

BMJ Open Extent and determinants of catastrophic health expenditure for tuberculosis care in Chongqing municipality, China: a cross-sectional study

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ABSTRACT

Objective To investigate the extent and associations of patient/diagnostic delay and other potential factors with catastrophic health expenditure (CHE) for tuberculosis (TB) care in Chongqing municipality, China.

Design A cross-sectional study.

Setting Four counties of Chongqing municipality, China.

Participants A total of 1199 patients with active pulmonary TB beyond 16 years and without mental disorders were consecutively recruited in the four counties' designated TB medical institutions.

Outcome measures The incidence and intensity of CHE for TB care were described. The association between patients' 'sociodemographic and clinical characteristics such as patient delay, diagnostic delay, forms of TB, health insurance status and hospitalisation and CHE were analysed using univariate and multivariate logistic regression.

Results The incidence of CHE was 52.8% and out-of-pocket (OOP) payments were 93% of the total costs for TB care. Compared with patients without delay, the incidence and intensity of CHE were higher in patients who had patient delay or diagnostic delay. Patients who experienced patient delay or diagnostic delay, who was a male, elderly (≥ 60 years), an inhabitant, a peasant, divorced/widow, the New Cooperative Medical Scheme membership had greater risks of incurring CHE for TB care. Having a higher educational level appeared to be a protective factor. However, hospitalisation was not associated with CHE after controlling for other variables.

Conclusion The incidence and intensity of CHE for TB care are high, which provides baseline data about catastrophic costs that TB-related households faced in Chongqing of China. Variety of determinants of CHE implicate that it is essential to take effective measures to promote early seeking care and early diagnosis, improve the actual reimbursement rates of health insurance, especially for outpatients, and need more fine-tuned interventions such as precise poverty alleviation to reduce catastrophic costs of the vulnerable population.

INTRODUCTION

Tuberculosis (TB) is one of the top 10 causes of death and the leading cause of a single infectious disease (above HIV/AIDS) worldwide.

Strengths and limitations of this study

- The study provides new data about tuberculosis (TB)-related households facing catastrophic costs and the determinants of catastrophic health expenditure (CHE) for TB care in China.
- The study highlights the importance of early care seeking and diagnosis of TB.
- Our findings will provide valuable information for policymakers to take fine-tuned interventions to decrease catastrophic costs for vulnerable TB-affected households.
- Some self-reported data such as dates for onset of symptoms and healthcare seeking may have been affected by recall bias.
- The non-medical costs and indirect costs were not taken into account, which may underestimate the extent of CHE for TB care and should be considered in the future study.

In 2017, about 10.0 million people developed TB disease and 1.6 million deaths caused by TB globally. China has the second largest burden of TB in the world, accounting for 9% of all cases.¹ Poverty is not only strongly associated with TB incidence but also a cause and a devastating outcome of TB.² Therefore, TB is not only a serious infectious disease but also a severe public health problem worldwide. 'End TB strategy', a plan announced by the WHO to end the global TB epidemic, aims to reduce TB death rate by 95% and cut new cases by 90% between 2015 and 2035, and no affected families face catastrophic costs due to TB by 2020.³ However, the projected 2015 baseline is not yet available.³ Achieving zero TB-induced catastrophic costs for households is too great to realise because the financial burden for patients with TB is extremely high in low-income, middle-income and high-income countries.⁴⁻⁷ For instance, the mean treatment costs per drug-sensitive TB patient

are \$39–\$858 in Africa, \$149–\$724 in China and €3427–€10282 in the European Union.^{4 6 8}

Catastrophic health expenditure (CHE) is a widely used index to calculate the burden of medical costs on households at a national level and is often incurred by households who have to pay out-of-pockets (OOP) for health services.^{9 10} Thus, the family may have to sacrifice the consumption of other goods and services necessary for their well-being.¹⁰ There are various definitions of CHE and no one gold standard for measuring it.^{11 12} WHO has defined CHE as OOP payment for direct healthcare spending exceeds 40% of a household's capacity,¹⁰ while many studies defined CHE as OOP payment for healthcare that exceeds a specified proportion of annual household income which often set the threshold at 10%–25%.^{11 13 14} According to the end TB strategy, it is now recommended to measure catastrophic costs incurred when the total costs exceed 20% of the annual household income.¹⁵ Eradicating catastrophic costs for TB-affected families is essential to ascertain the progress of universal health coverage (UHC) and social protection. However, the data about CHE for TB care are limited.

