0.99	0.25-3.94	
Residence							0.64
Rural	183	66.1	94	33.9	1.0	--	
Urban	23	62.2	14	37.8	0.84	0.42-1.72	
Household income level							**0.00**
Lowest group	60	75.0	20	25.0	1.0		
Lower group	54	76.1	17	23.9	1.06	0.50-2.23	
Higher group	58	63.0	34	37.0	0.57	0.29-1.10	

Highest group	34	47.9	37	52.1	0.31	0.15-0.61	
Debt status							**0.00**
No	135	60.3	89	39.7	1.0		
≤10000 Yuan(RMB)	44	77.2	13	22.8	2.23	1.14-4.38	
＞10000Yuan(RMB)	27	81.8	6	18.2	2.97	1.18-7.48	
Dibao household**							**0.03**
Yes	16	94.1	1	5.9	1.0		
No	190	64.0	107	36.0	0.11	0.02-0.85	
Working hours per day							0.65
≤8	134	64.7	73	35.3	1.0		
＞8	72	67.3	35	32.7	1.12	0.68-1.84	
Working days per week							0.22
≤5	93	69.4	41	30.6	1.0		
＞5	113	62.8	67	37.2	0.74	0.46-1.20	
Migrating with families or not							**0.00**
No	126	78.3	35	21.7	1.0		
Yes	80	52.3	73	47.7	0.30	0.19-0.50	
Health insurance status							0.97
Yes	73	65.8	38	34.2	1.0		
No	133	65.5	70	34.5	0.99	0.61-1.61	
Distance to local CTD (Kms)							0.56
0-	51	68.0	24	32.0	1.0		
5-	48	67.6	23	32.4	0.98	0.49-1.97	
10-	73	67.0	36	33.0	0.95	0.51-1.79	
20-	34	57.6	25	42.4	0.64	0.32-1.30	
Diagnosis symptom severity							**0.00**
mild	21	42.9	28	57.1	1.0		
moderate	122	67.0	60	33.0	2.71	1.42-5.17	
severe	63	75.9	20	24.1	4.20	1.97-8.96	
Understanding of whether TB is curable or not							**0.01**
Yes	182	63.2	106	36.8	1.0		
No	24	92.3	2	7.7	6.99	1.62-30.16	
Knowledge about the free TB treatment policy							**0.00**
Yes	139	59.9	93	40.1	1.0		
No	67	81.7	15	18.3	2.99	1.61-5.55	

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower

group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)；**：***Dibao* **household**：Low-income households identified and subsidized by local bureau of civil affairs.

The multivariate logistic regression model indicated that household income level, diagnosis symptom severity, understanding of whether TB was curable or not and knowledge about the free TB treatment policy were factors significantly associated with treatment delay (Table 4).

Table.4. Multivariate logistic regression model of the risk factors for treatment delay among migrant TB patients in Shandong ,China

Variables	**OR** $_{adj}$	95%**CI**	***P***
Age(in years)			
≥45	**1.0**		
15~29	1.56	0.55-4.42	0.40
30~44	1.03	0.43-2.48	0. 95
Marital Status			
Single	**1.0**		
Married	1.37	0.56-3.34	0.49
Divorced/ bereft of spouse	0.97	0.14-6.70	0.97
Household income level*			
Highest group	**1.0**		
Lowest group	3.79	1.55-9.29	**0.00**
Lower group	2.37	0.96-5.81	0.06
Higher group	1.42	0.66-3.07	0.37
Debt status			
No	**1.0**		
≤10000 Yuan(RMB)	1.91	0.84-4.32	0.12
＞10000Yuan(RMB)	2.23	0.76-6.52	0.14
Dibao household**			
Yes	**1.0**		
No	0.14	0.02-1.24	0.08
Migrating with families or not			
No	**1.0**		
Yes	0.21	0.11-0.43	**0.00**
Diagnosis symptom severity			

mild	**1.0**		
moderate	7.00	2.91-16.84	**0.00**
severe	13.35	4.87-36.63	**0.00**
Understanding of whether TB is curable or not			
No	**1.0**		
Yes	0.04	0.01-0.23	**0.00**
Knowledge about the free TB treatment policy			
No	**1.0**		
Yes	0.22	0.10-0.50	**0.00**

:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)； **：Dibao* **household:** Low-income households identified and subsidized by local bureau of civil affairs.

Discussion

Providing timely treatment after diagnosis is a key intervention to prevent TB transmission in community. Therefore, understanding the risk factors for treatment delay is of high significance. The median treatment delay in our study was 1 day, which was similar to the reported median (1 day) among permanent residents in research conducted in Ghana (21) and Ethiopia (13), and the median (1 day) of delay found in another study among permanent residents in the same study area (Shandong Province—22), but it was a slightly longer delay than the 0 day median reported among migrant TB patients in Changning District of Shanghai (15).

Similar to the findings of other studies, this study also indicated that economic status of migrant TB patients was a key barrier to accessing TB treatment (23-25). The policy implemented by the Chinese government to provide free treatment for TB patients has reached migrants and has, to a certain extent, reduced the financial burden of migrant TB patients. However, there are also some items that are critical to treating TB among migrants that

have not yet been included in the free policy, such as transport costs occurring in the care-seeking process and ancillary drugs for treatment. Those high out-of-pocket health expenditures may hinder migrant TB patients from seeking timely TB treatment after diagnosis. Therefore, in order to efficiently reach migrants and make these policies more pro-poor, the free TB control program should address the economic factors.

When compared with migrant patients who had migrated with their families, we found that patients living along in the study sites were more vulnerable to treatment delay. Some previous studies found that lack of social support was a positively-associated risk factor of TB-related health seeking behavior (26-27). As the most important source of social support for migrant TB patients, family members played an important role, which could not be replaced by any other sources, in encouraging them to seek timely treatment after TB diagnosis.

We found that migrant TB patients with mild and moderate diagnosis symptoms were more likely to experience treatment delay than those with severe diagnosis symptoms. In China, 80% of migrants are rural-to-urban workers (28). Among this population the average educational level is rather low (28), which may result in poor understanding of TB symptoms, the importance of timely treatment and the free TB treatment policy. Thus, the migrant TB patients may delay in seeking timely treatment after diagnosis due to their poor understanding of these factors.

A clear association was observed between treatment delay and patient understanding of the possibility of curing TB. Patients who thought TB was incurable were more likely to experience treatment delay than those who thought TB was curable. We also found that the patients who did not know about the free TB treatment policy were more likely to experience treatment

delay. The ***National TB Control Program Implementation Guide in China (2008)*** proposed that improving TB-related understanding level among TB patients was crucial to controlling TB in China (29). These findings should therefore give an impetus to carry out TB-related health education and also publicize the free TB treatment policy among migrants.

We were somewhat surprised to observe that health insurance status had no significant effect on the treatment delay among migrant TB patients. One possible explanation for this finding is the weakness of health insurance policies towards the migrants. In China, the health insurance system is tightly tied to the *hukou* (household registration) system. Due to localized management, health insurance is generally not transferrable to a new location. This means that insured migrants are generally unable to utilize local health services. Instead, insured migrants are usually required to return to their hometowns (*hukou* registered locations) if they want to make use of these benefits. Given general poor financial conditions among the migrant population, it is unlikely that insured migrants would travel all the way back to their hometowns to utilize these health services (30). Therefore, the true financial protection level among migrants through health insurance is relatively low, even if they had been covered by some kind of health insurance plans in their hometowns. This finding underlies the need for policymakers to make health insurance plans transferable for migrants.

This study had potential limitations. First, the selection of migrant TB patients might be biased. The target population of this study was the patients who had registered in a LTD. This means that undetected TB patients, patients who had not registered in a LTD and patients who had left the sample counties (districts) during the period of the survey were not included. This thus affects to some extent the representativeness of our result. Second,

the measure of treatment delay was self-reported and recall bias was unavoidable.

Conclusions

In this study, 65.6% of the participants experienced treatment delay (> 1 day). The study indicates that treatment delay was associated with the economic status of migrant patients, which suggests that future policies should extend the range of reimbursement for TB-related health services for the poor among migrant TB patients to make them more pro-poor. We find that TB patients' poor understanding of TB was significantly associated with higher treatment delay. This suggests that policymakers should carry out extensive TB-related health education among migrant TB patients. We also find that factors including diagnosis symptom severity and whether migrants lived with their families were associated with treatment delay. Understanding these risk factors may be helpful for policymakers to make more effective policies targeting the most at-risk patients.

Competing interests

The authors declare there are no competing interests.

Contributorship statement

CZ, LX and HG conceived the idea, CZ and HG implemented the field study. JC and XW participated in the statistical analysis and interpretation of the results. CZ wrote the manuscript. All authors read and approved the final manuscript.

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Data sharing

No additional data available.

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Abstract

Objectives A timely initiation of treatment is crucial to better control tuberculosis (TB).The aim of this study is to describe treatment delay among migrant TB patients and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Design A cross-sectional study was conducted in Shandong province of China. A total of 314 confirmed smear positive migrant pulmonary TB patients were included. Univariate logistic regression was used to analyze the association of variables with treatment delay among migrant TB patients. Multi-logistic regression model was developed to further assess the effect of variables on treatment delay.

