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A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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Abstract

Objectives: TB control in schools is a concern in low- and middle-income countries with high TB burdens. TB knowledge is recognized as important for TB control in China, which has one of the highest TB prevalence in the world. Accordingly, the country's 2008 National TB Control Guideline emphasized TB health education in schools as one of the core strategies for improving TB knowledge among the population. It was important to assess the level of TB knowledge in schools five years following implementation of the guideline, in order to determine if the information was reaching the targets.

Design: A cross-sectional study.

Methods and study setting: This survey assessed TB knowledge and access to TB health information by questionnaire survey among 1,486 medical undergraduates from medical universities in southwest China.

Results: Overall, the students had inadequate TB knowledge. Only 24.1%, 27.2%, and 34.1% of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively. Very few (14.5%) had heard about the Directly Observed Therapy Short Course (DOTs), and only about half (54%) had ever accessed TB health education information. Exposure to health education messages was significantly associated with increased knowledge of the five core TB knowledge as follows: classic TB symptoms of cough/blood-tinged sputum ([OR(95%CI): 0.5(0.4, 0.7]), TB modes of transmission ([OR(95%CI): 0.4(0.3, 0.5]), curability of TB ([OR(95%CI): 0.6(0.5, 0.7]), location and services provided by TB local dispensaries ([OR(95%CI): 0.6(0.5, 0.8]), and the national free TB treatment policy ([OR(95%CI): 0.7(0.5, 0.8]).

Conclusions: The findings pose the question of whether it is time for a rethink of the current national and global approach to TB health education/promotion which favors promotion of awareness on World TB Days rather than regular community sensitization efforts.

Key words: *Tuberculosis knowledge; undergraduate students; TB health promotion; China;*

ARTICLE SUMMARY

Article focus:

- To describe knowledge of TB among undergraduate medical students.
- To explore factors associated with TB knowledge among undergraduate medical students.
- To attract attention to reform of school-based TB health education and promotion

Key messages

- Overall, undergraduate medical students had inadequate TB knowledge.
- Undergraduate students had limited access to TB health education/promotion.
- A rethink of current national and global approaches to TB health education/promotion is urgently needed in the light of the current global burden of TB.

Strengths and limitations of this study

- The main strength of the manuscript is the establishment of a baseline level of TB knowledge among undergraduate medical students. This is the first study to assess school-based TB health education/promotion in study area.
- The main limitation is that the study is cross-sectional which cannot assess TB knowledge changes before and after school TB health education/promotion.

INTRODUCTION

The 16th Global Report on Tuberculosis (TB) published by WHO in 2012 showed that the Millennium Development Goal target for halting and reversing the TB epidemic by 2015 had already been achieved, with mortality and incidence rates falling in 22 high-burden countries. Nevertheless, the global burden of TB remains untenable, [1] in high-burden countries such as China. Globally, TB remains the second leading cause of death from infectious diseases (after HIV/AIDS).[1] Over the past five years, there has been a marked increase in the number of TB patients diagnosed with multi-drug resistant TB (MDR-TB) .[1]China has the world's second largest tuberculosis epidemic and has contributed significantly to this MDR-TB increase. In recent years, the country has undertaken measures to control TB, and in order to evaluate the progress of TB control in the past decade, the country launched the 5th National Sampling Survey of TB Epidemiology in 2010[2]. Results of the survey showed an estimated 8.28 million cases of pulmonary TB (PTB) in the country from 2001 to 2010.[2]In spite of concerted international and national efforts to address TB in the country, annual prevalence (per 100,000 people) declined only minimally from 466 in 2000 to 459 in 2010. [2] Similarly, incidence of MDR-TB among PTB cases has remained unchanged in the past decade, and resistance to first-line drugs among newly diagnosed TB patients rose from 34.2 % in 2007/2008 [3]to 36.9% in 2010 . [2]

Owing to lack of TB knowledge, less than half of patients with TB symptoms seek healthcare timely. [2] Available evidence shows that only 59% TB patients comply with treatment, and

among the public, only 57% have proper TB knowledge.[2] Limited knowledge about signs and symptoms of TB results in delays in TB diagnosis and treatment, which in return, increases not only the risk of TB transmission, but also the development of MDR-TB. China's MDR-TB prevalence rate of 6.8% is the highest in the world.[2]

TB control among undergraduate students is recognized as a concern in low- and middle-income countries with high TB burdens. Undergraduate students usually live in conditions of relative overcrowding that are conducive to TB outbreaks.[4] TB outbreaks among students have been reported even in such low-endemicity countries as the UK, Italy, Ireland, and the USA.[5-9] Chinese undergraduate students are recognized as a particularly vulnerable population for TB. The TB prevalence (per 100,000) among Chinese students has been reported to be as high as 1,520, which is significantly higher than the rate (459) for the general population.[10]. Chongqing, Guizhou, and Shanxi provinces were the three provinces with the highest TB burden among undergraduate students between 2005 and 2008.[11] In addition, several TB outbreaks among undergraduate students were recently reported in Chongqing, Liangning, Zhejiang, Shangdong, and Guizhou, with the incidence rates ranging from 620 to 31,370 per 100,000.[10-16]

University medical students can become exposed to TB infection during clinic rotations [17]. Thus, adequate knowledge of the epidemiology and control is critically important for this population group. Knowledge of TB among university medical undergraduates is also important since they represent potential future physicians or leaders in the fight against TB.[18]

In 1998, WHO released a document following a workshop on Tuberculosis Control and Medical Schools held in Rome, Italy, in 1997, which stressed the importance of graduating medical students with proper knowledge and skills related to effective TB control.[19] WHO later released a manual that aims to inform medical students and medical practitioners about best practices in managing TB patients.[20] Several studies have documented inadequate TB knowledge and poor compliance with TB treatment guidelines among practicing physicians.[21-23] In countries where TB (including MDR-TB) presents significant challenges to public health, equipping emerging physicians with in-depth TB knowledge is of critical importance in the overall efforts to reduce the burden of the disease. In China, school TB health promotion was emphasized in the 2008 National Guideline for TB Control.[24] It was important to assess the level of TB knowledge in schools five years following implementation of the guideline. This survey assessed TB knowledge and access to TB health information among 1,486 pre-clinical undergraduate students from two medical universities in southwest, China which has one of the highest burdens of TB in the country. It was hoped that the findings could help to identify whether the information was reaching the targets, and thus engender efforts to strengthen TB school education in the region and similar locales in low and middle income countries with high TB burden.

METHODS

Study setting

The study setting, Southwest China, includes Chongqing Municipality, the provinces of Sichuan, Yunnan, Guizhou, and Tibet Autonomous Region (Figure 1) where prevalence rates

(cases per 100,000) of active TB (695), smear positive TB (105), and culture positive TB (198) are much higher than the national prevalence rates of 459, 66, and 119, respectively.[2] Southwest China has a population of more than 19 million which represent more than 10 % of China's population of 1.3 billion people.

Participants

There were 10 medical universities in Southwest China. These universities offer 5-year majors in clinical medicine, public health, pharmacy, medical laboratory, Chinese medicine, and nursing. We randomly selected two of the 10 universities and restricted our sample frame to pre-clinical students in their first to third years of training. We excluded fourth- and fifth-year students since they may have received clinical training on TB as part of their curriculum rather than from government school TB health education. The survey was conducted between November 2011 and May 2012 and focused on the assessment of TB knowledge among the respondents. The sample frame consisted 20,000 eligible students. To obtain a power of 80% and a confidence level of 95%, we calculated the study sample to be 1536.[25] During recruitment, potential participants were approached and provided with detailed explanation of the study and its objectives. They were then asked if they would be interested in volunteering to participate. Those who expressed interest were asked to read the informed consent form, and were assured of confidentiality. They were then asked to sign the informed consent form as a conformation of their voluntary participation in the study. The ethics committees of the two study universities approved the study protocol prior to its implementation.

Questionnaire

The survey was cross-sectional in design. Following participant enrollment in the study, data were collected by means of a self-administered questionnaire that assessed participants' knowledge about TB transmission, management, and control. Data were elicited on the following variables: socio-demographic profile (age, sex), major, year in the medical program, (signs and symptoms, mode of transmission, knowledge about TB control facilities in the study setting, local TB prevention, management, and control policies and program), and core knowledge of TB, namely, five core TB knowledge areas which include: (i) classic TB symptoms of cough/blood-tinged sputum, (ii) TB modes of transmission, (iii) curability of TB, (iv) location and services provided by TB local dispensaries, and (v) the national free TB treatment policy.

Data analysis

Epi-data 6.0 was used for data entry, and analyses were conducted, using the Statistical Package for Social Sciences version 18.0. To assess TB knowledge among the participants, we calculated the percentage of people who provided correct responses to questions about the 5 core knowledge of TB, 6 symptoms of TB, 2 ways of transmitting TB, 4 items of the free TB treatment policy in China, and 5 contents of DOTS. We used chi-square statistics (χ^2) to assess participants' responses by gender, year in medical school, and program major. Multiple logistic regression models were used to examine factors associated with core knowledge of TB among the respondents. We used a two-tailed probability level of <0.05 as the level of statistical significance.

RESULTS

Demographic characteristics of participants

A total of 1,486 undergraduate medical students participated in the survey. Of these, 470 were in their first year medical training, 399 in the second year, and 617 in the third year. A majority of the respondents (74.2%; n=1102) were male， and 68.4% students were majoring in clinical medicine. Only 54% of the students indicated having access to some kind of TB health information (Table1).

Knowledge of TB symptoms

Survey results showed that as many as 91% of the students had heard of TB. In spite of this, about 18% (n=261) had no knowledge of any TB symptoms; less than 10% (n=132) were able to identify all of the TB symptoms (Figure 2 A). Only 50.9% and 40% could identify the two key TB symptoms of blood-stained sputum, and chronic cough lasting 3 weeks. Only 20% knew other TB symptoms such as fever, weakness, and weight loss (Table 2). Third-year students had better knowledge of TB symptoms ($p \leq 0.05$), and there were no statistically significant differences between students in clinical and non-clinical majors （$p>0.05$） （Table 2).

Knowledge about TB transmission

Only 27.9% (n=414) of the respondents were aware that TB could be transmitted through

exposure to droplet nuclei from the cough of an infected person; and slightly more than half (56.6%; n=841) knew that sneezing by TB patients could release droplet nuclei that could transmit the disease to others (Table 2). Only 14.7% (n=218) of the students knew the two main routes of TB transmission (Figure 2b). Overall, more females (88%; n=338) and third-year students (86.1%; n=531) knew the transmission routes of TB（$p<0.05$).

Knowledge about TB treatment and policies

Although 80% of the students knew that TB was curable, only 30% (n=446) knew the treatment course of TB. Only 27.2% (n=404) knew their local TB control facilities; 34% and 14.5% had heard of the national free TB treatment policy and DOTS, respectively (Table 2). A greater proportion of female than male respondents had better knowledge about the TB treatment course (32.8% vs 28.5%), TB control facilities (35.7% vs 24.4%), free TB treatment policy (41.9% vs 31.4%), and DOTS (19.0% vs 12.9%) ($P\leq0.05$). Overall, third-year students had better knowledge of TB treatment except for knowledge on TB control facilities. There were no significant differences between students in clinical and non-clinical majors (Table 2). Only 12% (n=178) of the respondents knew all the 4 items included in the free TB treatment policy (registration, sputum test, chest X-rays, and anti-TB drugs); 58% (n=862) did not know any items included in the free policy (Figure 3 A). Less than 10% (n=106) of the students were familiar with all 5 items of DOTS (Figure 3 B).

Core knowledge of TB

With regard to core knowledge of TB, only 24.1% (n=358), 27.2% (n=404), and 34.1%

(n=506) of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively (Figure 4A). Only 2.4% (n=36) were familiar with all five core **TB** knowledge areas (Figure 4B). Multiple logistic regression analysis indicated that access to health education was associated with knowledge of the five core TB knowledge areas, (OR [(95%CI): 0.5(0.4, 0.7]) for classic TB symptoms of cough/blood-tinged sputum, (OR [(95%CI): 0.4(0.3, 0.5]) for TB modes of transmission, (OR [(95%CI): 0.6(0.5, 0.7]) for curability of TB, (OR [(95%CI): 0.6(0.5, 0.8]) for location and services provided by TB local dispensaries, and (OR [(95%CI): 0.7(0.5, 0.8]) for the national free TB treatment policy. Males had poor knowledge related to transmission of TB, TB dispensaries and free TB treatment policy (OR (95%CI): 1.8(1.3, 2.7), 1.7(1.3, 2.4), 1.9(1.5, 2.4), respectively. Third year students had better knowledge of TB compared with students in the first and second years (Table 3).

Sources of TB Knowledge

With regard to how the respondents gained awareness and understanding of TB, survey results indicated that the most frequent source of information was textbooks, the second was the Internet, and the third was the media (newspaper and billboards) (Figure 5).

DISCUSSION

TB is still one of the most important global public health threats. If global control of the disease does not improve, the annual global incidence is expected to increase from the current 21% to 61% by 2020.[26] Early detection and adequate treatment are critical control measures. In spite of the fact that China carries one of the highest TB burdens in the world, lack of

knowledge about the disease remains an abiding problem in the country, and thus, presents a barrier to control efforts.[2]

Medical students are China's future health professionals and clinical leaders. Thus, understanding their level of awareness about TB is important. Unfortunately, this survey revealed that these students had generally poor knowledge of TB.

Similar surveys conducted in other countries have reported inadequate knowledge of TB among medical professional students. In Turkey for example, [27] a study of 828 fourth-year medical students found that they lacked skills in interpreting radiology and smears even in their last year of medical school. One study in Brazil found that medical students had poor knowledge of TB transmission and engaged in risky behaviors. [28] Similarly, a study in the United States reported that, prior to implementation of the National Tuberculosis Curriculum Consortium (NTCC) in U.S. medical schools, about one-third of medical students did not know the method for administering tuberculin skin test or that the BCG vaccine was not a contraindication to TB skin testing. [29]

The 2008 National Guideline for TB Control in China emphasizes five items of core knowledge of TB.[24] In the present study, it is of particular concern that the students scored very low in the TB core knowledge domain. The average knowledge base for all of the 5 core knowledge domains was only 2.4%, which was lower than the score (43.45%) reported in a previous study in China's Hunan province.[30] We also found that only 24.1% knew the classic symptoms of TB (cough and blood stained sputum), which was similar to the report in

Nanjing, China where only 26.3% students were familiar with TB symptoms.[31] Less than 30% of the respondents knew the course of TB treatment and were aware of TB control facilities in Southwest China. This was lower than the rate observed in a previous study by Zhang et al. (2012).We found that only 30% knew the free TB treatment policy in China, which is similar to that reported in a related study. [32] One-third of our respondents could not identify a mode of transmission for TB. A survey of final year medical students in China's Hunan province in 2000 concluded that knowledge and practical competencies regarding TB among final-year medical students were generally inadequate. [33] Results of our current study showed that the situation has not improved in the past 13 years.

TB education has been widely recognized as an effective way to promote TB knowledge among students. In 2003, the U.S. National Institutes of Health (NIH) perceived a need to strengthen the teaching of TB to health-profession students, and funded the National Tuberculosis Curriculum Consortium (NTCC) to help address this need. [29] Evidence shows that this has contributed to marked improvement in TB knowledge among students throughout the. [29, 34-35] Strong recommendations to strengthen TB knowledge of medical and other health-professions students through education have also been made by other countries . [36] Although the 2008 National Guideline for TB Control in China emphasizes TB health education and promotion for the public, TB patients, and students, TB health education and promotion in universities remain sub-optimal .[24] Findings from many studies have shown that 40%-63.7% of students reported "hearing from others" as their primary source of information about TB. [31,36] This study also found that only 54% students had ever received

TB health education. Accessing TB health education was significantly associated with core knowledge of TB. Given that non-clinical students have less opportunity to learn about TB as part of their regular curriculum, school TB health education should be seen as a primary source of information on TB for them.