A recent systematic review indicated that approximately a third of households with a TB patient experienced TB-associated catastrophic costs.⁵ For instance, the incidence of CHE for TB was 32.4% in Puducherry of India, 78.1% in Benin and 44% in Nigeria.^{11 16} In China, more than two-thirds of TB-related households experienced CHE overall, and 46.7% of the households still experienced CHE after reimbursement by the New Cooperative Medical Scheme (NCMS) in rural areas.^{17 18} Additionally, households with members having TB are ~1.8 times more likely to suffer CHE than those without.¹⁹ Therefore, it is essential to reduce the economic burden of patients with TB and save their families from CHE.

To reduce the economic burden on patients with TB, a 'free TB service policy' has been implemented in many countries.^{8 20 21} Although the policy has been conducted for many years, patients with TB still suffer from the high costs of TB treatment, which often forces their families into catastrophe and poverty in low-income and middle-income countries, such as in China, India, Peru, Ethiopia and Tajikistan.^{16–18 22 23} In China, the free TB service policy includes free X-ray examination and free sputum smear test for patients once with suspected TB at first visit, free first-line anti-TB drugs (6 months for new patients and 8 months if previously treated), three free sputum smear tests and one free X-ray test during anti-TB treatment.¹⁸ Also, there are three essential government-led complementary health insurances to cover some extra expenditures beyond the free TB service policy in China, including the NCMS for rural farmers, the Medical Insurance for Urban Residents (MIUR) and the Medical Insurance for Urban Employees (MIUE).¹⁸ Health insurance is the least for rural farmers followed by that for local urban residents, while it for urban employees is the most. However, the financial protection remains insufficient

though China has dramatically expanded health insurance coverage.¹⁹

According to a few studies conducted in China, Nigeria, Indonesia and Benin, the factors determining CHE for TB care include age, sex, number of family members, urban residence, educational level, being a breadwinner, job loss, health insurance status, poor households, adverse prediagnosis stage, treatment at a private facility, ratio of patient income to total household income, hospitalisation and previous of TB treatment.^{11 13 17 24} However, the factors associated with CHE among patients with TB remain not well elucidated. Considering fact that delay in TB diagnosis was not only a significant challenge of TB control and prevention programmes in low-income and middle-income settings but also was an vital risk factor increases the risk of transmission and economic costs to patients and communities at large,^{25 26} we planned to explore the associations between the patient and diagnostic delay and CHE for TB care. Also, the extent of CHE and other risk factors related to CHE are investigated as well. Consequently, a cross-sectional study was performed in Chongqing municipality, which was an economic and industrial hub of the southwest region of China with a heavy burden of TB.

METHODS

Study sites and participants

This cross-sectional study was conducted in four counties of Chongqing from March 2013 to August 2014. The TB epidemic was high in Chongqing, which ranked in the top 10 among the most upper TB burden provinces in China. The TB notification rate of Chongqing in 2015 had declined to 70.8 cases per 100 000 populations from the peak of 106 cases per 100 000 in 2005, but still above the average TB incidence of China. Recent years, ~20 000 patients were reported with TB in Chongqing, making up 2.5% of all notified TB cases in China.²⁷ There are 39 districts/counties in Chongqing. According to the Chongqing Statistical Yearbook 2015, the real GDP per capita was 47 850 ¥. Urban population accounts for 59.6% of the total population. The four counties with similar levels of economic development and similar human geographical environment were selected as the study sites. These four counties are among the middle-income counties in Chongqing, have both villages and cities and are in the process of urbanisation. In Chongqing, the reimbursement ratio in different counties was different. The reimbursement ratio of medical expenses was 0%–60% by MIUE, 0%–50% by MIUR and 0%–45% by NCMS for outpatients and 65% by MIUE, 35% by MIUR and 35% by NCMS for inpatients in Chongqing.