Results Of 314 migrant TB patients, 65.6% experienced treatment delay (>1 day).

Household income level, diagnosis symptom severity, understanding of whether TB is curable or not and knowledge about the free TB treatment policy are factors significantly associated with treatment delay.

Conclusions Economic status and knowledge about TB are key barriers to accessing TB treatment. An integrated policy of carrying out TB-related health education and publicizing the free TB treatment policy among migrants is needed. Health insurance schemes for migrants should be modified to make them transferrable and pro-poor.

Key Words

Tuberculosis, migrant, treatment delay, cross-sectional study-, China

Strengths and limitations of this study

- This study is one of the first to try to analyze treatment delay among migrant pulmonary TB patients in China.
- A cross-sectional study to examine the treatment delay and its risk factors was conducted in Shandong province of China with a recruitment of 314 confirmed smear positive migrant TB patients.
- ~~Migrant pulmonary TB patients' e~~Economic status and ~~cognition~~ knowledge about ~~on~~ TB ~~cure were~~are key barriers to accessing timely TB treatment.
- The measurement of treatment delay was self-reported, and reporting bias was unavoidable.

Introduction

China has one of the highest burdens of tuberculosis (TB) worldwide and it ranks second among the 22 high-burden countries in the world (1). Since 1991, China has implemented the Directly Observed Treatment-Short Course (DOTS) strategy and it has provided universal~~ly covered~~ coverage for TB patients (2). As a result, the cure rate of active TB cases has reached over 90% (3). However, the implementation of DOTS for the migrant population remains ~~as~~ one of the main challenges in China for controllingTB ~~control~~ (4-5).

As of 2012~~In 2011~~, the migrant population ~~number of migrants~~ in China has reached ~~increased to~~ 230~~ 6~~ million, and ~~it~~ is expected to ~~would~~ increase continuously in the up-coming decades (6). As reported in other studies, TB case management among migrants is more difficult than ~~that of~~among local residents due to ~~migrants~~ their "migratory" nature, poor financial conditions, low education level and ~~weak~~ minimal awareness of TB(4-5, 7~~,~~). The challenge of administering to the migrant population ~~which~~ presents an important barrier for National TB Control Program in China ~~(4-5, 7)~~. Early detection of cases and timely treatment of TB are essential for effective TB control (8-11). Delays occurring in any part of the health-seeking process would increase the probability of TB transmission and eventually result in a higher disease burden (12). Studies of delays have been conducted in many countries, most of which explain the delays in terms of patient delay, diagnosis delay and treatment delay (13-14).

In China, a number of studies have reported the length of the patient delay among migrant TB patients to last from 10 days (median) in Shandong province (12) to 20 days (median) in Changning District of Shanghai (15) to 43 days (median) in Shijiazhuang city (16). Previous studies have also

reported diagnosis delays among migrant TB patients of 5 days (median) in Putuo District of Shanghai (17) to 8 days (median) in Shandong province (12) to 13 days (median) in Changning District of Shanghai (15). Factors including age, economic status, TB symptoms, health insurance, educational level, working time, the specific health facilities first visited by the TB patients were found to be associated with the patient and diagnosis delays (12, 15-19). ~~Management of TB patients among migrants which involves early diagnosis and timely initiation of treatment is crucial to reduce transmission, morbidity, mortality and development of drug resistance (8-11). Many studies have reported the length of time from onset of symptoms related to TB to diagnosis of PTB and risk factors for the delay (12-15).~~ However, to the author's knowledge~~ment~~, few studies have documented the length of t~~ime from the time of PTB diagnosis to the start of anti-tuberculosis treatment among migrant PTB patients~~reatment delay, and few have ~~reported on~~identified risk factors for ~~this~~ treatment delay. ~~Hence~~Therefore, treatment delay among migrants is of a high priority among topics for study in China TB control.

The objective of this study is to describe treatment delay among migrant ~~P~~TB patients in Shandong, China, and to identify factors associated with treatment delay, so as to provide an evidence for ~~the~~ strategy development and improvement of TB control ~~strategy~~ among migrants in China.

Materials and Methods

Study design

This study was conducted in Shandong Province, which consists of 140 counties (districts) with a total population of nearly 100 million. By the end of 2008, Shandong had about 6.91 million migrants. The DOTS strategy for TB was introduced in the 1990s and is now ~~100%~~ available in ~~–~~ 100% of ~~all~~

counties (districts) in Shandong province. In China, TB cases are usually diagnosed and treated in local TB dispensaries (LTD). However, service providers at other levels, especially the lowest level providers (such as township health centers and clinics) cannot diagnose and treat the TB cases, only to identify suspected TB cases and refer them to the LTD. All diagnosed TB cases (including new and relapsed patients) are required to be registered in the LTD and reported to upper level health authorities.

~~By the end of 2008, Shandong had about 6.91 million migrants.~~A total of 12 counties/districts (including Huaiyin District, Lixia District, Dongying District, Guangrao County, Penglai County, Laizhou County, Zouping County, Chengyang District, Jimo County, Luozhuang District, Lanshan District, Gaomi County) were selected as study sites after considering the larger number of migrants in these counties (districts) and the feasibility of the study implementation.

The participants should meet the following selection criteria: 1) They were smear-positive migrant pulmonary ~~P~~TB patients registered in ~~county TB dispensary(C~~LTD~~)~~ of the 12 sampling sites during the period from August 1~~st~~ 2007 to July 31st 2008; 2) If the patients were being treated, the treatment time must be over 1 month; 3) If the patients had finished normal treatment, the ~~closure~~ end of treatment must happen within 6 months.

Table.1. Economic status and distribution of cases of study sites

Sites	GDP per capita (RMB)*	No. of Participants
Huaiyin	34511	25
Lixia	75148	25
Dongying	48163	25
Guangrao	41125	26

Penglai	54584	34
Laizhou	26936	26
Zouping	47566	25
Chengyang	97426	22
Jimo	39011	27
Luozhuang	34706	26
Lanshan	31111	26
Gaomi	22093	27

*The data of the GDP per capita sourced from *Shandong Statistical Yearbook 2007.*

There were a total of 418 migrant TB patients registered in the 12 sampling sites during the period, 372 of which met the above criteria. Of the 372 eligible cases, 20 individuals were unreachable because they had left the area, 16 individuals were unresponsive to contact, 11 individuals refused to participate in the study, and 11 individuals did not participate for other reasons.There were 314 patients ~~finally~~ successfully recruited into ~~this~~ the study. Table 1 presents the economic status and distribution of the patients in different sites.

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Data collection

A cross-sectional study was conducted between August 2~~nd~~ 2008 and October 17~~th~~ 2008. The participants were contacted and recruited by staff of the LTD and ~~All the participants~~ were interviewed face-to-face at ~~local CTD~~the LTD of the study site using ~~self-making~~ questionnaires which included socio-demographic characteristics, household income, health insurance status, health service geographic accessibility, knowledge about TB and its related policies, and patient health-seeking experiences from diagnosis to the initiation of treatment. ~~–~~The interviews were undertaken by trained postgraduates from the School of ~~public~~ Public ~~health~~ Health of

Shandong University and physicians from the Shandong ~~Centre~~ Center for TB Prevention and Control.

Definitions

In this study, "migrants" were non-local residents who had already lived or intended to stay~~planned to live~~ in our study areas ~~a certain area~~ for ~~more than~~at least 3 months (~~16~~20). The "diagnosis symptoms severity" was divided into three categories: mild, moderate and severe. The "mild symptoms" included the initial symptoms of cough, sputum, and night sweats;~~,~~ the "moderate symptoms" referred to the initial symptoms of the chest pain, weight loss, and fever; and the "severe symptoms" included high fever and haemoptysis (12). Treatment time was the period from the diagnosis of ~~P~~TB to the initiation of treatment. Using the median (1 day) as the cut-off point, a period of longer than 1 day was defined as a treatment delay.

Data analysis

The data was double entered using EPI Data 6.04, and the two copies were verified. We used SPSS 13.0 for Windows to analyze the data. Gender, age, educational level, marital status, residence and health insurance status were presented as percentages. ~~Descriptive and inferential analyses were performed as appropriate.~~ Univariate logistic regression was used to analyze the association of each variable with treatment delay across different subgroups of~~among~~ migrant ~~P~~TB patients. The identified risk factors (P<0.05) were included into a ~~Multi~~multi-logistic regression model ~~was developed~~ to further assess the impact of variables on treatment delay. The magnitude of the association was measured by the odds ratio (OR) with 95% confidence interval (95% CI). A P-value of <0.05 was considered statistically significant.

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Ethical consideration

The Ethical Committee of School of Public Health of Shandong University approved this study. All participants ~~provided~~ signed written informed consents ~~to participate in the study. The investigation was conducted after obtaining the informed consents of all participants~~ for participation prior to the start of study activities.