CONCLUSION

In countries with high TB burden, it is important that all opportunities to raise population awareness about the disease are used to the optimum. In line with the WHO settings approach to health promotion,[19] schools should be seen as important avenues for TB health education given the multiplier effect such intervention is likely to have on the students, their families, communities and others in their social networks. [19] Unfortunately, there is the tendency to focus promotion of TB awareness on national/global TB Control Days to the neglect of a plethora of opportunities for ongoing promotion in diverse settings. The overall poor knowledge of TB among medical and health-professions students demonstrated by this study supports the need to increase TB school health education, especially in the light of recent outbreaks of TB in universities in Southwest China.[12,16] Given the high burden of TB in southwest China, especially in rural provinces, TB health education and promotion in schools should be strengthened on an ongoing basis and in coordination with local TB control departments and district-level Centers for Disease Control and Prevention (CDC). There is a need for targeted efforts to educate students about TB since the students can be a major source of information to rural dwellers, including their own families and others in their circles of influence.

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Contributors YL designed this survey, JE guided the questionnaire design and data collection, YZ, DL and XL collected data, DL managed data, YZ analyzed data. YZ and YL drafted the manuscript; JE edited the manuscript. All authors interpreted the results, revised the report and approved the final version.

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Competing interests None.

Ethics approval The ethics committees of the two study universities approved the study protocol prior to its implementation.

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Tables

Table1 Demographic characteristics of undergraduates surveyed in medical universities in southwest China (n=1486)

Demographic factors		N	%
Sex	Male	1102	74.2
	Female	384	25.8
Grade	Year 1	617	41.5
	Year 2	399	26.9
	Year 3	470	31.6
Major	Clinic medicine	1017	68.4
	Non-clinic medicine	469	31.6
Access to TB health education	Yes	802	54
	No	684	45

Table 2 Knowledge about TB symptoms, transmission and treatment among undergraduates in medical university in Southwest China※

Knowledge of TB	Total n（%）	Sex n（%）		Grade n（%）			Major n（%）	
		Male	Female	Year 3	Year 2	Year 1	Clinic medicine	Non-clinic medicine
Knowledge on TB symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399 (39.2)	198 (42.2)
Blood-tinged sputum	756(50.9)	608(55.2)	148(38.5)*	332 (53.8)	176 (44.2)	248 (52.9)*	509 (50.0)	247 (52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204 (33.1)	73 (18.4)	94 (20.0)*	269 (26.5)	102 (21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209 (33.9)	54 (13.6)	65 (13.8)*	235 (23.1)	93 (19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212 (34.4)	73 (18.3)	113 (24.0)*	270 (26.5)	128 (27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190 (30.8)	43 (10.8)	85 (18.1)*	220 (21.7)	98 (20.9)
Knowledge on TB transmission								
Known of transmission	1231(82.8)	893（81.0）	338（88.0)*	531（86.1）	316（79.4）	384（81.5)*	854（84.0）	377(80.4)
Cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Sneezing and loudly speaking	841(56.6)	607 (55.1)	234 (60.9)*	386 (62.6)	191 (48.0)	264 (56.3)*	597 (58.8)	244 (52.0)*
Knowledge on TB treatment								
Curable disease	1183(79.6)	891（81.0）	292（76.0)*	477（77.3	318（80.1）	388（82.6)*	802（79.0）	381(81.4)
Knowing treatment course	439(29.5)	313（28.5）	126（32.8)*	207（33.5）	109（27.5）	123（26.2)*	304（30.0）	135 (28.8)
Knowing TB dispensary	404(27.2)	267（24.4）	137（35.7)*	169（27.4）	108（27.1）	127（27.0）	270（26.5）	134 (28.6)
TB free policy	506(34.1)	345（31.4）	161（41.9）*	197（31.9）	123（31.1）	186（39.5)*	356（35.1）	150(32.0)
Heard of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148（14.6）	67(14.3)

※ χ^2 test used to compare between males and females, different grades, and different majors.

*P ＜0.05

Table 3 Factors associated with the core knowledge of TB among undergraduates in medical university in Southwest China

Factors	OR (95%CI)				
	TB symptoms of cough and blood-tinged sputum	TB as one infectious disease	TB as one curable disease	TB dispensary	TB free policy
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	0.1(0.1, 0.2)	1.8(1.3, 2.7)	0.8(0.6, 1.1)	1.7(1.3, 2.4)	1.9(1.5, 2.4)
Grade					
Year 1	Reference	Reference	Reference	Reference	Reference
Year 2	1.6(1.5, 1.9)	1.7(1.5, 1.9)	1.3(0.9, 1.8)	1.1(0.8, 1.5)	1.6(1.2, 2.0)
Year 3	1.8(1.2,2.6)	1.2(0.8,1.7)	1.1(0.7, 1.5)	1.1(0.8, 1.6)	1.7(1.2, 2.3)
Major					
Clinic medicine	Reference	Reference	Reference	Reference	Reference
Non-clinic medicine	1.1(0.8, 1.4)	1.7(0.5, 1.9)	1.2(0.9, 1.6)	1.1(0.8, 1.4)	0.8(0.6, 1.1)
Access to TB health education					
Yes	Reference	Reference	Reference	Reference	Reference
No	0.5(0.4, 0.7)	0.4(0.3, 0.5)	0.6(0.5, 0.7)	0.6(0.5, 0.8)	0.7(0.5, 0.8)

Figure legends

Fig. 1: The Southwestern People's Republic of China.

In this this figure demonstrated Southwest China. The place marked with red color is Southwest China which includes the municipality of Chongqing, the provinces of Sichuan, Yunnan and Guizhou, and the Tibet Autonomous Regions.

Fig. 2: Knowledge of TB symptoms and transmission among undergraduate medical students in Southwest China.

Figure 2A presents undergraduate medical students' knowledge of classical symptoms of TB; Figure 2B presents students' knowledge of means of TB transmission.

Fig. 3: Knowledge of TB free policy and DOTS among undergraduate medical students in Southwest China.

Figure 3A presents undergraduate medical students' knowledge of the free TB treatment policy in China; Figure 3B presents undergraduate medical students' knowledge of the contents of the Directly Observed Therapy-Short Course (DOTS) program.

Fig. 4: Knowledge of core TB knowledge among undergraduate medical students in Southwest China.

Figure 4A presents the percentage of undergraduate medical students correctly answered each question for core TB knowledge; Figure 4B presents percentage of undergraduate medical students correctly answered none, only one question, any 2, any 3, any4 and any 5 questions for core TB knowledge.

This figure presents undergraduate medical students' knowledge of core TB symptoms

Fig. 5: Sources of TB knowledge among undergraduate medical students in Southwest China.

This figure presents undergraduate medical students' major sources of information on TB.

72x59mm (300 x 300 DPI)

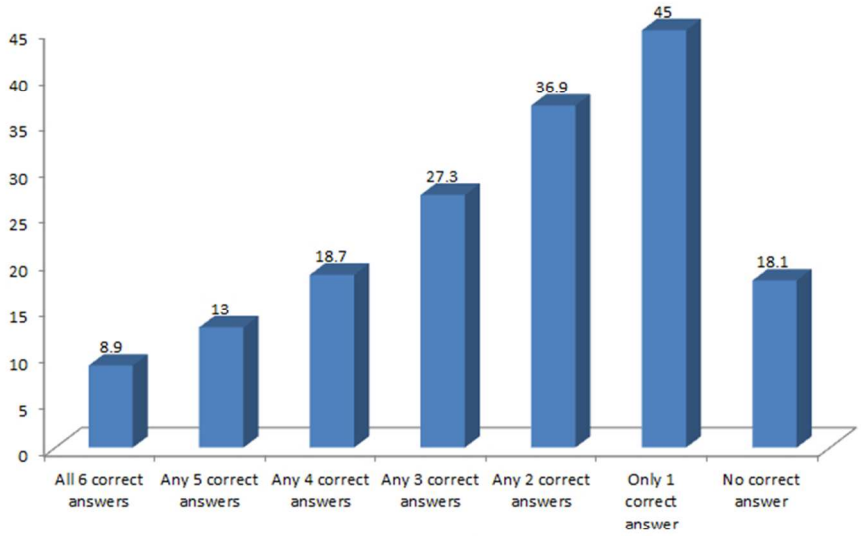

Figure2 A Percentage of correctly answered questions on knowledge about TB symptoms

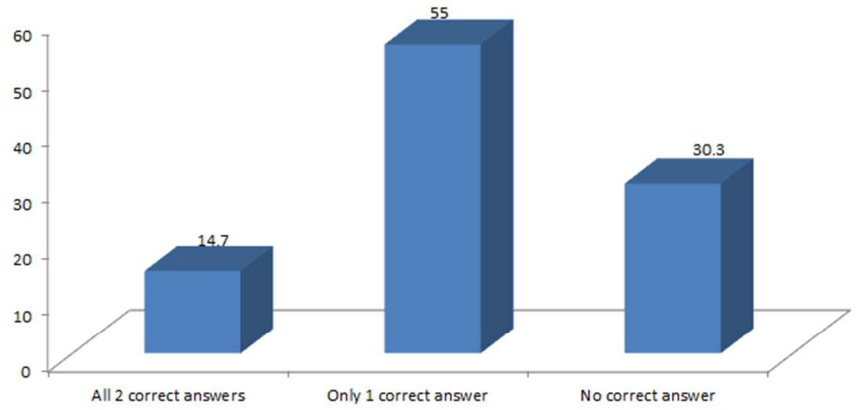

Figure2 B Percentage of correctly answered questions on knowledge about TB transmission

58x75mm (300 x 300 DPI)

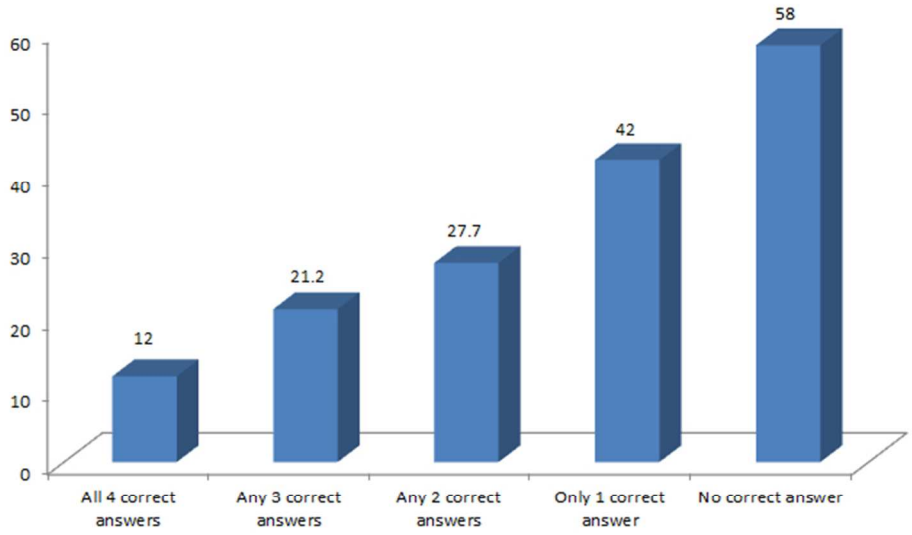

Figure3A Percentage of correctly answered questions on knowledge about TB free policy

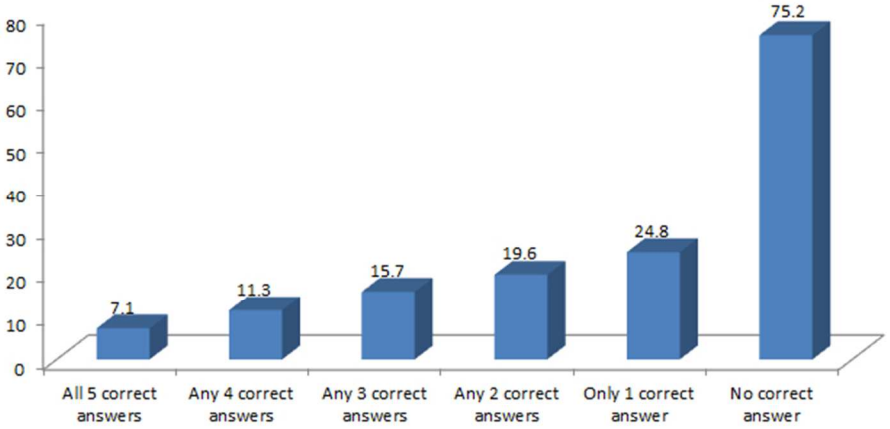

Figure3B Percentage of correctly answered questions on knowledge about DOTS

58x67mm (300 x 300 DPI)

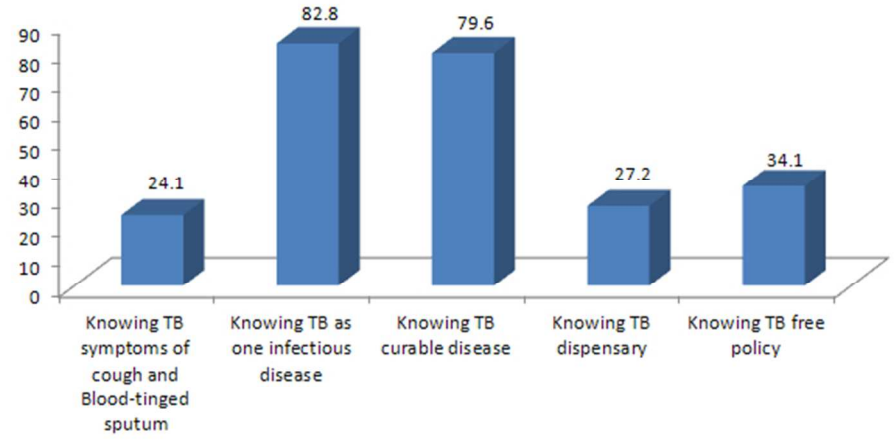

Figure 4A Percentage of correctly answered each question on TB core knowledge

Figure 4B Percentage of correctly answered questions on TB core knowledge

54x61mm (300 x 300 DPI)

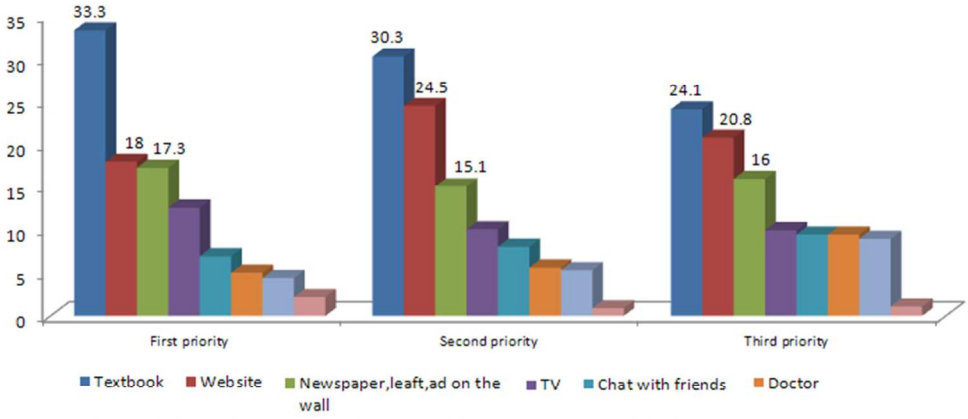

Figure 5 Percentage of students ranked the approach to get TB knowledge

60x30mm (300 x 300 DPI)

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A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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Abstract

Objectives: TB control in schools is a concern in low- and middle-income countries with high TB burdens. TB knowledge is recognized as important for TB control in China, which has one of the highest TB prevalence in the world. Accordingly, National TB Control Guideline in China emphasized TB health education in schools as one of the core strategies for improving TB knowledge among the population. It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline, in order to determine if the information was reaching the targets.

Design: A cross-sectional study.

Methods and study setting: This survey assessed TB knowledge and access to TB health information by questionnaire survey with 1,486 undergraduates from two medical universities in southwest China.

Results: Overall, the students had inadequate TB knowledge. Only 24.1%, 27.2%, and 34.1% of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively. Very few (14.5%) had heard about the Directly Observed Therapy Short Course (DOTs), and only about half (54%) had ever accessed TB health education information. Exposure to health education messages was significantly associated with increased knowledge of the five core TB knowledge as follows: classic TB symptoms of cough/blood-tinged sputum (OR[95%CI]: 0.5[0.4, 0.7]), TB modes of transmission (OR[95%CI]: 0.4[0.3, 0.5]), curability of TB (OR[95%CI]: 0.6[0.5, 0.7]), location and services provided by TB local dispensaries (OR[95%CI]: 0.6[0.5, 0.8]), and the national free TB treatment policy (OR[95%CI]: 0.7[0.5, 0.8]).