From March to December in 2013, all registered active pulmonary TB (PTB) patients excluding those aged <16 years or with mental disorders were recruited consecutively in the designated TB medical institutes of the four counties. Because extrapulmonary TB, tuberculous pleuritis, drug-resistant PTB and patients with PTB not

registered in counties' designated TB medical institutes were not covered by the free TB service policy during the period of research, only registered active PTB were included. Totally, 1290 patients with PTB were qualified, of who 61 refused to participate due to poor clinical conditions and 30 questionnaires were not completed. Thus, a total of 1199 patients were included in the study. All participants had access to free TB treatment and were prospectively followed throughout the treatment period.

Data collection

All data were collected in these four counties' designated TB medical institutes. The study was based on a well-structured questionnaire and patients' medical records. All participants at the local TB-designated medical institutes were interviewed face to face by a trained TB staff using the questionnaire. The following data were obtained: covered personal information, socioeconomic information (age, sex, residence, occupation, education, marital status, number of family members and household income and so on) and history of disease (forms of TB, date of first onset of suspected TB symptoms, date of first visit to any health provider, date of PTB diagnosis and direct medical costs for TB care). Clinic information (patient delay, diagnostic delay, forms of TB, health insurance status and hospitalisation) and exact date of TB diagnosis were checked against the patients' medical records. A 6-month or 8-month treatment regimen was recommended by the WHO. The follow-up survey was conducted with patients with TB till completion of the treatment. The treatment costs were collected every month by the trained TB staff. The staff interviewed each participant and then checked invoices or financial accounting systems to ensure accuracy. OOP payments and reimbursements of the direct medical costs in different periods of services (prediagnosis, diagnosis and treatment) were collected per individual and checked invoices or financial accounting systems as well. All costs were indicated in Ren Min Bi (RMB).

Definitions

Pulmonary TB

PTB was diagnosed based on the pathological, clinical and radiological findings, and confirmed through bacteriological and histological examinations, which were strictly performed according to the Chinese diagnostic criteria for PTB (WS-288-2008).²⁸

Patient delay

Patient delay is determined as a time interval from the first onset of TB symptoms to the first visit to any health provider; if the time interval lasts for >14 days, it is considered as a 'delay'.²⁹

Diagnostic delay

Diagnostic delay is defined as a time interval between a patient's first visit to any health provider and the final diagnosis as TB; if the time interval lasts for >14 days, it is considered as a delay.²⁹

Prediagnosis

Prediagnosis is the period from the onset of TB symptoms to the first visit to a local designated TB medical institution. *The period of diagnosis* is from the first visit to a local designated TB medical institution to the diagnosis of TB. *The period of treatment* is the full course of TB treatment.

Direct medical costs

Direct medical costs are composed of consultation fees, laboratory tests, X-rays, medical tests and drugs during the period of prediagnosis, diagnosis and treatment.

OOP payments

OOP payments are regarded as the direct medical costs paid by patients themselves.

Measuring the incidence and intensity of CHE

CHE is usually assessed by incidence and intensity. According to the definition of CHE in several previous studies,^{11 13 14} we defined 'catastrophic' as the OOP payments of total medical costs for TB care exceeding 10% of the annual household income in this study. Head count (HC) is used to measure the incidence of CHE, while the mean gap (MG) and mean positive gap (MPG) are used to reflect the intensity of CHE. HC means the percentage of households whose OOP payments equal or exceed 10% of their annual income to the total number of households. MG is the average amount by which OOP payments, as a proportion of annual household income, exceeds the threshold. MPG is equal to MG/HC, the excess expenditure per household experiencing CHE. The methods used in measuring HC, MG and MPG are based on the previous study.¹⁴

Statistical analysis

Data were double entered and checked using EPI Data V.3. Data analysis was performed using SPSS V.18.0. Continuous variables were presented as medians and IQRs, while categorical variables were presented as numbers and percentages (%). Pearson's χ^2 test was used in univariate analyses to identify factors associated with the CHE and ORs with 95% CIs were computed. All variables with a $p < 0.05$ in the univariate analysis were included in the multivariate model. A multivariate logistic regression model using a backward elimination method was used to assess the determinants of CHE and to calculate adjusted odds ratios (aOR) and 95% CIs. A two-sided p value of < 0.05 was considered statistically significant.

Patient and public involvement

Patients and the public were not involved in the design or planning of the study.