Results

Of the 314 respondents, 63.4% were male. The age of the participants ranged from 15 to 70 years, with a mean ~~age~~ of 31.8 years, and 53.8% ~~are~~ were from 15 to 29 years, 31.5% were from 30 to 44 years, 14.7% ~~are~~ were 45 years ~~old~~ and above. As for educational level,~~About~~ 18.8% had ~~were with~~ primary education or ~~illiterate~~below, 40.1% ~~with~~ had junior high education and 41.1% ~~with~~ had ~~senior~~ high school education and above. With regards to marital status, 44.6% of the respondents were single (never-married), while 51.9% were married, and 3.5% were divorced or widowed. 88.2% of the respondents are from rural areas~~,~~ and 11.8% were from urban areas. 64.6% of the patients did not have any kind of health insurance plans (Table ~~1~~2).

Table 2. ~~1~~ Socio-demographic characteristics of the participants

Characteristic	No. of Patients ~~No.~~	%
Gender		
Male	199	63.4
Female	115	36.6
Age(in years)		
15~29	169	53.8
30~44	99	31.5
≥45	46	14.7

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Educational level		
Primary ~~school and~~ or below	59	18.8
Junior ~~school~~high	126	40.1
~~Senior~~ High school and above	129	41.1
Marital Status		
Single	140	44.6
Married	163	51.9
Divorced/ bereft of spouse	11	3.5
~~**Household origin**~~**Residence**		
Rural	277	88.2
Urban	37	11.8
Health insurance status		
yes	111	35.4
no	203	64.6

The median of treatment delay was 1 day, with a mean of 2.5 days, ranging from 0 to 90 days. When we examined the treatment delay at the individual level, ~~During the study period~~we found that~~,~~ 65.6% of the subjects experienced treatment delay during the study period. The treatment delay was compared ~~among~~ across different subgroups using univariate logistic regression analysis. We found that migrant TB patients who were younger ($P<0.05$), who were single ($P<0.05$), whose household income level were lower($P<0.01$),who had a debt ($P<0.01$), who were from ~~*guarantee*~~ *Dibao* household (Low-income households identified and subsidized by local bureau of civil affairs—$P<0.05$),who ~~were not companied by~~ migrated without families ($P<0.01$),whose diagnosis symptoms were mild ($P<0.01$), who thought TB was incurable($P<0.01$) and who didn't know about the free TB ~~free~~ treatment policy ($P<0.01$) were more likely to experience treatment delay (Table ~~2~~3).

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Table 3. ~~2~~ Univariate analysis of the risk factors for treatment delay **(T-delay)** among migrant ~~P~~TB patients in Shandong, China

Variables	T-delay		No T-delay		OR	95% CI	*P*
	n	%	n	%			
~~Sex~~**Gender**							0.38
Male	127	63.8	72	36.2	1.0	--	
Female	79	68.7	36	31.3	1.24	0.76-2.03	
Age(in years)							**0.01**
15~29	124	73.4	45	26.6	1.0	--	
30~44	56	56.6	43	43.4	0.47	0.28-0.80	
≥45	26	56.5	20	43.5	0.47	0.24-0.93	
Educational level							0.26
Primary ~~school and~~ or below	35	59.3	24	40.7	1.0	--	
Junior ~~school~~high	89	70.6	37	29.4	1.65	0.87-3.15	
~~Senior~~ High school and above	82	63.6	47	36.4	1.20	0.64-2.25	
Marital Status							**0.04**
Single	102	72.9	38	27.1	1.0	--	
Married	96	58.9	67	41.1	0.53	0.33-0.87	
Divorced/ bereft of spouse	8	72.7	3	27.3	0.99	0.25-3.94	
~~**Household origin**~~**Residence**							0.64
Rural	183	66.1	94	33.9	1.0	--	
Urban	23	62.2	14	37.8	0.84	0.42-1.72	
Household income level							**0.00**
Lowest group	60	75.0	20	25.0	1.0		
Lower group	54	76.1	17	23.9	1.06	0.50-2.23	
Higher group	58	63.0	34	37.0	0.57	0.29-1.10	
Highest group	34	47.9	37	52.1	0.31	0.15-0.61	
Debt status							**0.00**
No	135	60.3	89	39.7	1.0		
≤10000 Yuan(RMB)	44	77.2	13	22.8	2.23	1.14-4.38	
＞10000Yuan(RMB)	27	81.8	6	18.2	2.97	1.18-7.48	
~~**Guaranteeing**~~ **Dibao household****							**0.03**
Yes	16	94.1	1	5.9	1.0		

No	190	64.0	107	36.0	0.11	0.02-0.85	
Working hours per day							0.65
≤8	134	64.7	73	35.3	1.0		
＞8	72	67.3	35	32.7	1.12	0.68-1.84	
Working days per week							0.22
≤5	93	69.4	41	30.6	1.0		
＞5	113	62.8	67	37.2	0.74	0.46-1.20	
~~Companied by~~Migrating with families or not							**0.00**
No	126	78.3	35	21.7	1.0		
Yes	80	52.3	73	47.7	0.30	0.19-0.50	
Health insurance status							0.97
Yes	73	65.8	38	34.2	1.0		
No	133	65.5	70	34.5	0.99	0.61-1.61	
Distance to local CTD (Kms)							0.56
0-	51	68.0	24	32.0	1.0		
5-	48	67.6	23	32.4	0.98	0.49-1.97	
10-	73	67.0	36	33.0	0.95	0.51-1.79	
20-	34	57.6	25	42.4	0.64	0.32-1.30	
Diagnosis symptom severity							**0.001**
mild	21	42.9	28	57.1	1.0		
moderate	122	67.0	60	33.0	2.71	1.42-5.17	
severe	63	75.9	20	24.1	4.20	1.97-8.96	
~~Cognition on~~Understanding of whether TB is curable or not							**0.009 01**
Yes	182	63.2	106	36.8	1.0		
No	24	92.3	2	7.7	6.99	1.62-30.16	
Knowledge about the free TB ~~free~~ treatment policy							**0.001**
Yes	139	59.9	93	40.1	1.0		
No	67	81.7	15	18.3	2.99	1.61-5.55	

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)；**：**~~Guaranteeing~~ Dibao household：** ~~the~~ Low-income households identified and subsidized by local bureau of civil affairs.

The ~~output of~~ multivariate logistic regression model ~~showed~~ indicated

that ~~patients'~~ household income level, diagnosis symptom severity, ~~cognition on~~understanding of whether TB was curable or not and knowledge about the free TB ~~free~~ treatment policy were factors significantly associated with treatment delay~~. None of the others entered the model~~ (Table ~~3~~4).

Table 4. ~~3~~ Multivariate logistic regression~~Final~~ model of the risk factors for treatment delay ~~(T-delay)~~ among migrant ~~P~~TB patients in Shandong, China

Variables	OR adj	95% CI	*P*
Age(in years)			
≥45	**1.0**		
15~29	1.56	0.55-4.42	0.40
30~44	1.03	0.43-2.48	0. 95
Marital Status			
Single	**1.0**		
Married	1.37	0.56-3.34	0.49
Divorced/ bereft of spouse	0.97	0.14-6.70	0.97
Household income level*			
Highest group	**1.0**		
Lowest group	3.79	1.55-9.29	**0.00**
Lower group	2.37	0.96-5.81	0.06
Higher group	1.42	0.66-3.07	0.37
Debt status			
No	**1.0**		
≤10000 Yuan(RMB)	1.91	0.84-4.32	0.12
>10000Yuan(RMB)	2.23	0.76-6.52	0.14
~~**Guaranteeing**~~ **Dibao household****			
Yes	**1.0**		
No	0.14	0.02-1.24	0.08
~~**Companied by**~~**Migrating with families or not**			
No	**1.0**		
Yes	0.21	0.11-0.43	**0.00**
Diagnosis symptom severity			
mild	**1.0**		

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moderate	7.00	2.91-16.84	**0.00**
severe	13.35	4.87-36.63	**0.00**
~~Cognition on~~Understanding of whether TB is curable or not			
No	**1.0**		
Yes	0.04	0.01-0.23	**0.00**
Knowledge about the free TB ~~free~~ treatment policy			
No	**1.0**		
Yes	0.22	0.10-0.50	**0.00**

*:**Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)； **： ~~Guaranteeing Dibao~~ household： ~~the l~~Low-income households identified and subsidized by local bureau of civil affairs.

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Discussion

Providing timely treatment after diagnosis is a key intervention to prevent ~~the spread of TB among migrants~~transmission in community. Therefore, understanding the risk factors for treatment delay is of high significance.~~to identify risk factors for treatment delay among migrant PTB patients is of high significance.~~ The median treatment delay in our study was 1 day, which was similar to the reported median (1 day) among permanent residents in research conducted in Ghana (~~17~~21) and Ethiopia (~~18~~13), and the median (1 day) of ~~the study~~delay found in another study among permanent residents ~~conducted~~ in the same ~~province~~ study area ~~among permanent residents~~(Shandong Province ~~19~~22), but it was a ~~little~~ slightly longer delay than the 0 day median reported among migrant TB patients~~s~~ in Changning District,Shanghai City(~~13~~15).