Conclusions: The findings pose the question of whether it is time for a rethink of the current national and global approach to TB health education/promotion which favors promotion of awareness on World TB Days rather than regular community sensitization efforts.

Key words: *Tuberculosis knowledge; undergraduate students; TB health promotion; China;*

ARTICLE SUMMARY

Article focus:

- To describe knowledge of TB among undergraduate medical students.
- To explore factors associated with TB knowledge among undergraduate medical students.
- To attract attention to reform of school-based TB health education and promotion

Key messages

- Overall, undergraduate medical students had inadequate TB knowledge.
- Undergraduate students had limited access to TB health education/promotion.
- A rethink of current national and global approaches to TB health education/promotion is urgently needed in the light of the current global burden of TB.

Strengths and limitations of this study

- The main strength of the manuscript is the establishment of a baseline level of TB knowledge among undergraduate medical students. This is the first study to assess school-based TB health education/promotion in the study setting.
- The main limitation is that the study used a cross-sectional design, which did assess TB knowledge changes before and after school TB health education/promotion.

INTRODUCTION

The 16th Global Report on Tuberculosis (TB) published by WHO in 2012 showed that the Millennium Development Goal target for halting and reversing the TB epidemic by 2015 had already been achieved, with mortality and incidence rates falling in 22 high-burden countries. Nevertheless, the global burden of TB remains untenable,[1] in high-burden countries such as China. Globally, TB remains the second leading cause of death from infectious diseases (after HIV/AIDS).[1] Globally over the past five years, there has been a marked increase in the number of TB patients diagnosed with multi-drug resistant TB (MDR-TB).[1] China has the world's second largest tuberculosis epidemic and has contributed significantly to this MDR-TB increase. In recent years, the country has undertaken measures to control TB, and in order to evaluate the progress of TB control in the past decade, the country launched the 5th National Sampling Survey of TB Epidemiology in 2010.[2] Results of the survey showed an estimated 8.28 million cases of pulmonary TB (PTB) in the country from 2001 to 2010.[2] In spite of concerted international and national efforts to address TB in the country, annual prevalence (per 100,000 people) declined only minimally from 466 in 2000 to 459 in 2010.[2] Similarly, incidence of MDR-TB among PTB cases has remained unchanged in the past decade, and resistance to first-line drugs among newly diagnosed TB patients rose from 34.2 % in 2007/2008[3] to 36.9% in 2010.[2]

Owing to lack of TB knowledge, less than half of patients with TB symptoms seek healthcare timely.[2] Available evidence shows that only 59% TB patients comply with treatment, and among the public, only 57% have proper TB knowledge.[2] Limited knowledge about signs and

symptoms of TB often results in delays in TB diagnosis and treatment[4], which in return, increases not only the risk of TB transmission, but also the development of MDR-TB. China's MDR-TB prevalence rate of 6.8% is the highest in the world.[2]

TB control among undergraduate students is recognized as a concern in low- and middle-income countries with high TB burdens. Undergraduate students usually live in relative overcrowding conditions that are conducive to TB outbreaks.[5] TB outbreaks among students have been reported even in such low-burden countries as the UK, Italy, Ireland, and the USA.[6-10] Chinese undergraduate students are recognized as a particularly vulnerable population for TB. The TB prevalence (per 100,000) among Chinese students has been reported to be as high as 1,520, which is significantly higher than the prevalence (459) for the general population.[11] Chongqing, Guizhou, and Shanxi provinces were the three provinces with the highest TB burden among undergraduate students between 2005 and 2008.[12] In addition, several TB outbreaks among undergraduate students were recently reported in Chongqing, Liangning, Zhejiang, Shangdong, and Guizhou, with the incidence rates ranging from 620 to 31,370 per 100,000.[11-17]

Medical students in university can expose to TB infection during clinic rotations.[18] Thus, adequate knowledge of TB epidemiology and control is critically important for this population. Knowledge of TB among medical undergraduates in university is also important since they represent potential future physicians or leaders in the fight against TB.[19] In 1998, WHO released a document in 1997 following a workshop on Tuberculosis Control and Medical

Schools held in Rome, Italy, which stressed the importance of graduating medical students with proper knowledge and skills related to effective TB control.[20] WHO later released a manual that aims to inform medical students and medical practitioners about best practices in managing TB patients.[21] Several studies have documented inadequate TB knowledge and poor compliance with TB treatment guidelines among practicing physicians.[22-24] In countries where TB (including MDR-TB) presents significant challenges to public health, equipping emerging physicians with in-depth TB knowledge is of critical importance in the overall efforts to reduce the burden of the disease. In China, school TB health promotion was emphasized in the 2008 National Guideline for TB Control.[25] It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline. This survey assessed TB knowledge and access to TB health information among 1,486 pre-clinical undergraduate students from two medical universities in southwest China which has one of the highest TB burdens of in the country. It was hoped that the findings could help to identify whether the information was reaching the targets, and thus engender efforts to strengthen TB school education in the region and similar locales in low and middle income countries with high TB burden.

METHODS

Study setting

The study setting, Southwest China, includes Chongqing Municipality, the provinces of Sichuan, Yunnan, Guizhou, and Tibet Autonomous Region (Figure 1) where prevalence rates (cases per 100,000) of active TB (695), smear positive TB (105), and culture positive TB

(198) are much higher than the national prevalence rates of 459, 66, and 119, respectively.[2] Southwest China has a population of more than 19 million which represent more than 10% of China's population of 1.3 billion people.

Participants

There were 10 medical universities in Southwest China. These universities offer 5-year majors in clinical medicine, public health, pharmacy, medical laboratory, Chinese medicine, and nursing. We randomly selected two of the 10 universities and restricted our sample frame to pre-clinical students (students who have not received clinic curriculum) in their first to third years of training. We excluded fourth- and fifth-year students since they might have obtained TB knowledge from their clinical training as part of their clinical curriculum rather than from government school TB health education. The survey was conducted between November 2011 and May 2012 and focused on the assessment of TB knowledge among the respondents. The sample frame consisted of 20,000 eligible students. To obtain a power of 80% and a confidence level of 95%, we calculated the study sample to be 1536.[26] During recruitment, potential participants were approached and provided with detailed explanation of the study and its objectives. They were then asked if they would be interested in volunteering to participate. Those who expressed interest were asked to read the informed consent form, and were assured of confidentiality. They were then asked to sign the informed consent form as a conformation of their voluntary participation in the study. Approval for the study was obtained from the Institutional Review Boards of the College of Preventive Medicine, Third Military Medical University, Chongqing, China (October, 20, 2011) and the School of

Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan Province, China (28 April, 2012).

Questionnaire

The survey was cross-sectional in design. Following participant enrollment in the study, data were collected by means of a self-administered questionnaire that assessed participants' knowledge about TB signs/symptoms, transmission, management, and control. Data were elicited on the following variables: socio-demographic profile (age, sex), degree major (clinical and non-clinical), year in the medical program, TB knowledge (symptoms, mode of transmission, treatment, knowledge of TB control facilities in the study setting, local TB control policies and program), and core knowledge of TB, namely, five core TB knowledge areas which include: (i) classic TB symptoms of cough/blood-tinged sputum, (ii) TB modes of transmission, (iii) curability of TB, (iv) location and services provided by TB local dispensaries, and (v) the national free TB treatment policy.

Data analysis

Epi-data 6.0 was used for data entry. Data analyses were conducted using the Statistical Package for Social Sciences version 18.0. To assess TB knowledge among the participants, we calculated the percentage of people who provided correct responses to questions about the 6 symptoms of TB, 3 ways of transmitting TB, 5 items related to TB treatment, and 5 core knowledge of TB. We used chi-square statistics (χ^2) to assess participants' responses by gender, year in medical school, and degree major. A binary logistic regression model which

included variables with statistical significance on the χ^2 test, were used to examine factors associated with core knowledge of TB among the respondents. We used a two-tailed probability level of <0.05 as the level of statistical significance.

RESULTS

Demographic characteristics of participants

A total of 1,486 undergraduate medical students participated in the survey. Of these, 617 were in their first year medical training, 399 in the second year, and 470 in the third year. A majority of the respondents (74.2%; n=1102) were male， and 68.4% students were majoring in clinical medicine. Only 54% of the students indicated having access to some kind of TB health information (Table 1).

Knowledge of TB symptoms

The respondents' knowledge of symptoms is shown in Table 2. About 18% (n=261) had no knowledge of any TB symptoms, and less than 10% (n=132) were able to identify all TB symptoms (Figure 2 A). As for overall knowledge of TB symptoms, 10.8% (119) male and female3.4% (13) year had knowledge of all of these classic symptoms($p \leq 0.05$), 13.6% (84), 4.3 % (17), 6.6% (31) students of third-year, second year and first-year had knowledge of all of these classic symptoms ($p \leq 0.05$). There were no statistically significant differences in knowledge of TB symptoms between students in clinical and non-clinical degree majors （$p>0.05$） （Table 2).

Knowledge about TB transmission

Only 27.9% (n=414) of the respondents were aware that TB could be transmitted through exposure to droplet nuclei from the cough of an infected person (Table 2), and only 14.7% (n=218) knew the two main routes of TB transmission (Figure 2B). Overall, more females (88%; n=338) and third-year students (86.1%; n=531) knew the transmission routes of TB （$p<0.05$).

Knowledge about TB treatment and policies

Although 80% of the students knew that TB was curable, only 30% (n=446) knew the duration of TB treatment. Only 27.2% (n=404) knew TB control facilities (TB dispensaries); 34% and 14.5% had heard of the national free TB treatment policy and DOTS, respectively (Table 2). A greater proportion of female than male respondents had better knowledge about the duration of TB treatment, TB control facilities, free TB treatment policy, and DOTS($P\leq0.05$). Overall, third-year students had better knowledge of TB treatment except for knowledge on TB as a curable disease and free treatment policy. There were no significant differences between students in clinical and non-clinical majors (Table 2). Only 12% (n=178) of the respondents knew all the 4 items included in the free TB treatment policy (registration, sputum test, chest X-rays, and anti-TB drugs) (Figure 3A). Less than 10% (n=106) of the students were familiar with all 5 items of DOTS (Figure 3B).

Core knowledge of TB

With regard to core knowledge of TB, less than half students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and the national free TB treatment policy (Figure 4A). Only 2.4% were familiar with all five core TB knowledge areas (Figure 4B). Multiple logistic regression analysis indicated that access to health education was associated with the five core TB knowledge: (OR [95%CI]: 0.5[0.4, 0.7]) for classic TB symptoms of cough/blood-tinged sputum, (OR [95%CI]: 0.4[0.3, 0.5]) for means of TB transmission, (OR [95%CI]: 0.6[0.5, 0.7]) for curability of TB, (OR [95%CI]: 0.6[0.5, 0.8]) for TB dispensaries, and (OR [95%CI]: 0.7[0.5, 0.8]) for the national free TB treatment policy. Males had poor knowledge related to transmission of TB, TB dispensaries and free TB treatment policy (OR [95%CI]: 1.8[1.3, 2.7], 1.7[1.3, 2.4], 1.9[1.5, 2.4]), respectively. Third year students had better knowledge of TB compared with students in the first and second years (Table 3).

Sources of TB Knowledge

With regard to how the respondents gained awareness and understanding of TB, survey results indicated that the most frequent source of information was textbooks, the second was the Internet, and the third was the media (newspaper and billboards) (Figure 5).

DISCUSSION

TB is still one of the most important global public health threats. If global control of the disease does not improve, the annual global incidence is expected to increase from the current 21% to 61% by 2020.[27] Early detection and adequate treatment are critical control measures. In spite of the fact that China carries one of the highest TB burdens in the world, lack of

knowledge about the disease remains an abiding problem in the country, and thus, presents a barrier to control efforts.[2]

Medical students are China's future health professionals and clinical leaders. Thus, understanding their level of awareness about TB is important. Unfortunately, this survey revealed that these students had generally poor knowledge of TB. Surveys conducted in other countries have reported inadequate knowledge of TB among medical professions students. In Turkey for example,[28] a study of 828 fourth-year medical students found that they lacked skills in interpreting radiology and smears even in their last year of medical school. One study in Brazil found that although medical students had had good knowledge of biosafety norms, they engaged in risky behaviors in health care settings where TB patients were assisted[29] Similarly, a study in the United States reported that, prior to implementation of the National Tuberculosis Curriculum Consortium (NTCC) in U.S. medical schools, about one-third of medical students did not know the method for administering tuberculin skin test or that the BCG vaccine was not a contraindication for TB skin testing.[30]

The 2008 National Guideline for TB Control in China emphasizes five items of core knowledge of TB.[25] In the present study, it is of particular concern that the students scored very low in the TB core knowledge domain. The average knowledge base for all of the 5 core knowledge domains was only 2.4%, which was lower than the score (43.45%) reported in a previous study in China's Hunan province.[31] We also found that only 24.1% knew the classic symptoms of TB (cough and blood stained sputum), which was similar to the report in

Nanjing, China where only 26.3% students were familiar with TB symptoms.[32] This study observed that less than 30% of the respondents knew the course of TB treatment and were aware of TB control facilities in Southwest China which was lower than the rate observed in a previous study (36.66%).[32] We found that only 30% knew the free TB treatment policy in China, which was similar to that reported in a related study.[33] One-third of our respondents could not identify a mode of transmission for TB. A survey of final year medical students in China's Hunan province in 2000 concluded that knowledge and practical competencies regarding TB among final-year medical students were generally inadequate.[34] Results of our current study showed that the situation has not improved in the past 13 years.

TB education has been widely recognized as an effective way to promote TB knowledge among students. In 2003, the U.S. National Institutes of Health (NIH) perceived a need to strengthen the teaching of TB to health-profession students, and funded the National Tuberculosis Curriculum Consortium (NTCC) to help address this need.[30] Evidence shows that this has contributed to marked improvement in TB knowledge among students, nationally.[30, 35-36] Strong recommendations to strengthen TB knowledge of medical and other health-professions students through education have also been made by other countries.[37] Although the National Guideline for TB Control in China emphasizes TB health education and promotion for the public, TB patients, and students, TB health education and promotion in universities remain sub-optimal.[25] Findings from many studies have shown that 40%-63.7% of students reported "hearing from others" as their primary source of information about TB.[32,37] This study also found that only 54% students had ever received TB health

education. Accessing TB health education was significantly associated with core knowledge of TB. Given that non-clinical students have less opportunity to learn about TB as part of their regular curriculum, school TB health education should be seen as a primary source of information on TB for them.

CONCLUSION

In countries with high TB burden, it is important that all opportunities to raise population awareness about the disease are used to the optimum. In line with the WHO settings approach to health promotion,[20] schools should be seen as important avenues for TB health education given the multiplier effect of such intervention is likely to have on the students, their families, communities and others in their social networks.[20] Unfortunately, there is the tendency to focus promotion of TB awareness on national/global TB Control Days to the neglect of a plethora of opportunities for ongoing promotion in diverse settings. The overall poor knowledge of TB among medical demonstrated by this study supports the need to increase school TB health promotion, especially in the light of recent outbreaks of TB in universities in Southwest China.[13,17] Given the high burden of TB in southwest China, especially in rural provinces, TB health promotion in schools should be strengthened on an ongoing basis and in coordination with local TB control departments and district-level Centers for Disease Control and Prevention (CDC). There is a need for targeted efforts to educate students about TB since the students can be a major source of information to rural dwellers, including their own families and others in their circles of influence.

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Contributors YL designed this survey, JE guided the questionnaire design and data collection, YZ, DL and XL collected data, DL managed data, YZ analyzed data. YZ and YL drafted the manuscript; JE edited the manuscript. All authors interpreted the results, revised the report and approved the final version.

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Competing interests None.

Ethics approval The ethics committees of the two study universities approved the study protocol prior to its implementation.

Data sharing statement No additional data are available.

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Behavior about Prevention and Treatment for Tuberculosis in Chengdu. *Parasitoses and Infectious Diseases* 2008; 6(4):185-187.