RESULTS

Patient characteristics

The characteristics of these patients with PTB are summarised in [table 1](#). A total of 1199 patients with PTB were enrolled in the study. The proportion of men

Table 1 Sociodemographic and clinical characteristics of the study participants (n=1199)

Variables	Patients (n)	Per cent
Sex		
Male	839	70.0
Female	360	30.0
Age (years)		
≤40	532	44.4
41–59	402	33.5
≥60	265	22.1
Residential status		
Inhabitant	848	70.7
Migrant	351	29.3
Marital status		
Single	340	28.4
Married	795	66.3
Divorced/widow	64	5.3
Educational level		
Primary or below	382	31.9
Junior high	356	29.7
High school and above	461	38.4
Occupation		
Unemployed	302	25.2
Employed	327	27.3
Peasant	353	29.4
Student	96	8.0
Retiree	121	10.1
Family size		
1–3	887	74.0
4–8	312	26.0
Health insurance status		
None	130	10.8
NCMS	548	45.7
MIUR	230	19.2
MIUE	249	20.8
Other insurance plan	42	3.5
Hospitalisation		
Yes	191	15.9
No	1008	84.1
Forms of TB		
Smear-negative PTB	892	74.4
Smear-positive PTB	307	25.6
Patient delay		
Yes	635	53.0
No	564	47.0
Median (IQR) (days)	16 (3–52)	
Diagnostic delay		
Yes	516	43.0

Continued

Table 1 Continued

Variables	Patients (n)	Per cent
No	683	57.0
Median (IQR) (days)	9 (3–33)	
Household annual income (RMB)		
Mean	42 200	
Median (IQR) (days)	35 000 (20 000–56 000)	

MIUE, Medical Insurance for Urban Employees; MIUR, Medical Insurance for Urban Residents; NCMS, New Cooperative Medical Scheme; PTB, pulmonary TB; TB, tuberculosis.

to women involved in this study was 2.3:1. More than three-quarters of patients were in their labour age (16–59 years), and the average age of the patients was 43.9 years, with a median age of 44 years. Approximately 30% of patients were migrants. Two-thirds of patients were married and received at least junior high school education. About one-quarter of patients were unemployed, about 30% patients were peasants and 8.0% patients were students. Approximately three-quarters of the households had one to three family members. In the majority, 89.2% of the patients had health insurance and about half of the patients had NCMS. Only 15.9% of patients had been hospitalised in the intensive period. Approximately three-quarters of patients were smearing negative. Of the total participants, 53.0% and 43.0% patients experienced patient and diagnostic delay, with a median (IQR) of 16 (3–52) and 9 (3–33) days measured in days, respectively. Patients' average annual household income was 42 200 ¥, with a median (IQR) of 35 000 ¥ (20 000–56 000 ¥).

Direct medical costs for TB in different periods of medical treatment

The OOP costs and health insurance reimbursement during the prediagnosis, diagnosis and treatment period are presented in table 2. Expenses in the prediagnosis period were all paid by OOP, accounting for nearly half of the total cost. Excluding the fees covered by free TB service policy, around 7% of costs were reimbursed by health insurance during the treatment period, but no costs were reimbursed during the period of prediagnosis and diagnosis. The median total direct medical costs paid by a TB patient were 4085 ¥, about 93% of which was paid by patients themselves.

Incidence and intensity of CHE

Table 3 shows that 52.8% (633/1199) of all TB-related households experienced CHE. On average, healthcare payments for TB were 18.1% higher than the threshold value (10%). For households experiencing CHE, the MPG was 34.2% higher than the threshold. The incidence of CHE in patients experiencing patient delay or diagnostic delay was 11% or 9.7% more than those not suffering patient delay or diagnostic delay, respectively. The intensity measure was also higher for the group of

Table 2 Direct medical costs for TB care in different periods of services (n=1199)

Costs in different periods (services)	Out-of-pockets		Health insurance reimbursement		Total	
	Median	IQR	Median	IQR	Median	IQR
Prediagnosis	750	250–3000	0	0	750	250–3000
Diagnosis*	157	121–250	0	0	157	121–250
Treatment†	1792	834–3050	0	0–501	1966	1000–3723
Total	3789	2106–6645	0	0–501	4085	2222–7371

Expenses excludes the costs of the free-TB policy reduction and exemption.