Similar to the findings of other studies, this study also indicated that economic status of migrant ~~P~~TB patients was a key barrier to accessing TB treatment (~~20~~23-~~22~~25). The policy implemented by the Chinese government to provide free treatment for TB patients has reached migrants and has~~had~~

~~covered migrants. The free policy~~, to a certain extent, ~~had~~ reduced the financial burden of migrant TB patients. However, there ~~were~~ are also some items that are critical to treating TB among migrants that have not yet been ~~being not~~ included in the free ~~package~~policy, such as transport costs occurring in the care-seeking process and ~~additional treatment for side effects~~ancillary drugs for treatment. Those high out-of-pocket ~~medical~~ health expenditures ~~would probably affect~~may hinder migrant ~~P~~TB patients~~'~~ from~~to~~ seeking timely TB treatment after diagnosis. Therefore, in order to efficiently reach migrants and make these polices more pro-poor, the free TB control program ~~me for migrants~~ should address the economic factors ~~to maximize its efficiency by expanding the free package or making pro-poverty policies to extend the range of reimbursement for TB-related health services for the poor among migrant PTB patients~~.

~~As~~ When compared with migrant patients who had migrated with ~~companied by~~their families, we found that patients living along in the study sites were more vulnerable to ~~have~~ treatment delay. Some previous studies found that lack of social support was a positively-associated risk factor of TB-related health seeking behavior (~~23~~26-~~24~~27). As the most important source of social support for migrant TB patients, family members played an important role,which could not be replaced by any other sources, in encouraging them to seek timely treatment after TB diagnosis.

We found that migrant ~~P~~TB patients with mild and moderate diagnosis symptoms were more ~~easily~~ likely to experience treatment delay than those with severe diagnosis symptoms ~~ones~~. In China, 80% of migrants are rural-to-urban workers (28). Among this population the average educational level is rather low (28), which may result in poor understanding of TB symptoms, the importance of timely treatment and the free TB treatment

policy. An explanation for such phenomenon might be patients' deficient knowledge on TB symptoms and thus manyThus, the migrant TB patients would may delay to in seeking timely treatment after diagnosis based ondue to their poor understanding of these factors.subjective cognition on mild diagnosis symptoms, then treatment delay would easily appear.

A clear association was observed between treatment delay and patient understanding s cognition onof the possibility of curing TB cure. The pPatients who thought TB was incurable would bewere more likely to experience treatment delay than those who thought TB was curable. We also found that the patients had who did not know about the freen TB free treatment policy were more easily likely to experience treatment delay. As The *National TB Control Program Implementation Guide in China (2008)* proposed that to improvinge TB-related cognitive understanding level among PTB patients was a crucial measure to controlling TB in China(2529). These findings should therefore give an impetus to carry out TB-related health education and also publicize the free TB treatment policy promotion among migrants PTB patients.

We were somewhat surprised to observe that health insurance status had no significant effect on the treatment delay among migrant TB patients. One possible explanation for this finding is the weakness of health insurance policies towards the migrants. In China, the health insurance system is tightly tied to the *hukou* (household registration) system. Due to localized management, health insurance is generally not transferrable to a new location. This means that insured migrants are generally unable to utilize local health services. Instead, insured migrants are usually required to return to their hometowns (*hukou* registered locations) if they want to make use of these benefits. Given general poor financial conditions among the migrant

population, it is unlikely that insured migrants would travel all the way back to their hometowns to utilize these health services (30). Therefore, the true financial protection level among migrants through health insurance is relatively low, even if they had been covered by some kind of health insurance plans in their hometowns. This finding underlies the need for policymakers to make health insurance plans transferable for migrants.

This study had potential limitations. First, ~~One limitation was that~~ the selection of migrant ~~P~~TB patients might be biased. The target population of this study ~~were~~ was the patients~~ose~~ who had registered in ~~local~~ a ~~CTD~~LTD. This means~~, but the cases who were~~ that undetected TB patients, patients who had ~~or had no~~not ~~registration~~ registratered in ~~local~~ a ~~CTD~~ LTD ~~or~~ and patients who had left the sample counties (districts) during the period of the survey were not included~~,~~. This thus ~~affected~~ affects to some extent the representativeness of our result. Second, ~~Another limitation was that~~ the measure of treatment delay was self-reported, and recall bias was unavoidable.

Conclusions

In this study, 65.6% of the participants experienced treatment delay (> 1 day). The study indicates that treatment delay was associated with the economic status of migrant patients, which ~~implicated~~ suggests that future policies ~~for policymakers that pro-poverty policies should be made to~~ should extend the range of reimbursement for TB-related health services for the poor among migrant ~~P~~TB patients to make them more pro-poor~~.~~ We ~~also~~ f~~ou~~nind that TB patients' poor ~~cognition~~ understanding ~~on~~ of TB was significantly associated with higher ~~cure might have negative impact on~~ treatment delay. ~~It~~ This suggests that ~~for~~ policy-makers ~~to~~ should carry out

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extensive TB-related health education among migrant TB patients. ~~Furthermore, w~~We also ~~found~~ fInd that factors including diagnosis symptom severity and whether migrants lived with ~~companied by~~their families ~~or not~~ were associated with treatment delay~~,~~. Understanding these risk factors may ~~which would~~ be helpful for policymakers to make more effective policies target ~~policies~~the most at-risk patients.

Competing interests

The authors declare there are no competing interests.

Contributorship statement

CZ, LX and HG conceived the idea, CZ and HG implemented the field study. JC and XW participated in the statistical analysis and interpretation of the results. CZ wrote the manuscript. All authors read and approved the final manuscript.

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Data sharing

~~Extra~~ No additional data ~~is~~ available ~~by emailing CZ~~.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2，5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4，5
Objectives	3	State specific objectives, including any prespecified hypotheses	4，5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Pulmonary tuberculosis among migrants in Shandong, China: Factors associated with treatment delay

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Pulmonary tuberculosis among migrants in Shandong, China: Factors associated with treatment delay

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Abstract

Objective A timely initiation of treatment is crucial to better control tuberculosis (TB).The aim of this study is to describe treatment delay among migrant TB patients and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Design A cross-sectional study was conducted in Shandong province of China. A total of 314 confirmed smear positive migrant pulmonary TB patients were included. Univariate logistic regression was used to analyze the association of variables with treatment delay among migrant TB patients. Multi-logistic regression model was developed to further assess the effect of variables on treatment delay.

Results Of 314 migrant TB patients, 65.6% experienced treatment delay (> 1day). Household income level, diagnosis symptom severity, understanding of whether TB is curable or not and knowledge about the free TB treatment policy are factors significantly associated with treatment delay.

Conclusions Economic status and knowledge about TB are key barriers to accessing TB treatment. An integrated policy of carrying out TB-related health education and publicizing the free TB treatment policy among migrants is needed. Health insurance schemes for migrants should be modified to make them transferrable and pro-poor.

Key Words

Tuberculosis, migrant, treatment delay, cross-sectional study, China

Strengths and limitations of this study

- This study is one of the first to try to analyze treatment delay among migrant pulmonary TB patients in China.
- A cross-sectional study to examine the treatment delay and its risk factors was conducted in Shandong province of China with a recruitment of 314 confirmed smear positive migrant TB patients.
- Economic status and knowledge about TB are key barriers to accessing timely TB treatment among migrants.
- The measurement of treatment delay was self-reported, and reporting bias was unavoidable.

Introduction

China has one of the highest burdens of tuberculosis (TB) worldwide and it ranks second among the 22 high-burden countries in the world (1). Since 1991, China has implemented the Directly Observed Treatment-Short Course (DOTS) strategy and has provided universal coverage for TB patients (2). As a result, the cure rate of active TB cases has reached over 90% (3). However, the implementation of DOTS for the migrant population remains one of the main challenges in China for controlling TB (4-5).

As of 2012, the migrant population in China has reached 236 million, and is expected to increase continuously in the up-coming decades (6). As reported in other studies, TB case management among migrants is more difficult than among local residents due to their "migratory" nature, poor financial conditions, low education level and minimal awareness of TB (4-5, 7). The challenge of administering to the migrant population presents an important barrier for National TB Control Program in China. Early detection of cases and timely treatment of TB are essential for effective TB control (8-11). Delays occurring in any part of the health-seeking process would increase the probability of TB transmission and eventually result in a higher disease burden (12). Studies of delays have been conducted in many countries, most of which explain the delays in terms of patient delay, diagnosis delay and treatment delay (13-14).

In China, a number of studies have reported the length of the patient delay among migrant TB patients to last from 10 days (median) in Shandong province (12) to 20 days (median) in Changning District of Shanghai (15) to 43 days (median) in Shijiazhuang city (16). Previous studies have also reported diagnosis delays among migrant TB patients of 5 days (median) in Putuo District of Shanghai (17) to 8 days (median) in Shandong province

(12) to 13 days (median) in Changning District of Shanghai (15). Factors including age, economic status, TB symptoms, health insurance, educational level, working time, the specific health facilities first visited by the TB patients were found to be associated with the patient and diagnosis delays (12, 15-19). However, to the author's knowledge, few studies have documented the length of treatment delay, and few have identified risk factors for treatment delay. Therefore, treatment delay among migrants is of a high priority among topics for study in China TB control.