Tables

Table1 Demographic characteristics of undergraduates surveyed in medical universities in southwest China (n=1486)

Demographic factors		N	%
Sex	Male	1102	74.2
	Female	384	25.8
Grade	Year 1	617	41.5
	Year 2	399	26.9
	Year 3	470	31.6
Major	Clinic medicine	1017	68.4
	Non-clinic medicine	469	31.6
Access to TB health education	Yes	802	54
	No	684	45

Table 2 Knowledge of TB signs/symptoms, transmission, and treatment among undergraduates in medical universities in Southwest China†

Knowledge of TB	Total n(%)	Sex n（%）		Grade n（%）			Major n（%）	
		Male	Female	Year 3	Year 2	Year 1	Clinical medicine	Non-clinical medicine
Students had knowledge of TB signs/symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399 (39.2)	198 (42.2)
Haemoptysis	756(50.9)	608(55.2)	148(38.5)*	332 (53.8)	176 (44.2)	248 (52.9)*	509 (50.0)	247 (52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204 (33.1)	73 (18.4)	94 (20.0)*	269 (26.5)	102 (21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209 (33.9)	54 (13.6)	65 (13.8)*	235 (23.1)	93 (19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212 (34.4)	73 (18.3)	113 (24.0)*	270 (26.5)	128 (27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190 (30.8)	43 (10.8)	85 (18.1)*	220 (21.7)	98 (20.9)
All above TB signs/symptoms	132(8.9)	119(10.8)	13(3.4) *	84 (13.6)	17 (4.3)	31 (6.6) *	88(8.7)	44(9.4)
Students had knowledge oof TB transmission								
TB is an infectious disease	1231(82.8)	893(81.0)	338(88.0)*	531(86.1)	316 (79.4)	384(81.5)*	854(84.0)	377(80.4)
Transmitted by cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Transmitted by sneezing & talking loudly	841(56.6)	607 (55.1)	234 (60.9)*	386 (62.6)	191(48.0)	264 (56.3)*	597 (58.8)	244 (52.0)*
Students had knowledge of TB treatment								
TB is a treatable disease	1183(79.6)	891(81.0)	292(76.0)*	477(77.3)	318(80.1)	388(82.6)*	802(79.0)	381(81.4)
Duration of treatment	439(29.5)	313(28.5)	126(32.8)*	207(33.5)	109(27.5)	123(26.2)*	304(30.0)	135 (28.8)
Aware of TB dispensary	404(27.2)	267(24.4)	137(35.7)*	169(27.4)	108(27.1)	127(27.0)	270(26.5)	134 (28.6)
Aware of free treatment policy	506(34.1)	345(31.4)	161(41.9)*	197(31.9)	123(31.1)	186(39.5)*	356(35.1)	150(32.0)
Aware of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148(14.6)	67(14.3)

†χ^2 test used to compare between males and females, different grades, and different majors.

*P ＜0.05

Table 3 Factors associated with the core knowledge of TB among undergraduates in medical university in Southwest China

Factors	OR (95%CI)				
	TB symptoms of cough and blood-tinged sputum	TB as one infectious disease	TB as one curable disease	TB dispensary	TB free policy
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	0.1(0.1, 0.2)	1.8(1.3, 2.7)	0.8(0.6, 1.1)	1.7(1.3, 2.4)	1.9(1.5, 2.4)
Grade					
Year 1	Reference	Reference	Reference	Reference	Reference
Year 2	1.6(1.5, 1.9)	1.7(1.5, 1.9)	1.3(0.9, 1.8)	1.1(0.8, 1.5)	1.6(1.2, 2.0)
Year 3	1.8(1.2,2.6)	1.2(0.8,1.7)	1.1(0.7, 1.5)	1.1(0.8, 1.6)	1.7(1.2, 2.3)
Major					
Clinic medicine	Reference	Reference	Reference	Reference	Reference
Non-clinic medicine	1.1(0.8, 1.4)	1.7(0.5, 1.9)	1.2(0.9, 1.6)	1.1(0.8, 1.4)	0.8(0.6, 1.1)
Access to TB health education					
Yes	Reference	Reference	Reference	Reference	Reference
No	0.5(0.4, 0.7)	0.4(0.3, 0.5)	0.6(0.5, 0.7)	0.6(0.5, 0.8)	0.7(0.5, 0.8)

Figure legends

Fig. 1: The Southwestern People's Republic of China.

In this this figure demonstrated Southwest China. The place marked with red color is Southwest China which includes the municipality of Chongqing, the provinces of Sichuan, Yunnan and Guizhou, and the Tibet Autonomous Regions.

Fig. 2: Knowledge of TB symptoms and transmission among undergraduate medical students in Southwest China.

Figure 2A presents undergraduate medical students' knowledge of classical symptoms of TB; Figure 2B presents students' knowledge of means of TB transmission.

Fig. 3: Knowledge of TB free policy and DOTS among undergraduate medical students in Southwest China.

Figure 3A presents undergraduate medical students' knowledge of the free TB treatment policy in China; Figure 3B presents undergraduate medical students' knowledge of the contents of the Directly Observed Therapy-Short Course (DOTS) program.

Fig. 4: Knowledge of core TB knowledge among undergraduate medical students in Southwest China.

Figure 4A presents the percentage of undergraduate medical students correctly answered each question for core TB knowledge; Figure 4B presents percentage of undergraduate medical students correctly answered none, only one question, any 2, any 3, any4 and any 5 questions for core TB knowledge.

This figure presents undergraduate medical students' knowledge of core TB symptoms

Fig. 5: Sources of TB knowledge among undergraduate medical students in Southwest China.

This figure presents undergraduate medical students' major sources of information on TB.

72x59mm (300 x 300 DPI)

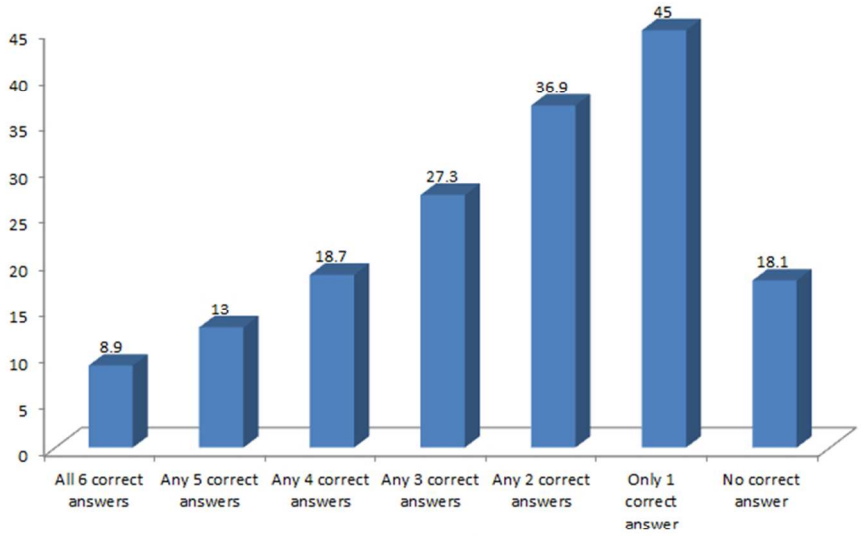

Figure2 A Percentage of correctly answered questions on knowledge about TB symptoms

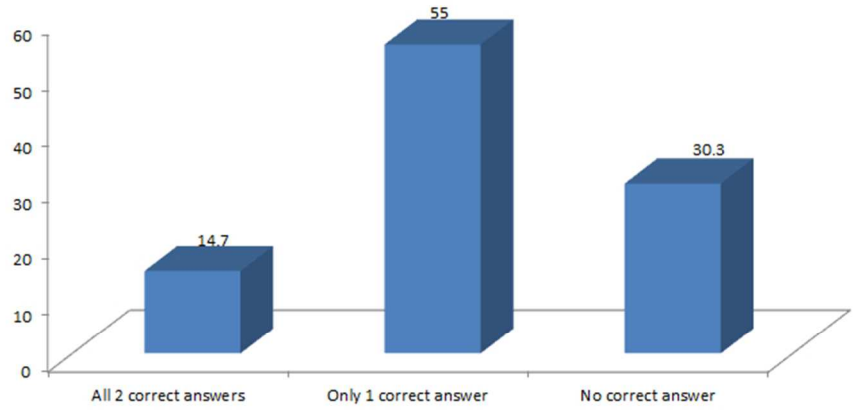

Figure2 B Percentage of correctly answered questions on knowledge about TB transmission

58x75mm (300 x 300 DPI)

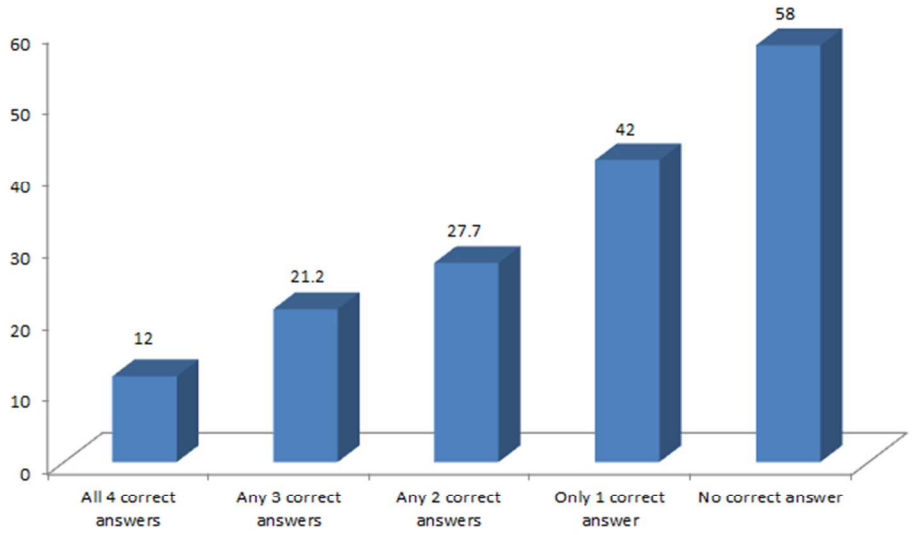

Figure3A Percentage of correctly answered questions on knowledge about TB free policy

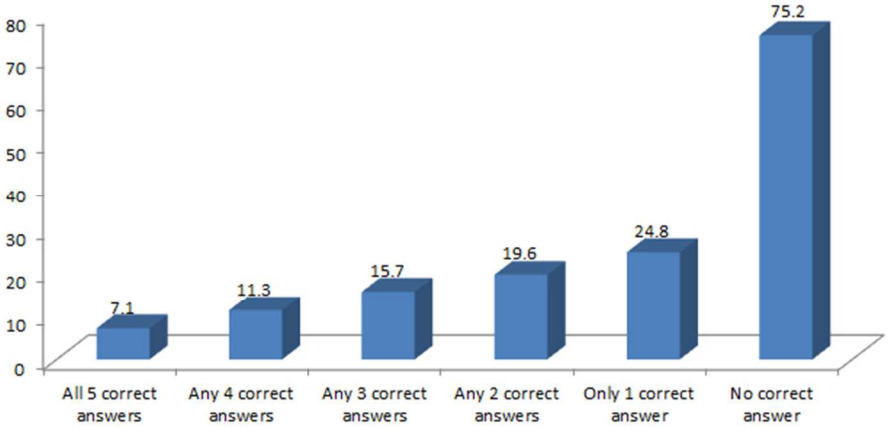

Figure3B Percentage of correctly answered questions on knowledge about DOTS

58x67mm (300 x 300 DPI)

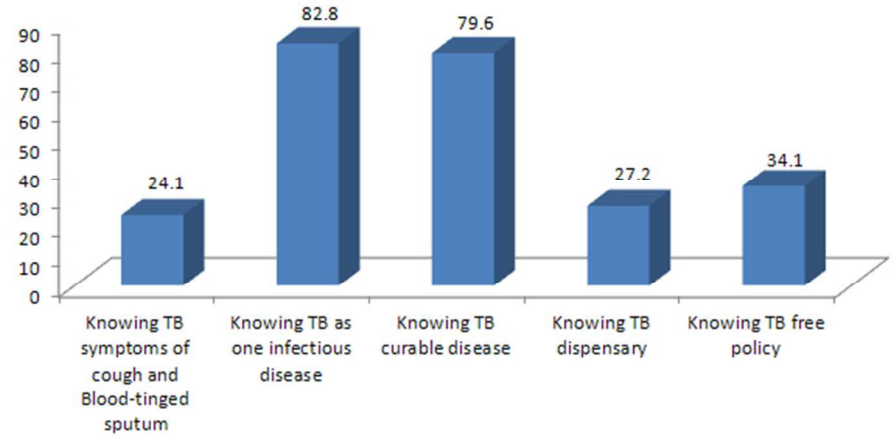

Figure 4A Percentage of correctly answered each question on TB core knowledge

Figure 4B Percentage of correctly answered questions on TB core knowledge

54x61mm (300 x 300 DPI)

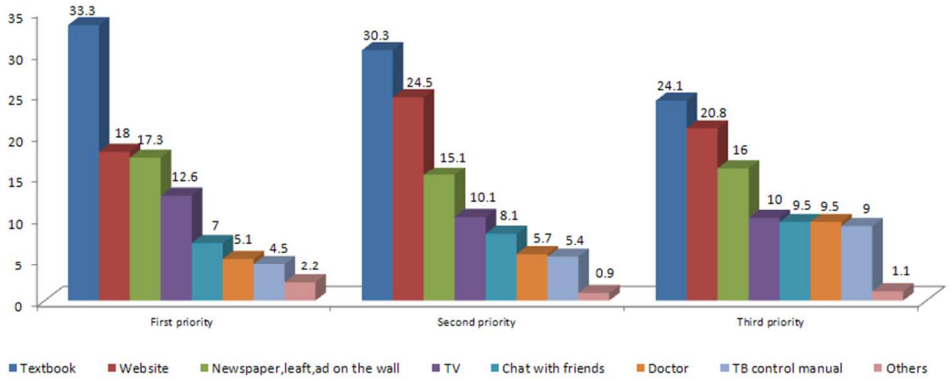

Figure 5 Percentage of students ranked the approach to get TB knowledge

76x35mm (300 x 300 DPI)

A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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Abstract

Objectives: TB control in schools is a concern in low- and middle-income countries with high TB burdens. TB knowledge is recognized as important for TB control in China, which has one of the highest TB prevalence in the world. Accordingly, ~~the country's 2008~~ National TB Control Guideline in China emphasized TB health education in schools as one of the core strategies for improving TB knowledge among the population. It was important to assess the level of TB knowledge in schools ~~five years~~ following five-year implementation of the guideline, in order to determine if the information was reaching the targets.

Design: A cross-sectional study.

Methods and study setting: This survey assessed TB knowledge and access to TB health information by questionnaire survey ~~among~~with ~~–~~1,486 ~~medical~~ undergraduates from two medical universities in southwest China.

Results: Overall, the students had inadequate TB knowledge. Only 24.1%, 27.2%, and 34.1% of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively. Very few (14.5%) had heard about the Directly Observed Therapy Short Course (DOTs), and only about half (54%) had ever accessed TB health education information. Exposure to health education messages was significantly associated with increased knowledge of the five core TB knowledge as follows: classic TB symptoms of cough/blood-tinged sputum (~~[~~OR~~(~~[95%CI~~):~~]: 0.5~~(~~[0.4, 0.7]), TB modes of transmission (~~[~~OR~~(~~[95%CI~~):~~]: 0.4~~(~~[0.3, 0.5]), curability of TB (~~[~~OR~~(~~[95%CI~~):~~]: 0.6~~(~~[0.5, 0.7]), location and services provided by TB local dispensaries (~~[~~OR~~(~~[95%CI~~):~~]: 0.6~~(~~[0.5, 0.8]), and the national free TB treatment policy (~~[~~OR~~(~~[95%CI~~):~~]: 0.7~~(~~[0.5, 0.8]).

Conclusions: The findings pose the question of whether it is time for a rethink of the current national and global approach to TB health education/promotion which favors promotion of awareness on World TB Days rather than regular community sensitization efforts.

Key words: *Tuberculosis knowledge; undergraduate students; TB health promotion; China;*

ARTICLE SUMMARY

Article focus:

- To describe knowledge of TB among undergraduate medical students.
- To explore factors associated with TB knowledge among undergraduate medical students.
- To attract attention to reform of school-based TB health education and promotion

Key messages

- Overall, undergraduate medical students had inadequate TB knowledge.
- Undergraduate students had limited access to TB health education/promotion.
- A rethink of current national and global approaches to TB health education/promotion is urgently needed in the light of the current global burden of TB.