*The expenses excluded the cost of one-time free chest X-ray and sputum smear examination.

†The expenses excluded anti-TB drugs (6 months for new patients, 8 months if previously treated), three times sputum smear tests and one time X-ray test during anti-TB treatment.
TB, tuberculosis.

experiencing patient delay or diagnostic delay than the group without delay.

Determinants of CHE

Table 4 shows the influence of different variables on CHE for TB care using a Pearson's χ^2 test. There were many factors associated with CHE, including patient delay, diagnostic delay, sex, age, resident status, marital status, educational level, occupation, health insurance status and hospitalisation. Those factors were included in the multivariate logistic regression.

Logistic regression produced a wide range of determinants related to CHE (table 5). Independent determinants of CHE were patient delay (aOR, 1.342; 95% CI 1.043 to 1.726), diagnostic delay (aOR, 1.540; 95% CI 1.195 to 1.983), male (aOR, 1.141; 95% CI 1.066 to 1.877), age ≥ 60 years (aOR, 2.117; 95% CI 1.281 to 3.498), inhabitant (aOR, 1.455; 95% CI 1.084 to 1.951), divorced or a widow (aOR, 2.211; 95% CI 1.093 to 4.475), peasant (aOR, 2.205; 95% CI 1.522 to 3.194), high school and above (aOR, 0.542; 95% CI 0.356 to 0.826) and as NCMS membership (aOR, 1.688; 95% CI 1.071 to 2.661). However, hospitalisation was not related to CHE after controlling for other variables (aOR, 1.342; 95% CI 0.950 to 1.897).

DISCUSSION

For the first time, global TB targets aimed to decrease catastrophic costs associated with TB. Evaluating the incidence and intensity of TB-related CHE not only provided insight into the UHC but also reflected the economic

burden of patients with TB and their families. In this study, the incidence of CHE for TB care was 52.8% after reimbursement, which was lower than the reported rates of 66.8%, 65% and 78.1% in other cities of China, Nigeria and Benin, respectively, using the same CHE measurement methods.^{11 13 17} However, the figure was a little higher than that in Indonesia (50%) when they involved in patients with multi-drug resistant tuberculosis (MDR-TB),²⁴ and much higher than the rate of CHE incurred by general population or patients with non-communicable chronic disease in China.¹⁹ In that TB inequitably affects poor people and households in poorer economic quintiles are more at risk of suffering CHE and impoverishment.^{19 30} The MG was 18.1% and the MPG was 34.2% for TB in our study, both were higher than that in Nigeria (6.0%, 9.3%)^{11 13} and in Benin (7.8%, 14.8%)¹³ but lower than that in other cities of China (40.8%, 62.2%)¹⁷ because we did not take non-medical costs into account while other studies did. Although many studies claimed that non-medical costs and indirect costs related to TB care were a severe financial burden for patients with TB and their households,^{5 31 32} some studies found that these costs were not high compared with direct medical costs.^{18 33 34} Thus, the extent of patients incurring catastrophic costs in this study population may be underestimated but remain reliable.

Although all patients in this study have access to free TB treatment and the majority of them have health insurance, they had a heavy financial burden of OOP payments and more than half of them incurred catastrophic costs. The phenomena is common in China,^{8 18 35} there may be

Table 3 Incidence and intensity of CHE for TB care stratified by patient and diagnostic delay

Catastrophic health expenditure	Patient delay		Diagnostic delay		All (n=1199)
	Yes	No	Yes	No	
Head count (%)	58.0	47.0	58.3	48.6	52.8
Mean gap (%)	21.1	14.6	19.3	17.2	18.1
Mean positive gap (%)	36.5	31.1	33.0	35.3	34.2

CHE, catastrophic health expenditure; TB, tuberculosis.