The objective of this study is to describe treatment delay among migrant TB patients in Shandong, China, and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Materials and Methods

Study design

This study was conducted in Shandong Province, which consists of 140 counties (districts) with a total population of nearly 100 million. By the end of 2008, Shandong had about 6.91 million migrants. The DOTS strategy for TB was introduced in the 1990s and is now available in 100% of counties (districts) in Shandong province. In China, TB cases are usually diagnosed and treated in local TB dispensaries (LTD). However, service providers at other levels, especially the lowest level providers (such as township health centers and clinics) cannot diagnose and treat the TB cases, only to identify suspected TB cases and refer them to the LTD. All diagnosed TB cases (including new and relapsed patients) are required to be registered in the LTD and reported to upper level health authorities.

A total of 12 counties/districts (including Huaiyin District, Lixia District, Dongying District, Guangrao County, Penglai County, Laizhou County,

Zouping County, Chengyang District, Jimo County, Luozhuang District, Lanshan District, Gaomi County) were selected as study sites after considering the larger number of migrants in these counties (districts) and the feasibility of the study implementation. The participants should meet the following selection criteria: 1) They were smear-positive migrant pulmonary TB patients registered in LTD of the 12 sampling sites during the period from August 1 2007 to July 31 2008; 2) If the patients were being treated, the treatment time must be over 1 month; 3) If the patients had finished normal treatment, the end of treatment must happen within 6 months.

Table.1. Economic status and distribution of cases of study sites

Sites	GDP per capita (RMB)*	No. of Participants
Huaiyin	34511	25
Lixia	75148	25
Dongying	48163	25
Guangrao	41125	26
Penglai	54584	34
Laizhou	26936	26
Zouping	47566	25
Chengyang	97426	22
Jimo	39011	27
Luozhuang	34706	26
Lanshan	31111	26
Gaomi	22093	27

*The data of the GDP per capita sourced from *Shandong Statistical Yearbook 2007*.

There were a total of 418 migrant TB patients registered in the 12 sampling sites during the period, 372 of which met the above criteria. Of the 372 eligible cases, 20 individuals were unreachable because they had left the

area, 16 individuals were unresponsive to contact, 11 individuals refused to participate in the study, and 11 individuals did not participate for other reasons. There were 314 patients successfully recruited into the study. Table 1 presents the economic status and distribution of the patients in different sites.

Data collection

A cross-sectional study was conducted between August 2 2008 and October 17 2008. The participants were contacted and recruited by staff of the LTD and were interviewed face-to-face at the LTD of the study site using questionnaires which included socio-demographic characteristics, household income, health insurance status, health service geographic accessibility, knowledge about TB and its related policies, and patient health-seeking experiences from diagnosis to the initiation of treatment.The interviews were undertaken by trained postgraduates from the School of Public Health of Shandong University and physicians from the Shandong Center for TB Prevention and Control.

Definitions

In this study, “migrants” were non-local residents who had already lived or intended to stay in our study areas for at least 3 months (20). The “diagnosis symptoms severity” was divided into three categories: mild, moderate and severe. The “mild symptoms” included the initial symptoms of cough, sputum, and night sweats; the “moderate symptoms” referred to the initial symptoms of chest pain, weight loss, and fever; and the “severe symptoms” included high fever and haemoptysis (12). Treatment time was the period from the diagnosis of TB to the initiation of treatment. Using the median (1 day) as the cut-off point, a period of longer than 1 day was defined as a treatment delay.

Data analysis

The data was double entered using EPI Data 6.04 and the two copies were verified. We used SPSS 13.0 for Windows to analyze the data. Gender, age, educational level, marital status, residence and health insurance status were presented as percentages. Univariate logistic regression was used to analyze the association of each variable with treatment delay across different subgroups of migrant TB patients. The identified risk factors (P<0.05) were included into a multivariate logistic regression model to further assess the impact of variables on treatment delay. The magnitude of the association was measured by the odds ratio (OR) with 95% confidence interval (95% CI). A P-value of <0.05 was considered statistically significant.

Ethical consideration

The Ethical Committee of School of Public Health of Shandong University approved this study. All participants signed written informed consents for participation prior to the start of study activities.

Results

Of the 314 respondents, 63.4% were male. The age of the participants ranged from 15 to 70 years, with a mean of 31.8 years, and 53.8% were from 15 to 29 years, 31.5% were from 30 to 44 years, 14.7% were 45 years and above. As for educational level, 18.8% had primary education or below, 40.1% had junior high education and 41.1% had high school education and above. With regards to marital status, 44.6% of the respondents were single (never-married), while 51.9% were married, and 3.5% were divorced or widowed. 88.2% of the respondents were from rural areas and 11.8% were from urban areas. 64.6% of the patients did not have any kind of health insurance plans (Table 2).

Table.2. Socio-demographic characteristics of the participants

Characteristic	No. of Patients	%
Gender		
Male	199	63.4
Female	115	36.6
Age(in years)		
15~29	169	53.8
30~44	99	31.5
≥45	46	14.7
Educational level		
Primary or below	59	18.8
Junior high	126	40.1
High school and above	129	41.1
Marital Status		
Single	140	44.6
Married	163	51.9
Divorced/ bereft of spouse	11	3.5
Residence		
Rural	277	88.2
Urban	37	11.8
Health insurance status		
yes	111	35.4
no	203	64.6

The median of treatment delay was 1 day, with a mean of 2.5 days, ranging from 0 to 90 days. When we examined the treatment delay at the individual level, we found that 65.6% of the subjects experienced treatment delay during the study period. The treatment delay was compared across different subgroups using univariate logistic regression analysis. We found that migrant TB patients who were younger ($P<0.05$), who were single ($P<0.05$), whose household income level were lower ($P<0.01$),who had a debt

($P<0.01$), who were from *Dibao* household (Low-income households identified and subsidized by local bureau of civil affairs—$P<0.05$), who migrated without families ($P<0.01$), whose diagnosis symptoms were mild ($P<0.01$), who thought TB was incurable ($P<0.01$) and who didn't know about the free TB treatment policy ($P<0.01$) were more likely to experience treatment delay (Table 3).

Table.3. Univariate analysis of the risk factors for treatment delay **(T-delay)** among migrant TB patients in Shandong, China

Variables	T-delay		No T-delay		OR	95%CI	*P*
	n	%	n	%			
Gender							0.38
Male	127	63.8	72	36.2	1.0	--	
Female	79	68.7	36	31.3	1.24	0.76-2.03	
Age(in years)							**0.01**
15~29	124	73.4	45	26.6	1.0	--	
30~44	56	56.6	43	43.4	0.47	0.28-0.80	
≥45	26	56.5	20	43.5	0.47	0.24-0.93	
Educational level							0.26
Primary and below	35	59.3	24	40.7	1.0	--	
Junior high	89	70.6	37	29.4	1.65	0.87-3.15	
High school and above	82	63.6	47	36.4	1.20	0.64-2.25	
Marital Status							**0.04**
Single	102	72.9	38	27.1	1.0	--	
Married	96	58.9	67	41.1	0.53	0.33-0.87	
Divorced/ bereft of spouse	8	72.7	3	27.3	0.99	0.25-3.94	
Residence							0.64
Rural	183	66.1	94	33.9	1.0	--	
Urban	23	62.2	14	37.8	0.84	0.42-1.72	
Household income level							**0.00**
Lowest group	60	75.0	20	25.0	1.0		
Lower group	54	76.1	17	23.9	1.06	0.50-2.23	
Higher group	58	63.0	34	37.0	0.57	0.29-1.10	

Highest group	34	47.9	37	52.1	0.31	0.15-0.61	
Debt status							**0.00**
No	135	60.3	89	39.7	1.0		
≤10000 Yuan(RMB)	44	77.2	13	22.8	2.23	1.14-4.38	
＞10000Yuan(RMB)	27	81.8	6	18.2	2.97	1.18-7.48	
Dibao household**							**0.03**
Yes	16	94.1	1	5.9	1.0		
No	190	64.0	107	36.0	0.11	0.02-0.85	
Working hours per day							0.65
≤8	134	64.7	73	35.3	1.0		
＞8	72	67.3	35	32.7	1.12	0.68-1.84	
Working days per week							0.22
≤5	93	69.4	41	30.6	1.0		
＞5	113	62.8	67	37.2	0.74	0.46-1.20	
Migrating with families or not							**0.00**
No	126	78.3	35	21.7	1.0		
Yes	80	52.3	73	47.7	0.30	0.19-0.50	
Health insurance status							0.97
Yes	73	65.8	38	34.2	1.0		
No	133	65.5	70	34.5	0.99	0.61-1.61	
Distance to local CTD (Kms)							0.56
0-	51	68.0	24	32.0	1.0		
5-	48	67.6	23	32.4	0.98	0.49-1.97	
10-	73	67.0	36	33.0	0.95	0.51-1.79	
20-	34	57.6	25	42.4	0.64	0.32-1.30	
Diagnosis symptom severity							**0.00**
mild	21	42.9	28	57.1	1.0		
moderate	122	67.0	60	33.0	2.71	1.42-5.17	
severe	63	75.9	20	24.1	4.20	1.97-8.96	
Understanding of whether TB is curable or not							**0.01**
Yes	182	63.2	106	36.8	1.0		
No	24	92.3	2	7.7	6.99	1.62-30.16	
Knowledge about the free TB treatment policy							**0.00**
Yes	139	59.9	93	40.1	1.0		
No	67	81.7	15	18.3	2.99	1.61-5.55	

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower

group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)；**：***Dibao* **household**：Low-income households identified and subsidized by local bureau of civil affairs.