Strengths and limitations of this study

- The main strength of the manuscript is the establishment of a baseline level of TB knowledge among undergraduate medical students. This is the first study to assess school-based TB health education/promotion in the study settingarea.
- The main limitation is that the study used is a cross-sectional design, which did cannot assess TB knowledge changes before and after school TB health education/promotion.

INTRODUCTION

The 16th Global Report on Tuberculosis (TB) published by WHO in 2012 showed that the Millennium Development Goal target for halting and reversing the TB epidemic by 2015 had already been achieved, with mortality and incidence rates falling in 22 high-burden countries. Nevertheless, the global burden of TB remains untenable,[1] in high-burden countries such as China. Globally, TB remains the second leading cause of death from infectious diseases (after HIV/AIDS).[1] Globally oOver the past five years, there has been a marked increase in the number of TB patients diagnosed with multi-drug resistant TB (MDR-TB).[1] China has the world's second largest tuberculosis epidemic and has contributed significantly to this MDR-TB increase. In recent years, the country has undertaken measures to control TB, and in order to evaluate the progress of TB control in the past decade, the country launched the 5th National Sampling Survey of TB Epidemiology in 2010.[2] Results of the survey showed an estimated 8.28 million cases of pulmonary TB (PTB) in the country from 2001 to 2010.[2] In spite of concerted international and national efforts to address TB in the country, annual prevalence (per 100,000 people) declined only minimally from 466 in 2000 to 459 in 2010.[2] Similarly, incidence of MDR-TB among PTB cases has remained unchanged in the past decade, and resistance to first-line drugs among newly diagnosed TB patients rose from 34.2 % in 2007/2008[3] to 36.9% in 2010.[2]

Owing to lack of TB knowledge, less than half of patients with TB symptoms seek healthcare timely.[2] Available evidence shows that only 59% TB patients comply with treatment, and

among the public, only 57% have proper TB knowledge.[2] Limited knowledge about signs and symptoms of TB often results in delays in TB diagnosis and treatment[4], which in return, increases not only the risk of TB transmission, but also the development of MDR-TB. China's MDR-TB prevalence rate of 6.8% is the highest in the world.[2]

TB control among undergraduate students is recognized as a concern in low- and middle-income countries with high TB burdens. Undergraduate students usually live in relative overcrowding conditions ~~of relative overcrowding~~ that are conducive to TB outbreaks.[4,5] TB outbreaks among students have been reported even in such low-burden countries as the UK, Italy, Ireland, and the USA.[~~5~~6,~~9~~ ~~10~~] Chinese undergraduate students are recognized as a particularly vulnerable population for TB. The TB prevalence (per 100,000) among Chinese students has been reported to be as high as 1,520, which is significantly higher than the prevalence~~rate~~ (459) for the general population.[~~10~~11] Chongqing, Guizhou, and Shanxi provinces were the three provinces with the highest TB burden among undergraduate students between 2005 and 2008.[~~11~~ 12] In addition, several TB outbreaks among undergraduate students were recently reported in Chongqing, Liangning, Zhejiang, Shangdong, and Guizhou, with the incidence rates ranging from 620 to 31,370 per 100,000.[~~10~~11,~~16~~17]

~~University medical~~ Medical students in university can ~~become~~ expose~~d~~ to TB infection during clinic rotations.[~~17~~18] Thus, adequate knowledge of ~~the~~ TB epidemiology and control is critically important for this population ~~group~~. Knowledge of TB among ~~university~~ medical undergraduates in university is also important since they represent potential future physicians

or leaders in the fight against TB.[18 19] In 1998, WHO released a document in 1997 following a workshop on Tuberculosis Control and Medical Schools held in Rome, Italy, in 1997, which stressed the importance of graduating medical students with proper knowledge and skills related to effective TB control.[19 20] WHO later released a manual that aims to inform medical students and medical practitioners about best practices in managing TB patients.[20 21] Several studies have documented inadequate TB knowledge and poor compliance with TB treatment guidelines among practicing physicians.[21 22 23 24] In countries where TB (including MDR-TB) presents significant challenges to public health, equipping emerging physicians with in-depth TB knowledge is of critical importance in the overall efforts to reduce the burden of the disease. In China, school TB health promotion was emphasized in the 2008 National Guideline for TB Control.[24–25] It was important to assess the level of TB knowledge in schools five years following five-year implementation of the guideline. This survey assessed TB knowledge and access to TB health information among 1,486 pre-clinical undergraduate students from two medical universities in southwest, China which has one of the highest TB burdens of TB in the country. It was hoped that the findings could help to identify whether the information was reaching the targets, and thus engender efforts to strengthen TB school education in the region and similar locales in low and middle income countries with high TB burden.

METHODS

Study setting

The study setting, Southwest China, includes Chongqing Municipality, the provinces of

Sichuan, Yunnan, Guizhou, and Tibet Autonomous Region (Figure 1) where prevalence rates (cases per 100,000) of active TB (695), smear positive TB (105), and culture positive TB (198) are much higher than the national prevalence rates of 459, 66, and 119, respectively.[2] Southwest China has a population of more than 19 million which represent more than 10 % of China's population of 1.3 billion people.

Participants

There were 10 medical universities in Southwest China. These universities offer 5-year majors in clinical medicine, public health, pharmacy, medical laboratory, Chinese medicine, and nursing. We randomly selected two of the 10 universities and restricted our sample frame to pre-clinical students (students who have not received clinic curriculum) in their first to third years of training. We excluded fourth- and fifth-year students since they might have ~~ay~~ obtained ~~get~~ TB knowledge from their clinical training ~~on TB~~ as part of their clinical curriculum rather than from government school TB health education. The survey was conducted between November 2011 and May 2012 and focused on the assessment of TB knowledge among the respondents. The sample frame consisted of 20,000 eligible students. To obtain a power of 80% and a confidence level of 95%, we calculated the study sample to be 1536.[~~25~~ 26] During recruitment, potential participants were approached and provided with detailed explanation of the study and its objectives. They were then asked if they would be interested in volunteering to participate. Those who expressed interest were asked to read the informed consent form, and were assured of confidentiality. They were then asked to sign the informed consent form as a conformation of their voluntary participation in the study.

Approval for the study was obtained from the Institutional Review Boards of the College of Preventive Medicine, Third Military Medical University, Chongqing, China (October, 20, 2011) and the School of Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan Province, China (28 April, 2012). ~~The ethics committees of the two study universities approved the study protocol prior to its implementation.~~

Questionnaire

The survey was cross-sectional in design. Following participant enrollment in the study, data were collected by means of a self-administered questionnaire that assessed participants' knowledge about TB signs/symptoms, transmission, management, and control. Data were elicited on the following variables: socio-demographic profile (age, sex), degree major (clinical and non-clinical), year in the medical program, TB knowledge (symptoms, mode of transmission, treatment, knowledge of ~~about~~ TB control facilities in the study setting, local TB control policies and program), and core knowledge of TB, namely, five core TB knowledge areas which include: (i) classic TB symptoms of cough/blood-tinged sputum, (ii) TB modes of transmission, (iii) curability of TB, (iv) location and services provided by TB local dispensaries, and (v) the national free TB treatment policy.

Data analysis

Epi-data 6.0 was used for data entry~~,~~. ~~and~~ Data analyses were conducted~~,~~ using the Statistical Package for Social Sciences version 18.0. To assess TB knowledge among the participants, we calculated the percentage of people who provided correct responses to questions about the

~~5 core knowledge of TB,~~ 6 symptoms of TB, ~~2~~ 3 ways of transmitting TB, ~~4~~ 5 items ~~of the free~~ related to TB treatment, and ~~policy in China, and 5 contents of DOTS~~5 core knowledge of TB. We used chi-square statistics (χ^2) to assess participants' responses by gender, year in medical school, and degree ~~program~~ major. A binary ~~Multiple~~ logistic regression model~~s~~ which included variables with statistical significance on~~by~~ the χ^2 test, were used to examine factors associated with core knowledge of TB among the respondents. We used a two-tailed probability level of <0.05 as the level of statistical significance.

RESULTS

Demographic characteristics of participants

A total of 1,486 undergraduate medical students participated in the survey. Of these, 617~~470~~ were in their first year medical training, 399 in the second year, and 470~~617~~ in the third year. A majority of the respondents (74.2%; n=1102) were male，and 68.4% students were majoring in clinical medicine. Only 54% of the students indicated having access to some kind of TB health information (Table 1).

Knowledge of TB symptoms

The respondents' knowledge of symptoms is shown in Table 2. ~~As Survey results showed that as many as 91% of the students had heard of TB. In spite of this, a~~About 18% (n=261) had no knowledge of any TB symptoms, and ~~;~~ less than 10% (n=132) were able to identify all ~~of the~~ TB symptoms (Figure 2 A). ~~Only 50.9% and 40% could identify the two key TB~~

symptoms of , and chronic cough lasting 3 weeks. Only 20% knew other TB symptoms such as fever, weakness, and weight loss (Table 2). As for overall knowledge of TB symptoms, 10.8% (119) male and female3.4% (13) year had knowledge of all of these classic symptoms(p≤0.05), 13.6% (84), 4.3 % (17), 6.6% (31) students of third-year, second year and first-year had knowledge of all of these classic symptoms (p≤0.05). Third-year students had better knowledge of TB symptoms (p≤0.05), , and tThere were no statistically significant differences in knowledge of TB symptoms between students in clinical and non-clinical degree majors（p>0.05）（Table 2).

Knowledge about TB transmission

Only 27.9% (n=414) of the respondents were aware that TB could be transmitted through exposure to droplet nuclei from the cough of an infected person; and slightly more than half (56.6%; n=841) knew that sneezing by TB patients could release droplet nuclei that could transmit the disease to others (Table 2), and Oonly 14.7% (n=218) of the students knew the two main routes of TB transmission (Figure 2b2B). Overall, more females (88%; n=338) and third-year students (86.1%; n=531) knew the transmission routes of TB（p<0.05).

Knowledge about TB treatment and policies

Although 80% of the students knew that TB was curable, only 30% (n=446) knew the duration of TB treatmenttreatment course of TB. Only 27.2% (n=404) knew their local TB control facilities (TB dispensaries); 34% and 14.5% had heard of the national free TB treatment policy and DOTS, respectively (Table 2). A greater proportion of female than

male respondents had better knowledge about the duration of TB treatment ~~the TB treatment course (32.8% vs 28.5%)~~, TB control facilities ~~(35.7% vs 24.4%)~~, free TB treatment policy ~~(41.9% vs 31.4%)~~, and DOTS ~~(19.0% vs 12.9%)~~ (P≤0.05). Overall, third-year students had better knowledge of TB treatment except for knowledge on TB as a curable disease and free treatment policy~~control facilities~~. There were no significant differences between students in clinical and non-clinical majors (Table 2). Only 12% (n=178) of the respondents knew all the 4 items included in the free TB treatment policy (registration, sputum test, chest X-rays, and anti-TB drugs)~~; 58% (n=862) did not know any items included in the free policy~~ (Figure 3-A). Less than 10% (n=106) of the students were familiar with all 5 items of DOTS (Figure 3-B).

Core knowledge of TB

With regard to core knowledge of TB, ~~only 24.1% (n=358), 27.2% (n=404), and 34.1% (n=506) of~~ less than half ~~the~~ students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and the national free TB treatment policy~~, respectively~~ (Figure 4A). Only 2.4% ~~(n=36)~~ were familiar with all five core TB knowledge areas (Figure 4B). Multiple logistic regression analysis indicated that access to health education was associated with ~~knowledge of~~ the five core TB knowledge ~~areas~~;~~,~~ (OR [~~(~~95%CI~~):~~]: 0.5~~(~~[0.4, 0.7]) for classic TB symptoms of cough/blood-tinged sputum, (OR [~~(~~95%CI~~):~~]: 0.4~~(~~[0.3, 0.5]) for ~~TB modes~~ means of TB ~~of~~ transmission, (OR [~~(~~95%CI~~):~~]: 0.6~~(~~[0.5, 0.7]) for curability of TB, (OR [~~(~~95%CI~~):~~]: 0.6~~(~~[0.5, 0.8]) for ~~location and services provided by~~ TB ~~local~~ dispensaries, and (OR [~~(~~95%CI~~):~~]: 0.7~~(~~[0.5, 0.8]) for the national free TB treatment policy.

Males had poor knowledge related to transmission of TB, TB dispensaries and free TB treatment policy (OR ~~([~~95%CI~~):~~ ~~]:~~ 1.8~~([~~1.3, 2.7~~),~~ ~~],~~ 1.7~~([~~1.3, 2.4~~),~~ ~~],~~ 1.9~~([~~1.5, 2.4~~),~~ ~~]),~~ respectively. Third year students had better knowledge of TB compared with students in the first and second years (Table 3).

Sources of TB Knowledge

With regard to how the respondents gained awareness and understanding of TB, survey results indicated that the most frequent source of information was textbooks, the second was the Internet, and the third was the media (newspaper and billboards) (Figure 5).

DISCUSSION

TB is still one of the most important global public health threats. If global control of the disease does not improve, the annual global incidence is expected to increase from the current 21% to 61% by 2020.~~[26—27]~~ Early detection and adequate treatment are critical control measures. In spite of the fact that China carries one of the highest TB burdens in the world, lack of knowledge about the disease remains an abiding problem in the country, and thus, presents a barrier to control efforts.[2]

Medical students are China's future health professionals and clinical leaders. Thus, understanding their level of awareness about TB is important. Unfortunately, this survey revealed that these students had generally poor knowledge of TB.

S~~imilar s~~urveys conducted in other countries have reported inadequate knowledge of TB ~~and possibly resulted in risky behaviors~~ among medical profession~~al~~ students. In Turkey for

example,[27 28] a study of 828 fourth-year medical students found that they lacked skills in interpreting radiology and smears even in their last year of medical school. One study in Brazil found that although medical students had had good knowledge of biosafety norms, they engaged in risky behaviors in health care settings where TB patients were assisted[28 29] Similarly, a study in the United States reported that, prior to implementation of the National Tuberculosis Curriculum Consortium (NTCC) in U.S. medical schools, about one-third of medical students did not know the method for administering tuberculin skin test or that the BCG vaccine was not a contraindication for~~to~~ TB skin testing.[29 30]

The 2008 National Guideline for TB Control in China emphasizes five items of core knowledge of TB.[24 25] In the present study, it is of particular concern that the students scored very low in the TB core knowledge domain. The average knowledge base for all of the 5 core knowledge domains was only 2.4%, which was lower than the score (43.45%) reported in a previous study in China's Hunan province.[30 31] We also found that only 24.1% knew the classic symptoms of TB (cough and blood stained sputum), which was similar to the report in Nanjing, China where only 26.3% students were familiar with TB symptoms.[31 32] This study observed that ~~Less~~ less than 30% of the respondents knew the course of TB treatment and were aware of TB control facilities in Southwest China~~. This~~ which was lower than the rate observed in a previous study (36.66%).[32] ~~by Zhang et al. (2012).~~ We found that only 30% knew the free TB treatment policy in China, which wa~~i~~s similar to that reported in a related study.[32 33] One-third of our respondents could not identify a mode of transmission for TB. A survey of final year medical students in China's Hunan province in 2000 concluded that

knowledge and practical competencies regarding TB among final-year medical students were generally inadequate.[33,34] Results of our current study showed that the situation has not improved in the past 13 years.

TB education has been widely recognized as an effective way to promote TB knowledge among students. In 2003, the U.S. National Institutes of Health (NIH) perceived a need to strengthen the teaching of TB to health-profession students, and funded the National Tuberculosis Curriculum Consortium (NTCC) to help address this need.[29,30] Evidence shows that this has contributed to marked improvement in TB knowledge among students, nationally throughout the country TB education.[29,30,34,35,36] Strong recommendations to strengthen TB knowledge of medical and other health-professions students through education have also been made by other countries.[36,37] Although the 2008 National Guideline for TB Control in China emphasizes TB health education and promotion for the public, TB patients, and students, TB health education and promotion in universities remain sub-optimal.[24,25] Findings from many studies have shown that 40%-63.7% of students reported "hearing from others" as their primary source of information about TB.[31,32,36,37] This study also found that only 54% students had ever received TB health education. Accessing TB health education was significantly associated with core knowledge of TB. Given that non-clinical students have less opportunity to learn about TB as part of their regular curriculum, school TB health education should be seen as a primary source of information on TB for them.