Table 4 Single factor analysis of catastrophic health expenditure in patients

Variables	Experiencing CHE (n, %)	Not experiencing CHE (n, %)	OR (95% CI)	χ^2	P value
Patient delay					
No	265 (47.0)	299 (53.0)	1.0		
Yes	368 (58.0)	267 (42.0)	1.555 (1.238 to 1.954)	14.415	0.000
Diagnostic delay					
No	332 (48.6)	351 (51.4)	1.0		
Yes	301 (58.3)	215 (41.7)	1.480 (1.175 to 1.864)	11.153	0.001
Sex					
Female	151 (41.9)	209 (58.1)	1.0		
Male	482 (57.4)	357 (42.6)	1.869 (1.455 to 2.400)	24.300	0.000
Age (years)					
≤40	200 (37.6)	332 (62.4)	1.0		
41–59	242 (60.2)	160 (39.8)	2.511 (1.925 to 3.275)	46.936	0.000
≥60	191 (72.1)	74 (27.9)	4.285 (3.109 to 5.904)	84.156	0.000
Resident status					
Migrant	129 (36.8)	222 (63.2)	1.0		
Inhabitant	504 (59.4)	344 (40.6)	2.521 (1.951 to 3.259)	51.246	0.000
Marital status					
Single	133 (39.1)	207 (60.9)	1.0		
Married	450 (56.7)	344 (43.3)	2.036 (1.571 to 2.638)	29.377	0.000
Divorced/widow	50 (76.9)	15 (23.1)	5.188 (2.800 to 9.613)	31.488	0.000
Educational level					
Primary or below	277 (72.5)	105 (27.5)	1.0		
Junior high	190 (53.4)	166 (46.6)	0.434 (0.319 to 0.589)	29.058	0.000
High school and above	166 (36.0)	295 (64.0)	0.213 (0.159 to 0.286)	111.600	0.000
Occupation					
Unemployed	139 (46.0)	163 (54.0)	1.0		
Employed	128 (39.1)	199 (60.9)	0.754 (0.549 to 1.036)	3.044	0.081
Peasant	261 (73.9)	92 (26.1)	3.327 (2.396 to 4.519)	53.331	0.000
Student	37 (38.5)	59 (61.5)	0.735 (0.460 to 1.176)	1.654	0.198
Retiree	68 (56.2)	53 (43.8)	1.505 (0.984 to 2.300)	3.577	0.059
Family size					
1–3	479 (54.0)	408 (46.0)	1.0		
4–8	154 (49.4)	158 (50.6)	0.830 (0.641 to 1.075)	1.997	0.158
Health insurance status					
None	47 (36.2)	83 (63.8)	1.0		
NCMS	351 (64.1)	197 (35.9)	3.146 (2.113 to 4.685)	31.853	0.000
MIUR	111 (48.3)	119 (51.7)	1.647 (1.059 to 2.561)	4.910	0.027
MIUE	109 (43.8)	140 (56.2)	1.675 (0.888 to 2.128)	2.042	0.153
Other insurance plan	15 (35.7)	27 (64.3)	0.981 (0.475 to 2.027)	0.003	0.959
Hospitalisation					
No	517 (51.3)	491 (48.7)	1.0		
Yes	116 (60.7)	75 (39.3)	1.469 (1.071 to 2.014)	5.746	0.017
Forms of TB					
Smear-negative PTB	480 (53.8)	412 (46.2)	1.0		

Continued

Table 4 Continued

Variables	Experiencing CHE (n, %)	Not experiencing CHE (n, %)	OR (95% CI)	χ^2	P value
Smear-positive PTB	153 (49.8)	154 (50.2)	0.853 (0.658 to 1.105)	1.448	0.229

CHE, catastrophic health expenditure; MIUE, Medical Insurance for Urban Employees; MIUR, Medical Insurance for Urban Residents; NCMS, New Cooperative Medical Scheme; PTB, pulmonary TB; TB, tuberculosis.

three reasons to explain it: (i) many associated health-care costs are not covered in the free TB policy, for example, payment for drugs of ancillary and liver protection, and extra diagnostic tests.^{2 8 36} (ii) Driven by profits, doctors may prescribe additional medicines and tests.³⁷ (iii) The reimbursement ratio for outpatient services is low and often ignored, as well as the actual implementation strength of inpatients reimbursement was weak.^{38–40} Besides, we also found nearly half of all OOP payments were paid before diagnosis, which was similar to many previous studies.^{6 23 41} This cost had aroused particular concern in that it not only reflected the economic burden

on families for obtaining a diagnosis but also may act as an obstacle for poor patients to access timely TB care.