The multivariate logistic regression model indicated that household income level, diagnosis symptom severity, understanding of whether TB was curable or not and knowledge about the free TB treatment policy were factors significantly associated with treatment delay (Table 4).

Table.4. Multivariate logistic regression model of the risk factors for treatment delay among migrant TB patients in Shandong ,China

Variables	**OR** $_{adj}$	95%**CI**	***P***
Age(in years)			
≥45	**1.0**		
15~29	1.56	0.55-4.42	0.40
30~44	1.03	0.43-2.48	0. 95
Marital Status			
Single	**1.0**		
Married	1.37	0.56-3.34	0.49
Divorced/ bereft of spouse	0.97	0.14-6.70	0.97
Household income level*			
Highest group	**1.0**		
Lowest group	3.79	1.55-9.29	**0.00**
Lower group	2.37	0.96-5.81	0.06
Higher group	1.42	0.66-3.07	0.37
Debt status			
No	**1.0**		
≤10000 Yuan(RMB)	1.91	0.84-4.32	0.12
＞10000Yuan(RMB)	2.23	0.76-6.52	0.14
Dibao household**			
Yes	**1.0**		
No	0.14	0.02-1.24	0.08
Migrating with families or not			
No	**1.0**		
Yes	0.21	0.11-0.43	**0.00**
Diagnosis symptom severity			

mild	**1.0**		
moderate	7.00	2.91-16.84	**0.00**
severe	13.35	4.87-36.63	**0.00**
Understanding of whether TB is curable or not			
No	**1.0**		
Yes	0.04	0.01-0.23	**0.00**
Knowledge about the free TB treatment policy			
No	**1.0**		
Yes	0.22	0.10-0.50	**0.00**

:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)； **：Dibao* **household:** Low-income households identified and subsidized by local bureau of civil affairs.

Discussion

Providing timely treatment after diagnosis is a key intervention to prevent TB transmission in community. Therefore, understanding the risk factors for treatment delay is of high significance. The median treatment delay in our study was 1 day, which was similar to the reported median (1 day) among permanent residents in research conducted in Ghana (21) and Ethiopia (13), and the median (1 day) of delay found in another study among permanent residents in the same study area (Shandong Province—22), but it was a slightly longer delay than the 0 day median reported among migrant TB patients in Changning District of Shanghai (15).

Similar to the findings of other studies, this study also indicated that economic status of migrant TB patients was a key barrier to accessing TB treatment (23-25). The policy implemented by the Chinese government to provide free treatment for TB patients has reached migrants and has, to a certain extent, reduced the financial burden of migrant TB patients. However, there are also some items that are critical to treating TB among migrants that

have not yet been included in the free policy, such as transport costs occurring in the care-seeking process and ancillary drugs for treatment. Those high out-of-pocket health expenditures may hinder migrant TB patients from seeking timely TB treatment after diagnosis. Therefore, in order to efficiently reach migrants and make these policies more pro-poor, the free TB control program should address the economic factors.

When compared with migrant patients who had migrated with their families, we found that patients living along in the study sites were more vulnerable to treatment delay. Some previous studies found that lack of social support was a positively-associated risk factor of TB-related health seeking behavior (26-27). As the most important source of social support for migrant TB patients, family members played an important role, which could not be replaced by any other sources, in encouraging them to seek timely treatment after TB diagnosis.

We found that migrant TB patients with mild and moderate diagnosis symptoms were more likely to experience treatment delay than those with severe diagnosis symptoms. In China, 80% of migrants are rural-to-urban workers (28). Among this population the average educational level is rather low (28), which may result in poor understanding of TB symptoms, the importance of timely treatment and the free TB treatment policy. Thus, the migrant TB patients may delay in seeking timely treatment after diagnosis due to their poor understanding of these factors.

A clear association was observed between treatment delay and patient understanding of the possibility of curing TB. Patients who thought TB was incurable were more likely to experience treatment delay than those who thought TB was curable. We also found that the patients who did not know about the free TB treatment policy were more likely to experience treatment

delay. The ***National TB Control Program Implementation Guide in China (2008)*** proposed that improving TB-related understanding level among TB patients was crucial to controlling TB in China (29). These findings should therefore give an impetus to carry out TB-related health education and also publicize the free TB treatment policy among migrants.

We were somewhat surprised to observe that health insurance status had no significant effect on the treatment delay among migrant TB patients. One possible explanation for this finding is the weakness of health insurance policies towards the migrants. In China, the health insurance system is tightly tied to the *hukou* (household registration) system. Due to localized management, health insurance is generally not transferrable to a new location. This means that insured migrants are generally unable to utilize local health services. Instead, insured migrants are usually required to return to their hometowns (*hukou* registered locations) if they want to make use of these benefits. Given general poor financial conditions among the migrant population, it is unlikely that insured migrants would travel all the way back to their hometowns to utilize these health services (30). Therefore, the true financial protection level among migrants through health insurance is relatively low, even if they had been covered by some kind of health insurance plans in their hometowns. This finding underlies the need for policymakers to make health insurance plans transferable for migrants.

This study had potential limitations. First, the measure of treatment delay was self-reported and recall bias was thus a serious threat to the estimate of the treatment delay. Similar with other studies, we minimized the estimation error by helping the migrant TB patients in their recall efforts , and also collecting data from LTD registration system. ~~First~~Second, the selection of migrant TB patients might be biased. The target population of

this study was the patients who had registered in a LTD. This means that undetected TB patients, patients who had not registered in a LTD and patients who had left the sample counties (districts) during the period of the survey were not included. This thus affects to some extent the representativeness of our result. ~~Second, the measure of treatment delay was self-reported and recall bias was unavoidable.~~

Conclusions

In this study, 65.6% of the participants experienced treatment delay (> 1 day). The study indicates that treatment delay was associated with the economic status of migrant patients, which suggests that future policies should extend the range of reimbursement for TB-related health services for the poor among migrant TB patients to make them more pro-poor. We find that TB patients' poor understanding of TB was significantly associated with higher treatment delay. This suggests that policymakers should carry out extensive TB-related health education among migrant TB patients. We also find that factors including diagnosis symptom severity and whether migrants lived with their families were associated with treatment delay. Understanding these risk factors may be helpful for policymakers to make more effective policies targeting the most at-risk patients.

Competing interests

The authors declare there are no competing interests.

Contributorship statement

CZ, LX and HG conceived the idea, CZ and HG implemented the field study. JC and XW participated in the statistical analysis and interpretation of the results. CZ wrote the manuscript. All authors read and approved the final

manuscript.

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Data sharing

No additional data available.

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Pulmonary tuberculosis among migrants in Shandong, China: Factors associated with treatment delay

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Abstract

Objective A timely initiation of treatment is crucial to better control tuberculosis (TB).The aim of this study is to describe treatment delay among migrant TB patients and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Design A cross-sectional study was conducted in Shandong province of China. A total of 314 confirmed smear positive migrant pulmonary TB patients were included. Univariate logistic regression was used to analyze the association of variables with treatment delay among migrant TB patients. Multi-logistic regression model was developed to further assess the effect of variables on treatment delay.

Results Of 314 migrant TB patients, 65.6% experienced treatment delay (＞1day). Household income level, diagnosis symptom severity, understanding of whether TB is curable or not and knowledge about the free TB treatment policy are factors significantly associated with treatment delay.

Conclusions Economic status and knowledge about TB are key barriers to accessing TB treatment. An integrated policy of carrying out TB-related health education and publicizing the free TB treatment policy among migrants is needed. Health insurance schemes for migrants should be modified to make them transferrable and pro-poor.

Key Words

Tuberculosis, migrant, treatment delay, cross-sectional study, China

Strengths and limitations of this study

- This study is one of the first to try to analyze treatment delay among migrant pulmonary TB patients in China.
- A cross-sectional study to examine the treatment delay and its risk factors was conducted in Shandong province of China with a recruitment of 314 confirmed smear positive migrant TB patients.
- Economic status and knowledge about TB are key barriers to accessing timely TB treatment among migrants.
- The measurement of treatment delay was self-reported, and reporting bias was unavoidable.

Introduction

China has one of the highest burdens of tuberculosis (TB) worldwide and it ranks second among the 22 high-burden countries in the world (1). Since 1991, China has implemented the Directly Observed Treatment-Short Course (DOTS) strategy and has provided universal coverage for TB patients (2). As a result, the cure rate of active TB cases has reached over 90% (3). However, the implementation of DOTS for the migrant population remains one of the main challenges in China for controlling TB (4-5).