CONCLUSION

In countries with high TB burden, it is important that all opportunities to raise population awareness about the disease are used to the optimum. In line with the WHO settings approach to health promotion,[19 20] schools should be seen as important avenues for TB health education given the multiplier effect of such intervention is likely to have on the students, their families, communities and others in their social networks.[19 20] Unfortunately, there is the tendency to focus promotion of TB awareness on national/global TB Control Days to the neglect of a plethora of opportunities for ongoing promotion in diverse settings. The overall poor knowledge of TB among medical ~~and health professions students~~ demonstrated by this study supports the need to increase school TB ~~school~~ health ~~education~~promotion, especially in the light of recent outbreaks of TB in universities in Southwest China.[12 13,16 17] Given the high burden of TB in southwest China, especially in rural provinces, TB health ~~education and~~ promotion in schools should be strengthened on an ongoing basis and in coordination with local TB control departments and district-level Centers for Disease Control and Prevention (CDC). There is a need for targeted efforts to educate students about TB since the students can be a major source of information to rural dwellers, including their own families and others in their circles of influence.

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Contributors YL designed this survey, JE guided the questionnaire design and data collection, YZ, DL and XL collected data, DL managed data, YZ analyzed data. YZ and YL drafted the manuscript; JE edited the manuscript. All authors interpreted the results, revised the report and approved the final version.

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Tables

Table1 Demographic characteristics of undergraduates surveyed in medical universities in southwest China (n=1486)

Demographic factors		N	%
Sex	Male	1102	74.2
	Female	384	25.8
Grade	Year 1	617	41.5
	Year 2	399	26.9
	Year 3	470	31.6
Major	Clinic medicine	1017	68.4
	Non-clinic medicine	469	31.6
Access to TB health education	Yes	802	54
	No	684	45

Table 2 Knowledge of TB signs/symptoms, transmission, and treatment among undergraduates in medical universities in Southwest China†

Knowledge of TB	Total n(%)	Sex n（%）		Grade n（%）			Major n（%）	
		Male	Female	Year 3	Year 2	Year 1	Clinical medicine	Non-clinical medicine
Students had knowledge of TB signs/symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399(39.2)	198(42.2)
Haemoptysis	756(50.9)	608(55.2)	148(38.5)*	332(53.8)	176(44.2)	248(52.9)*	509(50.0)	247(52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204(33.1)	73(18.4)	94(20.0)*	269(26.5)	102(21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209(33.9)	54(13.6)	65(13.8)*	235(23.1)	93(19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212(34.4)	73(18.3)	113(24.0)*	270(26.5)	128(27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190(30.8)	43(10.8)	85(18.1)*	220(21.7)	98(20.9)
All above TB signs/symptoms	132(8.9)	119(10.8)	13(3.4)*	84(13.6)	17(4.3)	31(6.6)*	88(8.7)	44(9.4)
Students had knowledge oof TB transmission								
TB is an infectious disease	1231(82.8)	893(81.0)	338(88.0)*	531(86.1)	316(79.4)	384(81.5)*	854(84.0)	377(80.4)
Transmitted by cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Transmitted by sneezing & talking loudly	841(56.6)	607(55.1)	234(60.9)*	386(62.6)	191(48.0)	264(56.3)*	597(58.8)	244(52.0)*
Students had knowledge of TB treatment								
TB is a treatable disease	1183(79.6)	891(81.0)	292(76.0)*	477(77.3)	318(80.1)	388(82.6)*	802(79.0)	381(81.4)
Duration of treatment	439(29.5)	313(28.5)	126(32.8)*	207(33.5)	109(27.5)	123(26.2)*	304(30.0)	135 (28.8)
Aware of TB dispensary	404(27.2)	267(24.4)	137(35.7)*	169(27.4)	108(27.1)	127(27.0)	270(26.5)	134 (28.6)
Aware of free treatment policy	506(34.1)	345(31.4)	161(41.9)*	197(31.9)	123(31.1)	186(39.5)*	356(35.1)	150(32.0)
Aware of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148(14.6)	67(14.3)

†χ^2 test used to compare between males and females, different grades, and different majors.

*P ＜0.05

~~**Table 2 Knowledge about TB symptoms, transmission and treatment among**~~

undergraduates in medical university in Southwest China※

Knowledge of TB	Total n (%)	Sex n (%)		Grade n (%)			Major n (%)	
		Male	Female	Year 3	Year 2	Year 1	Clinic medicine	Non-clinic medicine
Knowledge on TB symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399(39.2)	198(42.2)
Blood tinged sputum	756(50.9)	608(55.2)	148(38.5)*	332(53.8)	176(44.2)	248(52.9)*	509(50.0)	247(52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204(33.1)	73(18.4)	94(20.0)*	269(26.5)	102(21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209(33.9)	54(13.6)	65(13.8)*	235(23.1)	93(19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212(34.4)	73(18.3)	113(24.0)*	270(26.5)	128(27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190(30.8)	43(10.8)	85(18.1)*	220(21.7)	98(20.9)
Knowledge on TB transmission								
Known of transmission	1231(82.8)	893 (81.0)	338 (88.0)*	531 (86.1)	316 (79.4)	384 (81.5)*	854 (84.0)	377(80.4)
Cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Sneezing and loudly speaking	841(56.6)	607(55.1)	234(60.9)*	386(62.6)	191(48.0)	264(56.3)*	597(58.8)	244(52.0)*
Knowledge on TB treatment								
Curable disease	1183(79.6)	891 (81.0)	292 (76.0)*	477 (77.3	318 (80.1)	388 (82.6)*	802 (79.0)	381(81.4)
Knowing treatment course	439(29.5)	313 (28.5)	126 (32.8)*	207 (33.5)	109 (27.5)	123 (26.2)*	304 (30.0)	135(28.8)
Knowing TB dispensary	404(27.2)	267 (24.4)	137 (35.7)*	169 (27.4)	108 (27.1)	127 (27.0)	270 (26.5)	134(28.6)
TB free policy	506(34.1)	345 (31.4)	161 (41.9) *	197 (31.9)	123 (31.1)	186 (39.5)*	356 (35.1)	150(32.0)
Heard of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148 (14.6)	67(14.3)

※χ^2 test used to compare between males and females, different grades, and different majors.

*P <0.05

Table 3 Factors associated with the core knowledge of TB among undergraduates in

medical university in Southwest China

Factors	OR (95%CI)				
	TB symptoms of cough and blood-tinged sputum	TB as one infectious disease	TB as one curable disease	TB dispensary	TB free policy
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	0.1(0.1, 0.2)	1.8(1.3, 2.7)	0.8(0.6, 1.1)	1.7(1.3, 2.4)	1.9(1.5, 2.4)
Grade					
Year 1	Reference	Reference	Reference	Reference	Reference
Year 2	1.6(1.5, 1.9)	1.7(1.5, 1.9)	1.3(0.9, 1.8)	1.1(0.8, 1.5)	1.6(1.2, 2.0)
Year 3	1.8(1.2,2.6)	1.2(0.8,1.7)	1.1(0.7, 1.5)	1.1(0.8, 1.6)	1.7(1.2, 2.3)
Major					
Clinic medicine	Reference	Reference	Reference	Reference	Reference
Non-clinic medicine	1.1(0.8, 1.4)	1.7(0.5, 1.9)	1.2(0.9, 1.6)	1.1(0.8, 1.4)	0.8(0.6, 1.1)
Access to TB health education					
Yes	Reference	Reference	Reference	Reference	Reference
No	0.5(0.4, 0.7)	0.4(0.3, 0.5)	0.6(0.5, 0.7)	0.6(0.5, 0.8)	0.7(0.5, 0.8)

Figure legends

Fig. 1: The Southwestern People's Republic of China.

In this this figure demonstrated Southwest China. The place marked with red color is Southwest China which includes the municipality of Chongqing, the provinces of Sichuan, Yunnan and Guizhou, and the Tibet Autonomous Regions.

Fig. 2: Knowledge of TB symptoms and transmission among undergraduate medical students in Southwest China.

Figure 2A presents undergraduate medical students' knowledge of classical symptoms of TB; Figure 2B presents students' knowledge of means of TB transmission.

Fig. 3: Knowledge of TB free policy and DOTS among undergraduate medical students in Southwest China.

Figure 3A presents undergraduate medical students' knowledge of the free TB treatment policy in China; Figure 3B presents undergraduate medical students' knowledge of the contents of the Directly Observed Therapy-Short Course (DOTS) program.

Fig. 4: Knowledge of core TB knowledge among undergraduate medical students in Southwest China.

Figure 4A presents the percentage of undergraduate medical students correctly answered each question for core TB knowledge; Figure 4B presents percentage of undergraduate medical students correctly answered none, only one question, any 2, any 3, any4 and any 5 questions for core TB knowledge.

This figure presents undergraduate medical students' knowledge of core TB symptoms

Fig. 5: Sources of TB knowledge among undergraduate medical students in Southwest

China.

This figure presents undergraduate medical students' major sources of information on TB.

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A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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Abstract

Objectives: TB control in schools is a concern in low- and middle-income countries with high TB burdens. TB knowledge is recognized as important for TB control in China, which has one of the highest TB prevalence in the world. Accordingly, National TB Control Guideline in China emphasized TB health education in schools as one of the core strategies for improving TB knowledge among the population. It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline, in order to determine if the information was reaching the targets.

Design: A cross-sectional study.

Methods and study setting: This survey assessed TB knowledge and access to TB health information by questionnaire survey with 1,486 undergraduates from two medical universities in southwest China.

Results: Overall, the students had inadequate TB knowledge. Only 24.1%, 27.2%, and 34.1% of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively. Very few (14.5%) had heard about the Directly Observed Therapy Short Course (DOTs), and only about half (54%) had ever accessed TB health education information. Exposure to health education messages was significantly associated with increased knowledge of the five core TB knowledge as follows: classic TB symptoms of cough/blood-tinged sputum (OR[95%CI]: 0.5[0.4, 0.7]), TB modes of transmission (OR[95%CI]: 0.4[0.3, 0.5]), curability of TB (OR[95%CI]: 0.6[0.5, 0.7]), location and services provided by TB local dispensaries (OR[95%CI]: 0.6[0.5, 0.8]), and the national free TB treatment policy (OR[95%CI]: 0.7[0.5, 0.8]).

Conclusions: The findings pose the question of whether it is time for a rethink of the current national and global approach to TB health education/promotion which favors promotion of awareness on World TB Days rather than regular community sensitization efforts.

Key words: *Tuberculosis knowledge; undergraduate students; TB health promotion; China;*

ARTICLE SUMMARY

Article focus:

- To describe knowledge of TB among undergraduate medical students.
- To explore factors associated with TB knowledge among undergraduate medical students.
- To attract attention to reform of school-based TB health education and promotion

Key messages

- Overall, undergraduate medical students had inadequate TB knowledge.
- Undergraduate students had limited access to TB health education/promotion.
- A rethink of current national and global approaches to TB health education/promotion is urgently needed in the light of the current global burden of TB.

Strengths and limitations of this study

- The main strength of the manuscript is the establishment of a baseline level of TB knowledge among undergraduate medical students. This is the first study to assess school-based TB health education/promotion in the study setting.
- The main limitation is that the study used a cross-sectional design, which did assess TB knowledge changes before and after school TB health education/promotion.

INTRODUCTION

The 16th Global Report on Tuberculosis (TB) published by WHO in 2012 showed that the Millennium Development Goal target for halting and reversing the TB epidemic by 2015 had already been achieved, with mortality and incidence rates falling in 22 high-burden countries. Nevertheless, the global burden of TB remains untenable,[1] in high-burden countries such as China. Globally, TB remains the second leading cause of death from infectious diseases (after HIV/AIDS).[1] Globally over the past five years, there has been a marked increase in the number of TB patients diagnosed with multi-drug resistant TB (MDR-TB).[1] China has the world's second largest tuberculosis epidemic and has contributed significantly to this MDR-TB increase. In recent years, the country has undertaken measures to control TB, and in order to evaluate the progress of TB control in the past decade, the country launched the 5th National Sampling Survey of TB Epidemiology in 2010.[2] Results of the survey showed an estimated 8.28 million cases of pulmonary TB (PTB) in the country from 2001 to 2010.[2] In spite of concerted international and national efforts to address TB in the country, annual prevalence (per 100,000 people) declined only minimally from 466 in 2000 to 459 in 2010.[2] Similarly, incidence of MDR-TB among PTB cases has remained unchanged in the past decade, and resistance to first-line drugs among newly diagnosed TB patients rose from 34.2 % in 2007/2008[3] to 36.9% in 2010.[2]

Owing to lack of TB knowledge, less than half of patients with TB symptoms seek healthcare timely.[2] Available evidence shows that only 59% TB patients comply with treatment, and among the public, only 57% have proper TB knowledge.[2] Limited knowledge about signs and

symptoms of TB often results in delays in TB diagnosis and treatment[4], which in return, increases not only the risk of TB transmission, but also the development of MDR-TB. China's MDR-TB prevalence rate of 6.8% is the highest in the world.[2]

TB control among undergraduate students is recognized as a concern in low- and middle-income countries with high TB burdens. Undergraduate students usually live in relative overcrowding conditions that are conducive to TB outbreaks.[5] TB outbreaks among students have been reported even in such low-burden countries as the UK, Italy, Ireland, and the USA.[6-10] Chinese undergraduate students are recognized as a particularly vulnerable population for TB. The TB prevalence (per 100,000) among Chinese students has been reported to be as high as 1,520, which is significantly higher than the prevalence (459) for the general population.[11] Chongqing, Guizhou, and Shanxi provinces were the three provinces with the highest TB burden among undergraduate students between 2005 and 2008.[12] In addition, several TB outbreaks among undergraduate students were recently reported in Chongqing, Liangning, Zhejiang, Shangdong, and Guizhou, with the incidence rates ranging from 620 to 31,370 per 100,000.[11-17]

Medical students in university can expose to TB infection during clinic rotations.[18] Thus, adequate knowledge of TB epidemiology and control is critically important for this population. Knowledge of TB among medical undergraduates in university is also important since they represent potential future physicians or leaders in the fight against TB.[19] In 1997, WHO released a report following a workshop on Tuberculosis Control and Medical Schools held in

Rome, Italy, which stressed the importance of graduating medical students with proper knowledge and skills related to effective TB control.[20] WHO later released a manual that aims to inform medical students and medical practitioners about best practices in managing TB patients.[21] Several studies have documented inadequate TB knowledge and poor compliance with TB treatment guidelines among practicing physicians.[22-24] In countries where TB (including MDR-TB) presents significant challenges to public health, equipping emerging physicians with in-depth TB knowledge is of critical importance in the overall efforts to reduce the burden of the disease. In China, school TB health promotion was emphasized in the 2008 National Guideline for TB Control.[25] It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline. This survey assessed TB knowledge and access to TB health information among 1,486 pre-clinical undergraduate students from two medical universities in southwest China which has one of the highest TB burdens of in the country. It was hoped that the findings could help to identify whether the information was reaching the targets, and thus engender efforts to strengthen TB school education in the region and similar locales in low and middle income countries with high TB burden.

METHODS

Study setting

The study setting, Southwest China, includes Chongqing Municipality, the provinces of Sichuan, Yunnan, Guizhou, and Tibet Autonomous Region (Figure 1) where prevalence rates (cases per 100,000) of active TB (695), smear positive TB (105), and culture positive TB

(198) are much higher than the national prevalence rates of 459, 66, and 119, respectively.[2] Southwest China has a population of more than 19 million which represent more than 10% of China's population of 1.3 billion people.

Participants

There were 10 medical universities in Southwest China. These universities offer 5-year majors in clinical medicine, public health, pharmacy, medical laboratory, Chinese medicine, and nursing. We randomly selected two of the 10 universities and restricted our sample frame to pre-clinical students (students who have not received clinic curriculum) in their first to third years of training. We excluded fourth- and fifth-year students since they might have obtained TB knowledge from their clinical training as part of their clinical curriculum rather than from government school TB health education. The survey was conducted between November 2011 and May 2012 and focused on the assessment of TB knowledge among the respondents. The sample frame consisted of 20,000 eligible students. To obtain a power of 80% and a confidence level of 95%, we calculated the study sample to be 1536.[26] During recruitment, potential participants were approached and provided with detailed explanation of the study and its objectives. They were then asked if they would be interested in volunteering to participate. Those who expressed interest were asked to read the informed consent form, and were assured of confidentiality. They were then asked to sign the informed consent form as a conformation of their voluntary participation in the study. Approval for the study was obtained from the Institutional Review Boards of the College of Preventive Medicine, Third Military Medical University, Chongqing, China (October, 20, 2011) and the School of

Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan Province, China (28 April, 2012).