Delay in diagnosis had a massive impact on TB transmission in the community, aggravating the severity and mortality, resulting in an unfavourable treatment outcome and significantly increasing total patient costs.^{42–45} In this study, we further investigated the relationship between patient/diagnostic delay and CHE for TB care among patients with TB. We found about half patients encountered patient delay or diagnostic delay, who incurred more serious CHE than those without delay. Also, we demonstrated that patient delay and

Table 5 Independent determinants of CHE for TB care using a logistic regression model

Variables	β	SE	Wald	P value	OR (95% CI)
Patient delay (Ref: without delay)	0.294	0.128	5.251	0.022	1.342 (1.043 to 1.726)
Diagnostic delay (Ref: without delay)	0.431	0.129	11.145	0.001	1.540 (1.195 to 1.983)
Sex (Ref: female)	0.347	0.144	5.764	0.016	1.141 (1.066 to 1.877)
Age (years) (Ref: ≤ 40)			8.557	0.014	
41–59	0.336	0.187	3.216	0.073	1.399 (0.969 to 2.019)
≥ 60	0.75	0.256	8.554	0.003	2.117 (1.281 to 3.498)
Resident status (Ref: migrant)	0.375	0.15	6.247	0.012	1.455 (1.084 to 1.951)
Marital status (Ref: single)			6.239	0.044	
Married	–0.005	0.192	0.001	0.977	0.995 (0.683 to 1.448)
Divorced/widow	0.794	0.36	4.87	0.027	2.211 (1.093 to 4.475)
Educational level (Ref: primary or below)			8.224	0.016	
Junior high	–0.294	0.187	2.485	0.115	0.745 (0.517 to 1.074)
High school and above	–0.612	0.215	8.114	0.004	0.542 (0.356 to 0.826)
Occupation (Ref: unemployed)			28.975	0.000	
Employed	0.025	0.176	0.02	0.887	1.025 (0.726 to 1.448)
Peasant	0.791	0.189	17.475	0.000	2.205 (1.522 to 3.194)
Student	0.368	0.279	1.745	0.187	1.446 (0.837 to 2.497)
Retiree	–0.318	0.257	1.53	0.216	0.727 (0.439 to 1.204)
Health insurance (Ref: none)			6.355	0.174	
NCMS	0.524	0.232	5.087	0.024	1.688 (1.071 to 2.661)
MIUR	0.358	0.248	2.085	0.149	1.431 (0.880 to 2.327)
MIUE	0.158	0.266	0.353	0.553	1.171 (0.695 to 1.974)
Other insurance plan	0.169	0.398	0.181	0.671	1.184 (0.543 to 2.583)
Hospitalisation (Ref: not hospitalisation)	0.294	0.176	2.784	0.095	1.342 (0.950 to 1.897)

The variables that showed association with CHE ($p < 0.05$) in the univariate analysis were included in the multivariate model.

CHE, catastrophic health expenditure; MIUE, Medical Insurance for Urban Employees; MIUR, Medical Insurance for Urban Residents; NCMS, New Cooperative Medical Scheme; Ref, reference group; TB, tuberculosis.

diagnostic delay were crucial determinants of CHE. Consistently, Laokri *et al* found that patient delay over 1 month was an independent determinant of incurring catastrophic expenditure.¹³ In addition, a large number of studies had revealed that patient delay and diagnostic delay were independent factors associated with total OOP costs.^{23 25 34 35 46} Actually, prolonged delays in TB diagnosis are still prevailing problems in many countries in many low-income and middle-income countries, such as in Ethiopia, Zambia, Tanzania, Mozambique, Indonesia and so on.^{43 47–50} Therefore, it is vital to take measures to shorten the delay in diagnosis.

Patient delay may be related to the fact that patients do not take minor symptoms seriously in its early stage and will pay greater attention to it until symptoms become more severe.³⁸ In addition, many sociodemographic and economic factors contribute to patient delay.²⁹ Therefore, we should adopt comprehensive measures to facilitate patients to seek care early, such as strengthening TB health education to the public and adopting a precise poverty alleviation to increase the income of poverty-stricken patients. Early diagnosis is difficult due to the vast percentage of asymptomatic PTB patients and non-availability of rapid, accurate and cost-effective tests in many settings.⁵¹ In this study, only one-quarter of patients has been confirmed bacteriological and mainly based on traditional methods. Rapid molecular methods were not frequently used in Chongqing in 2013. Hence, more rapid, accurate and affordable methods are urgently needed to shorten the time of diagnosis.