As of 2012, the migrant population in China has reached 236 million, and is expected to increase continuously in the up-coming decades (6). As reported in other studies, TB case management among migrants is more difficult than among local residents due to their "migratory" nature, poor financial conditions, low education level and minimal awareness of TB (4-5, 7). The challenge of administering to the migrant population presents an important barrier for National TB Control Program in China. Early detection of cases and timely treatment of TB are essential for effective TB control (8-11). Delays occurring in any part of the health-seeking process would increase the probability of TB transmission and eventually result in a higher disease burden (12). Studies of delays have been conducted in many countries, most of which explain the delays in terms of patient delay, diagnosis delay and treatment delay (13-14).

In China, a number of studies have reported the length of the patient delay among migrant TB patients to last from 10 days (median) in Shandong province (12) to 20 days (median) in Changning District of Shanghai (15) to 43 days (median) in Shijiazhuang city (16). Previous studies have also reported diagnosis delays among migrant TB patients of 5 days (median) in Putuo District of Shanghai (17) to 8 days (median) in Shandong province

(12) to 13 days (median) in Changning District of Shanghai (15). Factors including age, economic status, TB symptoms, health insurance, educational level, working time, the specific health facilities first visited by the TB patients were found to be associated with the patient and diagnosis delays (12, 15-19). However, to the author's knowledge, few studies have documented the length of treatment delay, and few have identified risk factors for treatment delay. Therefore, treatment delay among migrants is of a high priority among topics for study in China TB control.

The objective of this study is to describe treatment delay among migrant TB patients in Shandong, China, and to identify factors associated with treatment delay, so as to provide evidence for strategy development and improvement of TB control among migrants in China.

Materials and Methods

Study design

This study was conducted in Shandong Province, which consists of 140 counties (districts) with a total population of nearly 100 million. By the end of 2008, Shandong had about 6.91 million migrants. The DOTS strategy for TB was introduced in the 1990s and is now available in 100% of counties (districts) in Shandong province. In China, TB cases are usually diagnosed and treated in local TB dispensaries (LTD). However, service providers at other levels, especially the lowest level providers (such as township health centers and clinics) cannot diagnose and treat the TB cases, only to identify suspected TB cases and refer them to the LTD. All diagnosed TB cases (including new and relapsed patients) are required to be registered in the LTD and reported to upper level health authorities.

A total of 12 counties/districts (including Huaiyin District, Lixia District, Dongying District, Guangrao County, Penglai County, Laizhou County,

Zouping County, Chengyang District, Jimo County, Luozhuang District, Lanshan District, Gaomi County) were selected as study sites after considering the larger number of migrants in these counties (districts) and the feasibility of the study implementation. The participants should meet the following selection criteria: 1) They were smear-positive migrant pulmonary TB patients registered in LTD of the 12 sampling sites during the period from August 1 2007 to July 31 2008; 2) If the patients were being treated, the treatment time must be over 1 month; 3) If the patients had finished normal treatment, the end of treatment must happen within 6 months.

Table.1. Economic status and distribution of cases of study sites

Sites	GDP per capita (RMB)*	No. of Participants
Huaiyin	34511	25
Lixia	75148	25
Dongying	48163	25
Guangrao	41125	26
Penglai	54584	34
Laizhou	26936	26
Zouping	47566	25
Chengyang	97426	22
Jimo	39011	27
Luozhuang	34706	26
Lanshan	31111	26
Gaomi	22093	27

*The data of the GDP per capita sourced from *Shandong Statistical Yearbook 2007*.

There were a total of 418 migrant TB patients registered in the 12 sampling sites during the period, 372 of which met the above criteria. Of the 372 eligible cases, 20 individuals were unreachable because they had left the

area, 16 individuals were unresponsive to contact, 11 individuals refused to participate in the study, and 11 individuals did not participate for other reasons. There were 314 patients successfully recruited into the study. Table 1 presents the economic status and distribution of the patients in different sites.

Data collection

A cross-sectional study was conducted between August 2 2008 and October 17 2008. The participants were contacted and recruited by staff of the LTD and were interviewed face-to-face at the LTD of the study site using questionnaires which included socio-demographic characteristics, household income, health insurance status, health service geographic accessibility, knowledge about TB and its related policies, and patient health-seeking experiences from diagnosis to the initiation of treatment.The interviews were undertaken by trained postgraduates from the School of Public Health of Shandong University and physicians from the Shandong Center for TB Prevention and Control.

Definitions

In this study, “migrants” were non-local residents who had already lived or intended to stay in our study areas for at least 3 months (20). The “diagnosis symptoms severity” was divided into three categories: mild, moderate and severe. The “mild symptoms” included the initial symptoms of cough, sputum, and night sweats; the “moderate symptoms” referred to the initial symptoms of chest pain, weight loss, and fever; and the “severe symptoms” included high fever and haemoptysis (12). Treatment time was the period from the diagnosis of TB to the initiation of treatment. Using the median (1 day) as the cut-off point, a period of longer than 1 day was defined as a treatment delay.

Data analysis

The data was double entered using EPI Data 6.04 and the two copies were verified. We used SPSS 13.0 for Windows to analyze the data. Gender, age, educational level, marital status, residence and health insurance status were presented as percentages. Univariate logistic regression was used to analyze the association of each variable with treatment delay across different subgroups of migrant TB patients. The identified risk factors (P<0.05) were included into a multivariate logistic regression model to further assess the impact of variables on treatment delay. The magnitude of the association was measured by the odds ratio (OR) with 95% confidence interval (95% CI). A P-value of <0.05 was considered statistically significant.

Ethical consideration

The Ethical Committee of School of Public Health of Shandong University approved this study. All participants signed written informed consents for participation prior to the start of study activities.

Results

Of the 314 respondents, 63.4% were male. The age of the participants ranged from 15 to 70 years, with a mean of 31.8 years, and 53.8% were from 15 to 29 years, 31.5% were from 30 to 44 years, 14.7% were 45 years and above. As for educational level, 18.8% had primary education or below, 40.1% had junior high education and 41.1% had high school education and above. With regards to marital status, 44.6% of the respondents were single (never-married), while 51.9% were married, and 3.5% were divorced or widowed. 88.2% of the respondents were from rural areas and 11.8% were from urban areas. 64.6% of the patients did not have any kind of health insurance plans (Table 2).

Table.2. Socio-demographic characteristics of the participants

Characteristic	No. of Patients	%
Gender		
Male	199	63.4
Female	115	36.6
Age(in years)		
15~29	169	53.8
30~44	99	31.5
≥45	46	14.7
Educational level		
Primary or below	59	18.8
Junior high	126	40.1
High school and above	129	41.1
Marital Status		
Single	140	44.6
Married	163	51.9
Divorced/ bereft of spouse	11	3.5
Residence		
Rural	277	88.2
Urban	37	11.8
Health insurance status		
yes	111	35.4
no	203	64.6

The median of treatment delay was 1 day, with a mean of 2.5 days, ranging from 0 to 90 days. When we examined the treatment delay at the individual level, we found that 65.6% of the subjects experienced treatment delay during the study period. The treatment delay was compared across different subgroups using univariate logistic regression analysis. We found that migrant TB patients who were younger ($P<0.05$), who were single ($P<0.05$), whose household income level were lower ($P<0.01$),who had a debt

($P<0.01$), who were from *Dibao* household (Low-income households identified and subsidized by local bureau of civil affairs—$P<0.05$), who migrated without families ($P<0.01$), whose diagnosis symptoms were mild ($P<0.01$), who thought TB was incurable ($P<0.01$) and who didn't know about the free TB treatment policy ($P<0.01$) were more likely to experience treatment delay (Table 3).