Questionnaire

The survey was cross-sectional in design. Following participant enrollment in the study, data were collected by means of a self-administered questionnaire that assessed participants' knowledge about TB signs/symptoms, transmission, management, and control. Data were elicited on the following variables: socio-demographic profile (age, sex), degree major (clinical and non-clinical), year in the medical program, TB knowledge (symptoms, mode of transmission, treatment, knowledge of TB control facilities in the study setting, local TB control policies and program), and core knowledge of TB, namely, five core TB knowledge areas which include: (i) classic TB symptoms of cough/blood-tinged sputum, (ii) TB modes of transmission, (iii) curability of TB, (iv) location and services provided by TB local dispensaries, and (v) the national free TB treatment policy.

Data analysis

Epi-data 6.0 was used for data entry. Data analyses were conducted using the Statistical Package for Social Sciences version 18.0. To assess TB knowledge among the participants, we calculated the percentage of people who provided correct responses to questions about the 6 symptoms of TB, 3 ways of transmitting TB, 5 items related to TB treatment, and 5 core knowledge of TB. We used chi-square statistics (χ^2) to assess participants' responses by gender, year in medical school, and degree major. A binary logistic regression model which

included variables with statistical significance on the χ^2 test, were used to examine factors associated with core knowledge of TB among the respondents. We used a two-tailed probability level of <0.05 as the level of statistical significance.

RESULTS

Demographic characteristics of participants

A total of 1,486 undergraduate medical students participated in the survey. Of these, 617 were in their first year medical training, 399 in the second year, and 470 in the third year. A majority of the respondents (74.2%; n=1102) were male， and 68.4% students were majoring in clinical medicine. Only 54% of the students indicated having access to some kind of TB health information (Table 1).

Knowledge of TB symptoms

The respondents' knowledge of symptoms is shown in Table 2. About 18% (n=261) had no knowledge of any TB symptoms, and less than 10% (n=132) were able to identify all TB symptoms (Figure 2 A). As for overall knowledge of TB symptoms, 10.8% (n=119) of males and 3.4% (n=13) of female had knowledge of all of the classic symptoms of TB ($p \leq 0.05$). Slightly more than thirteen per cent (13.6%; n=84) of students in the third year of medical school, 4.3 % (n=17) of those in the second year, and 6.6% (n=31) of first-year students had knowledge of all of the classic symptoms ($p \leq 0.05$). There were no statistically significant differences in knowledge of TB symptoms between students in clinical and non-clinical

degree majors（p>0.05）（Table 2).

Knowledge about TB transmission

Only 27.9% (n=414) of the respondents were aware that TB could be transmitted through exposure to droplet nuclei from the cough of an infected person (Table 2), and only 14.7% (n=218) knew the two main routes of TB transmission (Figure 2B). Overall, more females (88%; n=338) and third-year students (86.1%; n=531) knew the transmission routes of TB （p<0.05).

Knowledge about TB treatment and policies

Although 80% of the students knew that TB was curable, only 30% (n=446) knew the duration of TB treatment. Only 27.2% (n=404) knew TB control facilities (TB dispensaries); 34% and 14.5% had heard of the national free TB treatment policy and DOTS, respectively (Table 2). A greater proportion of female than male respondents had better knowledge about the duration of TB treatment, TB control facilities, free TB treatment policy, and DOTS (P≤0.05). Overall, third-year students had better knowledge of TB treatment except for knowledge on TB as a curable disease and free treatment policy. There were no significant differences between students in clinical and non-clinical majors (Table 2). Only 12% (n=178) of the respondents knew all the 4 items included in the free TB treatment policy (registration, sputum test, chest X-rays, and anti-TB drugs) (Figure 3A). Less than 10% (n=106) of the students were familiar with all 5 items of DOTS (Figure 3B).

Core knowledge of TB

With regard to core knowledge of TB, less than half students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and the national free TB treatment policy (Figure 4A). Only 2.4% were familiar with all five core TB knowledge areas (Figure 4B). Multiple logistic regression analysis indicated that access to health education was associated with the five core TB knowledge: (OR [95%CI]: 0.5[0.4, 0.7]) for classic TB symptoms of cough/blood-tinged sputum, (OR [95%CI]: 0.4[0.3, 0.5]) for means of TB transmission, (OR [95%CI]: 0.6[0.5, 0.7]) for curability of TB, (OR [95%CI]: 0.6[0.5, 0.8]) for TB dispensaries, and (OR [95%CI]: 0.7[0.5, 0.8]) for the national free TB treatment policy. Males had poor knowledge related to transmission of TB, TB dispensaries and free TB treatment policy (OR [95%CI]: 1.8[1.3, 2.7], 1.7[1.3, 2.4], 1.9[1.5, 2.4]), respectively. Third year students had better knowledge of TB compared with students in the first and second years (Table 3).

Sources of TB Knowledge

With regard to how the respondents gained awareness and understanding of TB, survey results indicated that the most frequent source of information was textbooks, the second was the Internet, and the third was the media (newspaper and billboards) (Figure 5).

DISCUSSION

TB is still one of the most important global public health threats. If global control of the disease does not improve, the annual global incidence is expected to increase from the current 21% to 61% by 2020.[27] Early detection and adequate treatment are critical control measures.

In spite of the fact that China carries one of the highest TB burdens in the world, lack of knowledge about the disease remains an abiding problem in the country, and thus, presents a barrier to control efforts.[2]

Medical students are China's future health professionals and clinical leaders. Thus, understanding their level of awareness about TB is important. Unfortunately, this survey revealed that these students had generally poor knowledge of TB. Surveys conducted in other countries have reported inadequate knowledge of TB among medical professions students. In Turkey for example,[28] a study of 828 fourth-year medical students found that they lacked skills in interpreting radiology and smears even in their last year of medical school. One study in Brazil found that although medical students had had good knowledge of biosafety norms, they engaged in risky behaviors in health care settings where TB patients were assisted.[29] Similarly, a study in the United States reported that, prior to implementation of the National Tuberculosis Curriculum Consortium (NTCC) in U.S. medical schools, about one-third of medical students did not know the method for administering tuberculin skin test or that the BCG vaccine was not a contraindication for TB skin testing.[30]

The 2008 National Guideline for TB Control in China emphasizes five items of core knowledge of TB.[25] In the present study, it is of particular concern that the students scored very low in the TB core knowledge domain. The average knowledge base for all of the 5 core knowledge domains was only 2.4%, which was lower than the score (43.45%) reported in a previous study in China's Hunan province.[31] We also found that only 24.1% knew the classic

symptoms of TB (cough and blood stained sputum), which was similar to the report in Nanjing, China where only 26.3% students were familiar with TB symptoms.[32] This study observed that less than 30% of the respondents knew the course of TB treatment and were aware of TB control facilities in Southwest China which was lower than the rate observed in a previous study (36.66%).[32] We found that only 30% knew the free TB treatment policy in China, which was similar to that reported in a related study.[33] One-third of our respondents could not identify a mode of transmission for TB. A survey of final year medical students in China's Hunan province in 2000 concluded that knowledge and practical competencies regarding TB among final-year medical students were generally inadequate.[34] Results of our current study showed that the situation has not improved in the past 13 years.

TB education has been widely recognized as an effective way to promote TB knowledge among students. In 2003, the U.S. National Institutes of Health (NIH) perceived a need to strengthen the teaching of TB to health-profession students, and funded the National Tuberculosis Curriculum Consortium (NTCC) to help address this need.[30] Evidence shows that this has contributed to marked improvement in TB knowledge among students, nationally.[30, 35-36] Strong recommendations to strengthen TB knowledge of medical and other health-professions students through education have also been made by other countries.[37] Although the National Guideline for TB Control in China emphasizes TB health education and promotion for the public, TB patients, and students, TB health education and promotion in universities remain sub-optimal.[25] Findings from many studies have shown that 40%-63.7% of students reported "hearing from others" as their primary source of information

about TB.[32,37] This study also found that only 54% students had ever received TB health education. Accessing TB health education was significantly associated with core knowledge of TB. Given that non-clinical students have less opportunity to learn about TB as part of their regular curriculum, school TB health education should be seen as a primary source of information on TB for them.

CONCLUSION

In countries with high TB burden, it is important that all opportunities to raise population awareness about the disease are used to the optimum. In line with the WHO settings approach to health promotion,[20] schools should be seen as important avenues for TB health education given the multiplier effect of such intervention is likely to have on the students, their families, communities and others in their social networks.[20] Unfortunately, there is the tendency to focus promotion of TB awareness on national/global TB Control Days to the neglect of a plethora of opportunities for ongoing promotion in diverse settings. The overall poor knowledge of TB among medical demonstrated by this study supports the need to increase school TB health promotion, especially in the light of recent outbreaks of TB in universities in Southwest China.[13,17] Given the high burden of TB in southwest China, especially in rural provinces, TB health promotion in schools should be strengthened on an ongoing basis and in coordination with local TB control departments and district-level Centers for Disease Control and Prevention (CDC). There is a need for targeted efforts to educate students about TB since

the students can be a major source of information to rural dwellers, including their own families and others in their circles of influence.

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Contributors YL designed this survey, JE guided the questionnaire design and data collection, YZ, DL and XL collected data, DL managed data, YZ analyzed data. YZ and YL drafted the manuscript; JE edited the manuscript. All authors interpreted the results, revised the report and approved the final version.

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Tables

Table1 Demographic characteristics of undergraduates surveyed in medical universities in southwest China (n=1486)

Demographic factors		N	%
Sex	Male	1102	74.2
	Female	384	25.8
Grade	Year 1	617	41.5
	Year 2	399	26.9
	Year 3	470	31.6
Major	Clinic medicine	1017	68.4
	Non-clinic medicine	469	31.6
Access to TB health education	Yes	802	54
	No	684	45

Table 2 Knowledge of TB signs/symptoms, transmission, and treatment among undergraduates in medical universities in Southwest China†

Knowledge of TB	Total n(%)	Sex n（%）		Grade n（%）			Major n（%）	
		Male	Female	Year 3	Year 2	Year 1	Clinical medicine	Non-clinical medicine
Students had knowledge of TB signs/symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399 (39.2)	198 (42.2)
Haemoptysis	756(50.9)	608(55.2)	148(38.5)*	332 (53.8)	176 (44.2)	248 (52.9)*	509 (50.0)	247 (52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204 (33.1)	73 (18.4)	94 (20.0)*	269 (26.5)	102 (21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209 (33.9)	54 (13.6)	65 (13.8)*	235 (23.1)	93 (19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212 (34.4)	73 (18.3)	113 (24.0)*	270 (26.5)	128 (27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190 (30.8)	43 (10.8)	85 (18.1)*	220 (21.7)	98 (20.9)
All above TB signs/symptoms	132(8.9)	119(10.8)	13(3.4) *	84 (13.6)	17 (4.3)	31 (6.6) *	88(8.7)	44(9.4)
Students had knowledge oof TB transmission								
TB is an infectious disease	1231(82.8)	893(81.0)	338(88.0)*	531(86.1)	316 (79.4)	384(81.5)*	854(84.0)	377(80.4)
Transmitted by cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Transmitted by sneezing & talking loudly	841(56.6)	607 (55.1)	234 (60.9)*	386 (62.6)	191(48.0)	264 (56.3)*	597 (58.8)	244 (52.0)*
Students had knowledge of TB treatment								
TB is a treatable disease	1183(79.6)	891(81.0)	292(76.0)*	477(77.3)	318(80.1)	388(82.6)*	802(79.0)	381(81.4)
Duration of treatment	439(29.5)	313(28.5)	126(32.8)*	207(33.5)	109(27.5)	123(26.2)*	304(30.0)	135 (28.8)
Aware of TB dispensary	404(27.2)	267(24.4)	137(35.7)*	169(27.4)	108(27.1)	127(27.0)	270(26.5)	134 (28.6)
Aware of free treatment policy	506(34.1)	345(31.4)	161(41.9)*	197(31.9)	123(31.1)	186(39.5)*	356(35.1)	150(32.0)
Aware of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148(14.6)	67(14.3)

†χ^2 test used to compare between males and females, different grades, and different majors.

*P ＜0.05

Table 3 Factors associated with the core knowledge of TB among undergraduates in medical university in Southwest China

Factors	OR (95%CI)				
	TB symptoms of cough and blood-tinged sputum	TB as one infectious disease	TB as one curable disease	TB dispensary	TB free policy
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	0.1(0.1, 0.2)	1.8(1.3, 2.7)	0.8(0.6, 1.1)	1.7(1.3, 2.4)	1.9(1.5, 2.4)
Grade					
Year 1	Reference	Reference	Reference	Reference	Reference
Year 2	1.6(1.5, 1.9)	1.7(1.5, 1.9)	1.3(0.9, 1.8)	1.1(0.8, 1.5)	1.6(1.2, 2.0)
Year 3	1.8(1.2,2.6)	1.2(0.8,1.7)	1.1(0.7, 1.5)	1.1(0.8, 1.6)	1.7(1.2, 2.3)
Major					
Clinic medicine	Reference	Reference	Reference	Reference	Reference
Non-clinic medicine	1.1(0.8, 1.4)	1.7(0.5, 1.9)	1.2(0.9, 1.6)	1.1(0.8, 1.4)	0.8(0.6, 1.1)
Access to TB health education					
Yes	Reference	Reference	Reference	Reference	Reference
No	0.5(0.4, 0.7)	0.4(0.3, 0.5)	0.6(0.5, 0.7)	0.6(0.5, 0.8)	0.7(0.5, 0.8)

Figure legends

Fig. 1: The Southwestern People's Republic of China.

In this this figure demonstrated Southwest China. The place marked with red color is Southwest China which includes the municipality of Chongqing, the provinces of Sichuan, Yunnan and Guizhou, and the Tibet Autonomous Regions.

Fig. 2: Knowledge of TB symptoms and transmission among undergraduate medical students in Southwest China.

Figure 2A presents undergraduate medical students' knowledge of classical symptoms of TB; Figure 2B presents students' knowledge of means of TB transmission.

Fig. 3: Knowledge of TB free policy and DOTS among undergraduate medical students in Southwest China.

Figure 3A presents undergraduate medical students' knowledge of the free TB treatment policy in China; Figure 3B presents undergraduate medical students' knowledge of the contents of the Directly Observed Therapy-Short Course (DOTS) program.

Fig. 4: Knowledge of core TB knowledge among undergraduate medical students in Southwest China.

Figure 4A presents the percentage of undergraduate medical students correctly answered each question for core TB knowledge; Figure 4B presents percentage of undergraduate medical students correctly answered none, only one question, any 2, any 3, any4 and any 5 questions for core TB knowledge.

This figure presents undergraduate medical students' knowledge of core TB symptoms

Fig. 5: Sources of TB knowledge among undergraduate medical students in Southwest China.

This figure presents undergraduate medical students' major sources of information on TB.