Multivariate regression analysis indicated that demographic factors such as age, sex, marital status, occupation, resident status and education level independently affected the risk of catastrophic costs for TB care. Consistent with previous studies in Nigeria and other cities of China, age was an essential determinant of CHE,^{11 17} but only patients who were ≥ 60 years significantly affect CHE after removing the confounding factors in our study. Usually, men were the breadwinner of a family, thus we and Ukwaja *et al* found male patients were more easily to experience CHE,¹¹ but Zhou *et al* showed that gender had no significant associations with CHE.¹⁷ In contrast with a previous study in China,¹⁷ we found marital status was an independent factor related with CHE, but the family size and hospitalisation were not determinants of CHE because we grouped different segments of the household population. Besides, only 15.9% of patients had been hospitalised during the treatment, much lower than the figure in a previous study of 55%.¹⁷ Generally, people with low educational level also have less economic income, and thus we all demonstrated patients with less education were more likely to incur CHE.^{11 13} Compared with inhabitants, migrants had a smaller proportion of patients being male, elderly or peasant and a higher proportion of patients with high educational level, thus migrant patients were less likely to experience CHE compared with inhabitant patients.

We found that patients covered by NCMS, compared with those without any type of health insurance, were more likely to experience CHE. A series of studies conducted in China have demonstrated that NCMS could not relieve the financial burden of TB-related medical costs and had a partial effect on protecting TB-related households from CHE.^{17 39 52} Compared with patients not covered by NCMS, patients with TB covered by the NCMS only had a 5% higher reimbursement rate regarding outpatient and total medical costs in Zhejiang and Sichuan provinces of China.³⁹ NCMS is designed exclusively for rural residents particular for peasants, who are usually in low-income status. Also, the majority of patients without health insurance were migrants. In contrast with the previous study in China, we did not find MIUR or MIUE has any positive effect on reducing CHE.¹⁷ It may be due to the actual reimbursement rate of health insurance is low in China. These three types of health insurances largely cover inpatient services but the benefit package for outpatient care vary widely. In fact, a lot of areas existed to ignore reimbursements to varying degrees in China, especially for outpatient services.⁴⁰ In research, there was no reimbursement for medical costs during prediagnosis and diagnosis, which further indicated that the actual reimbursement rate is very low. Thus, so far health insurance plan did not actually help to relieve the financial burden for patients with TB in China. Consequently, the health insurance policy should be implemented effectively.

This study has some limitations. First, some data collected based on self-reporting could not be checked, which may be subjected to recall bias. Second, the data in this study were collected 4 years ago, and the per capita income has increased from 2014 to 2017. However, China's free TB service policy has not changed in recent years, and TB inequitably affects poor people. Therefore, the CHE remains a problem for TB now in China. Third, we did not use the new definition of 'catastrophic costs due to TB' recommended by WHO, which is the total (direct and indirect) costs exceeding 20% of annual household income recently.¹⁵ Although the threshold (10%) we set was lower than the new definition and we did not take indirect costs into account, it may also be valuable to present the proportion of TB-affected patients (and their households) facing catastrophic costs if direct costs alone are counted.¹⁵ Furthermore, the data about the CHE associated with TB were limited worldwide and correlational research has been conducted only in three cities in China. Consequently, our study may add some new data of CHE for TB care in China.

CONCLUSION

Although all patients have access to free TB service policy and the majority of them have health insurance, patients with TB still shoulder a high burden of OOP payments and experience high incidence and intensity of CHE for TB care in Chongqing, China. Except for sociodemographic factors, patient delay and diagnostic delay are essential

determinants of CHE for TB care, which highlights the significance of early care seeking and early diagnosis. In addition, NCMS aggravates the catastrophic costs, which implicates that it is essential to improve the actual reimbursement rates of health insurance, especially for outpatients. Furthermore, more fine-tuned interventions such as precise poverty alleviation are essential to be taken for vulnerable patients with TB to reduce their catastrophic costs. Overall, our results have provided some baseline data about CHE for TB, which may give some clues for a further prospective study.

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