Table.3. Univariate analysis of the risk factors for treatment delay **(T-delay)** among migrant TB patients in Shandong, China

Variables	T-delay		No T-delay		OR	95%CI	*P*
	n	%	n	%			
Gender							0.38
Male	127	63.8	72	36.2	1.0	--	
Female	79	68.7	36	31.3	1.24	0.76-2.03	
Age(in years)							**0.01**
15~29	124	73.4	45	26.6	1.0	--	
30~44	56	56.6	43	43.4	0.47	0.28-0.80	
≥45	26	56.5	20	43.5	0.47	0.24-0.93	
Educational level							0.26
Primary and below	35	59.3	24	40.7	1.0	--	
Junior high	89	70.6	37	29.4	1.65	0.87-3.15	
High school and above	82	63.6	47	36.4	1.20	0.64-2.25	
Marital Status							**0.04**
Single	102	72.9	38	27.1	1.0	--	
Married	96	58.9	67	41.1	0.53	0.33-0.87	
Divorced/ bereft of spouse	8	72.7	3	27.3	0.99	0.25-3.94	
Residence							0.64
Rural	183	66.1	94	33.9	1.0	--	
Urban	23	62.2	14	37.8	0.84	0.42-1.72	
Household income level							**0.00**
Lowest group	60	75.0	20	25.0	1.0		
Lower group	54	76.1	17	23.9	1.06	0.50-2.23	
Higher group	58	63.0	34	37.0	0.57	0.29-1.10	

Highest group	34	47.9	37	52.1	0.31	0.15-0.61	
Debt status							**0.00**
No	135	60.3	89	39.7	1.0		
≤10000 Yuan(RMB)	44	77.2	13	22.8	2.23	1.14-4.38	
＞10000Yuan(RMB)	27	81.8	6	18.2	2.97	1.18-7.48	
Dibao household**							**0.03**
Yes	16	94.1	1	5.9	1.0		
No	190	64.0	107	36.0	0.11	0.02-0.85	
Working hours per day							0.65
≤8	134	64.7	73	35.3	1.0		
＞8	72	67.3	35	32.7	1.12	0.68-1.84	
Working days per week							0.22
≤5	93	69.4	41	30.6	1.0		
＞5	113	62.8	67	37.2	0.74	0.46-1.20	
Migrating with families or not							**0.00**
No	126	78.3	35	21.7	1.0		
Yes	80	52.3	73	47.7	0.30	0.19-0.50	
Health insurance status							0.97
Yes	73	65.8	38	34.2	1.0		
No	133	65.5	70	34.5	0.99	0.61-1.61	
Distance to local CTD (Kms)							0.56
0-	51	68.0	24	32.0	1.0		
5-	48	67.6	23	32.4	0.98	0.49-1.97	
10-	73	67.0	36	33.0	0.95	0.51-1.79	
20-	34	57.6	25	42.4	0.64	0.32-1.30	
Diagnosis symptom severity							**0.00**
mild	21	42.9	28	57.1	1.0		
moderate	122	67.0	60	33.0	2.71	1.42-5.17	
severe	63	75.9	20	24.1	4.20	1.97-8.96	
Understanding of whether TB is curable or not							**0.01**
Yes	182	63.2	106	36.8	1.0		
No	24	92.3	2	7.7	6.99	1.62-30.16	
Knowledge about the free TB treatment policy							**0.00**
Yes	139	59.9	93	40.1	1.0		
No	67	81.7	15	18.3	2.99	1.61-5.55	

***:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower

group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)；**：***Dibao* **household**：Low-income households identified and subsidized by local bureau of civil affairs.

The multivariate logistic regression model indicated that household income level, diagnosis symptom severity, understanding of whether TB was curable or not and knowledge about the free TB treatment policy were factors significantly associated with treatment delay (Table 4).

Table.4. Multivariate logistic regression model of the risk factors for treatment delay among migrant TB patients in Shandong ,China

Variables	OR $_{adj}$	95%CI	*P*
Age(in years)			
≥45	**1.0**		
15~29	1.56	0.55-4.42	0.40
30~44	1.03	0.43-2.48	0. 95
Marital Status			
Single	**1.0**		
Married	1.37	0.56-3.34	0.49
Divorced/ bereft of spouse	0.97	0.14-6.70	0.97
Household income level*			
Highest group	**1.0**		
Lowest group	3.79	1.55-9.29	**0.00**
Lower group	2.37	0.96-5.81	0.06
Higher group	1.42	0.66-3.07	0.37
Debt status			
No	**1.0**		
≤10000 Yuan(RMB)	1.91	0.84-4.32	0.12
＞10000Yuan(RMB)	2.23	0.76-6.52	0.14
Dibao household**			
Yes	**1.0**		
No	0.14	0.02-1.24	0.08
Migrating with families or not			
No	**1.0**		
Yes	0.21	0.11-0.43	**0.00**
Diagnosis symptom severity			

mild	**1.0**		
moderate	7.00	2.91-16.84	**0.00**
severe	13.35	4.87-36.63	**0.00**
Understanding of whether TB is curable or not			
No	**1.0**		
Yes	0.04	0.01-0.23	**0.00**
Knowledge about the free TB treatment policy			
No	**1.0**		
Yes	0.22	0.10-0.50	**0.00**

:Household income level:** 1) Lowest group (≤10000 RMB Yuan per year); 2) Lower group(10001-20000 RMB Yuan per year); 3) Higher group (20001-30000 RMB Yuan per year); 4) Highest group (＞30000 RMB Yuan per year)； **：Dibao* **household:** Low-income households identified and subsidized by local bureau of civil affairs.

Discussion

Providing timely treatment after diagnosis is a key intervention to prevent TB transmission in community. Therefore, understanding the risk factors for treatment delay is of high significance. The median treatment delay in our study was 1 day, which was similar to the reported median (1 day) among permanent residents in research conducted in Ghana (21) and Ethiopia (13), and the median (1 day) of delay found in another study among permanent residents in the same study area (Shandong Province—22), but it was a slightly longer delay than the 0 day median reported among migrant TB patients in Changning District of Shanghai (15).

Similar to the findings of other studies, this study also indicated that economic status of migrant TB patients was a key barrier to accessing TB treatment (23-25). The policy implemented by the Chinese government to provide free treatment for TB patients has reached migrants and has, to a certain extent, reduced the financial burden of migrant TB patients. However, there are also some items that are critical to treating TB among migrants that

have not yet been included in the free policy, such as transport costs occurring in the care-seeking process and ancillary drugs for treatment. Those high out-of-pocket health expenditures may hinder migrant TB patients from seeking timely TB treatment after diagnosis. Therefore, in order to efficiently reach migrants and make these policies more pro-poor, the free TB control program should address the economic factors.

When compared with migrant patients who had migrated with their families, we found that patients living along in the study sites were more vulnerable to treatment delay. Some previous studies found that lack of social support was a positively-associated risk factor of TB-related health seeking behavior (26-27). As the most important source of social support for migrant TB patients, family members played an important role, which could not be replaced by any other sources, in encouraging them to seek timely treatment after TB diagnosis.

We found that migrant TB patients with mild and moderate diagnosis symptoms were more likely to experience treatment delay than those with severe diagnosis symptoms. In China, 80% of migrants are rural-to-urban workers (28). Among this population the average educational level is rather low (28), which may result in poor understanding of TB symptoms, the importance of timely treatment and the free TB treatment policy. Thus, the migrant TB patients may delay in seeking timely treatment after diagnosis due to their poor understanding of these factors.

A clear association was observed between treatment delay and patient understanding of the possibility of curing TB. Patients who thought TB was incurable were more likely to experience treatment delay than those who thought TB was curable. We also found that the patients who did not know about the free TB treatment policy were more likely to experience treatment

delay. The ***National TB Control Program Implementation Guide in China (2008)*** proposed that improving TB-related understanding level among TB patients was crucial to controlling TB in China (29). These findings should therefore give an impetus to carry out TB-related health education and also publicize the free TB treatment policy among migrants.

We were somewhat surprised to observe that health insurance status had no significant effect on the treatment delay among migrant TB patients. One possible explanation for this finding is the weakness of health insurance policies towards the migrants. In China, the health insurance system is tightly tied to the *hukou* (household registration) system. Due to localized management, health insurance is generally not transferrable to a new location. This means that insured migrants are generally unable to utilize local health services. Instead, insured migrants are usually required to return to their hometowns (*hukou* registered locations) if they want to make use of these benefits. Given general poor financial conditions among the migrant population, it is unlikely that insured migrants would travel all the way back to their hometowns to utilize these health services (30). Therefore, the true financial protection level among migrants through health insurance is relatively low, even if they had been covered by some kind of health insurance plans in their hometowns. This finding underlies the need for policymakers to make health insurance plans transferable for migrants.

This study had potential limitations. First, the measure of treatment delay was self-reported and recall bias was thus a serious threat to the estimate of the treatment delay. Similar with other studies, we minimized the estimation error by helping the migrant TB patients in their recall efforts, and also collecting data from LTD registration system. Second, the selection of migrant TB patients might be biased. The target population of this study

was the patients who had registered in a LTD. This means that undetected TB patients, patients who had not registered in a LTD and patients who had left the sample counties (districts) during the period of the survey were not included. This thus affects to some extent the representativeness of our result .

Conclusions

In this study, 65.6% of the participants experienced treatment delay (> 1 day). The study indicates that treatment delay was associated with the economic status of migrant patients, which suggests that future policies should extend the range of reimbursement for TB-related health services for the poor among migrant TB patients to make them more pro-poor. We find that TB patients' poor understanding of TB was significantly associated with higher treatment delay. This suggests that policymakers should carry out extensive TB-related health education among migrant TB patients. We also find that factors including diagnosis symptom severity and whether migrants lived with their families were associated with treatment delay. Understanding these risk factors may be helpful for policymakers to make more effective policies targeting the most at-risk patients.

Competing interests

The authors declare there are no competing interests.

Contributorship statement

CZ, LX and HG conceived the idea, CZ and HG implemented the field study. JC and XW participated in the statistical analysis and interpretation of the results. CZ wrote the manuscript. All authors read and approved the final manuscript.

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Data sharing

No additional data available.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2，5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4，5
Objectives	3	State specific objectives, including any prespecified hypotheses	4，5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.