72x59mm (300 x 300 DPI)

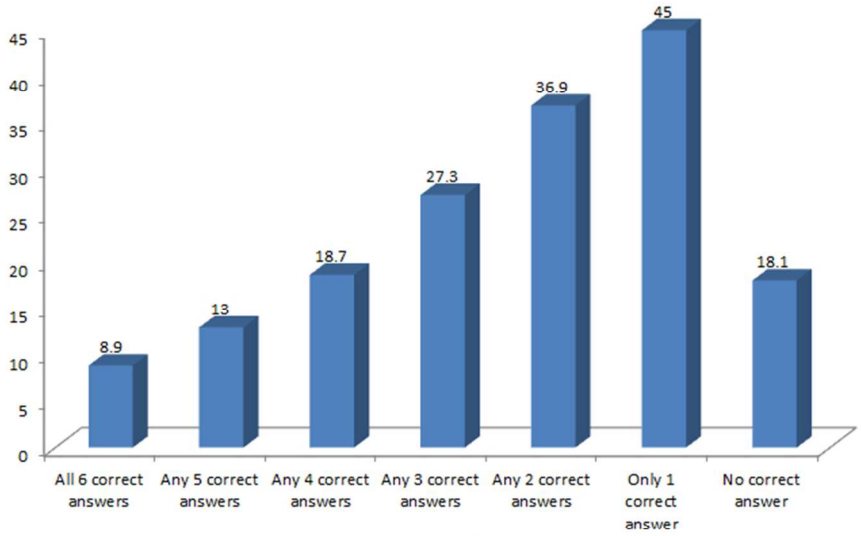

Figure2 A Percentage of correctly answered questions on knowledge about TB symptoms

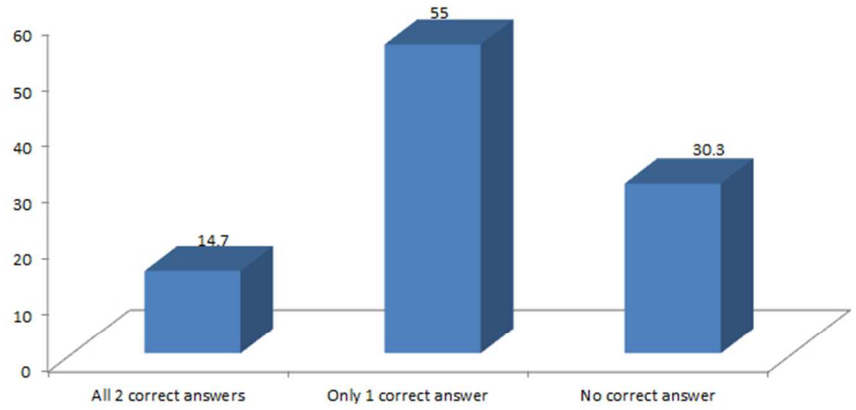

Figure2 B Percentage of correctly answered questions on knowledge about TB transmission

58x75mm (300 x 300 DPI)

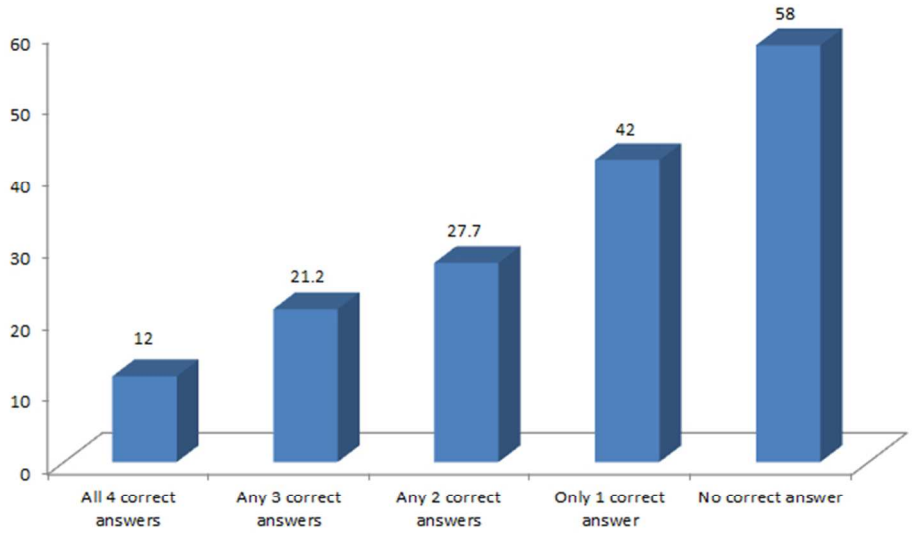

Figure3A Percentage of correctly answered questions on knowledge about TB free policy

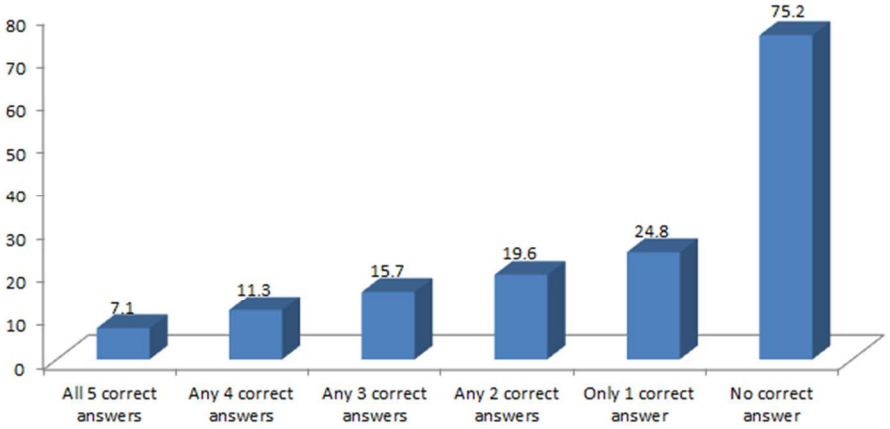

Figure3B Percentage of correctly answered questions on knowledge about DOTS

58x67mm (300 x 300 DPI)

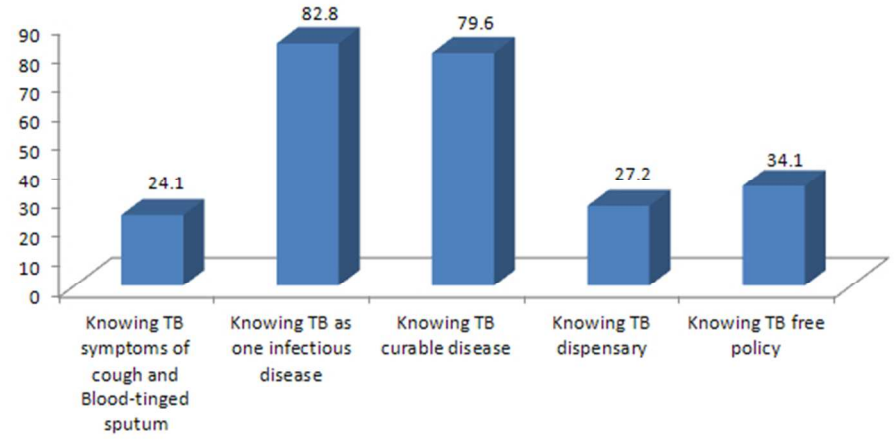

Figure 4A Percentage of correctly answered each question on TB core knowledge

Figure 4B Percentage of correctly answered questions on TB core knowledge

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54x61mm (300 x 300 DPI)

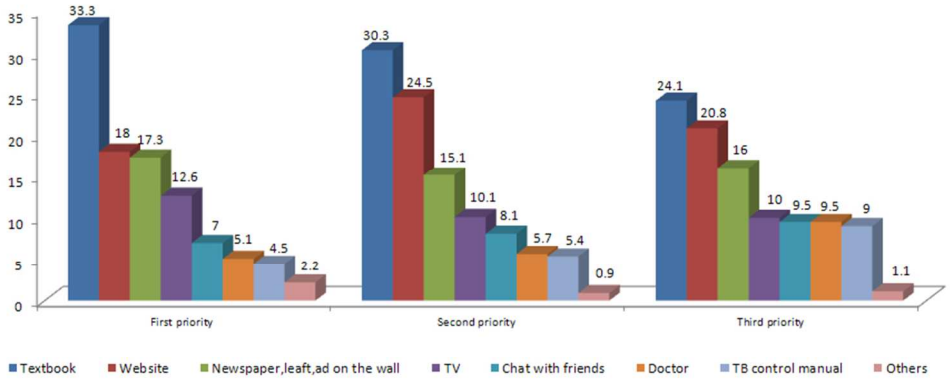

Figure 5 Percentage of students ranked the approach to get TB knowledge

76x35mm (300 x 300 DPI)

A survey of TB knowledge among medical students in Southwest China: Is the information reaching the target?

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Abstract

Objectives: TB control in schools is a concern in low- and middle-income countries with high TB burdens. TB knowledge is recognized as important for TB control in China, which has one of the highest TB prevalence in the world. Accordingly, National TB Control Guideline in China emphasized TB health education in schools as one of the core strategies for improving TB knowledge among the population. It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline, in order to determine if the information was reaching the targets.

Design: A cross-sectional study.

Methods and study setting: This survey assessed TB knowledge and access to TB health information by questionnaire survey with 1,486 undergraduates from two medical universities in southwest China.

Results: Overall, the students had inadequate TB knowledge. Only 24.1%, 27.2%, and 34.1% of the students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and free TB treatment policy, respectively. Very few (14.5%) had heard about the Directly Observed Therapy Short Course (DOTs), and only about half (54%) had ever accessed TB health education information. Exposure to health education messages was significantly associated with increased knowledge of the five core TB knowledge as follows: classic TB symptoms of cough/blood-tinged sputum (OR[95%CI]: 0.5[0.4, 0.7]), TB modes of transmission (OR[95%CI]: 0.4[0.3, 0.5]), curability of TB (OR[95%CI]: 0.6[0.5, 0.7]), location and services provided by TB local dispensaries (OR[95%CI]: 0.6[0.5, 0.8]), and the national free TB treatment policy (OR[95%CI]: 0.7[0.5, 0.8]).

Conclusions: The findings pose the question of whether it is time for a rethink of the current national and global approach to TB health education/promotion which favors promotion of awareness on World TB Days rather than regular community sensitization efforts.

Key words: *Tuberculosis knowledge; undergraduate students; TB health promotion; China;*

ARTICLE SUMMARY

Article focus:

- To describe knowledge of TB among undergraduate medical students.
- To explore factors associated with TB knowledge among undergraduate medical students.
- To attract attention to reform of school-based TB health education and promotion

Key messages

- Overall, undergraduate medical students had inadequate TB knowledge.
- Undergraduate students had limited access to TB health education/promotion.
- A rethink of current national and global approaches to TB health education/promotion is urgently needed in the light of the current global burden of TB.

Strengths and limitations of this study

- The main strength of the manuscript is the establishment of a baseline level of TB knowledge among undergraduate medical students. This is the first study to assess school-based TB health education/promotion in the study setting.
- The main limitation is that the study used a cross-sectional design, which did assess TB knowledge changes before and after school TB health education/promotion.

INTRODUCTION

The 16th Global Report on Tuberculosis (TB) published by WHO in 2012 showed that the Millennium Development Goal target for halting and reversing the TB epidemic by 2015 had already been achieved, with mortality and incidence rates falling in 22 high-burden countries. Nevertheless, the global burden of TB remains untenable,[1] in high-burden countries such as China. Globally, TB remains the second leading cause of death from infectious diseases (after HIV/AIDS).[1] Globally over the past five years, there has been a marked increase in the number of TB patients diagnosed with multi-drug resistant TB (MDR-TB).[1] China has the world's second largest tuberculosis epidemic and has contributed significantly to this MDR-TB increase. In recent years, the country has undertaken measures to control TB, and in order to evaluate the progress of TB control in the past decade, the country launched the 5th National Sampling Survey of TB Epidemiology in 2010.[2] Results of the survey showed an estimated 8.28 million cases of pulmonary TB (PTB) in the country from 2001 to 2010.[2] In spite of concerted international and national efforts to address TB in the country, annual prevalence (per 100,000 people) declined only minimally from 466 in 2000 to 459 in 2010.[2] Similarly, incidence of MDR-TB among PTB cases has remained unchanged in the past decade, and resistance to first-line drugs among newly diagnosed TB patients rose from 34.2 % in 2007/2008[3] to 36.9% in 2010.[2]

Owing to lack of TB knowledge, less than half of patients with TB symptoms seek healthcare timely.[2] Available evidence shows that only 59% TB patients comply with treatment, and among the public, only 57% have proper TB knowledge.[2] Limited knowledge about signs and

symptoms of TB often results in delays in TB diagnosis and treatment[4], which in return, increases not only the risk of TB transmission, but also the development of MDR-TB. China's MDR-TB prevalence rate of 6.8% is the highest in the world.[2]

TB control among undergraduate students is recognized as a concern in low- and middle-income countries with high TB burdens. Undergraduate students usually live in relative overcrowding conditions that are conducive to TB outbreaks.[5] TB outbreaks among students have been reported even in such low-burden countries as the UK, Italy, Ireland, and the USA.[6-10] Chinese undergraduate students are recognized as a particularly vulnerable population for TB. The TB prevalence (per 100,000) among Chinese students has been reported to be as high as 1,520, which is significantly higher than the prevalence (459) for the general population.[11] Chongqing, Guizhou, and Shanxi provinces were the three provinces with the highest TB burden among undergraduate students between 2005 and 2008.[12] In addition, several TB outbreaks among undergraduate students were recently reported in Chongqing, Liangning, Zhejiang, Shangdong, and Guizhou, with the incidence rates ranging from 620 to 31,370 per 100,000.[11-17]

Medical students in university can expose to TB infection during clinic rotations.[18] Thus, adequate knowledge of TB epidemiology and control is critically important for this population. Knowledge of TB among medical undergraduates in university is also important since they represent potential future physicians or leaders in the fight against TB.[19] In ~~1998~~1997, WHO released a report~~document in 1997~~ following a workshop on Tuberculosis Control and

Medical Schools held in Rome, Italy, which stressed the importance of graduating medical students with proper knowledge and skills related to effective TB control.[20] WHO later released a manual that aims to inform medical students and medical practitioners about best practices in managing TB patients.[21] Several studies have documented inadequate TB knowledge and poor compliance with TB treatment guidelines among practicing physicians.[22-24] In countries where TB (including MDR-TB) presents significant challenges to public health, equipping emerging physicians with in-depth TB knowledge is of critical importance in the overall efforts to reduce the burden of the disease. In China, school TB health promotion was emphasized in the 2008 National Guideline for TB Control.[25] It was important to assess the level of TB knowledge in schools following five-year implementation of the guideline. This survey assessed TB knowledge and access to TB health information among 1,486 pre-clinical undergraduate students from two medical universities in southwest China which has one of the highest TB burdens of in the country. It was hoped that the findings could help to identify whether the information was reaching the targets, and thus engender efforts to strengthen TB school education in the region and similar locales in low and middle income countries with high TB burden.

METHODS

Study setting

The study setting, Southwest China, includes Chongqing Municipality, the provinces of Sichuan, Yunnan, Guizhou, and Tibet Autonomous Region (Figure 1) where prevalence rates (cases per 100,000) of active TB (695), smear positive TB (105), and culture positive TB

(198) are much higher than the national prevalence rates of 459, 66, and 119, respectively.[2] Southwest China has a population of more than 19 million which represent more than 10% of China's population of 1.3 billion people.

Participants

There were 10 medical universities in Southwest China. These universities offer 5-year majors in clinical medicine, public health, pharmacy, medical laboratory, Chinese medicine, and nursing. We randomly selected two of the 10 universities and restricted our sample frame to pre-clinical students (students who have not received clinic curriculum) in their first to third years of training. We excluded fourth- and fifth-year students since they might have obtained TB knowledge from their clinical training as part of their clinical curriculum rather than from government school TB health education. The survey was conducted between November 2011 and May 2012 and focused on the assessment of TB knowledge among the respondents. The sample frame consisted of 20,000 eligible students. To obtain a power of 80% and a confidence level of 95%, we calculated the study sample to be 1536.[26] During recruitment, potential participants were approached and provided with detailed explanation of the study and its objectives. They were then asked if they would be interested in volunteering to participate. Those who expressed interest were asked to read the informed consent form, and were assured of confidentiality. They were then asked to sign the informed consent form as a conformation of their voluntary participation in the study. Approval for the study was obtained from the Institutional Review Boards of the College of Preventive Medicine, Third Military Medical University, Chongqing, China (October, 20, 2011) and the School of

Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan Province, China (28 April, 2012).

Questionnaire

The survey was cross-sectional in design. Following participant enrollment in the study, data were collected by means of a self-administered questionnaire that assessed participants' knowledge about TB signs/symptoms, transmission, management, and control. Data were elicited on the following variables: socio-demographic profile (age, sex), degree major (clinical and non-clinical), year in the medical program, TB knowledge (symptoms, mode of transmission, treatment, knowledge of TB control facilities in the study setting, local TB control policies and program), and core knowledge of TB, namely, five core TB knowledge areas which include: (i) classic TB symptoms of cough/blood-tinged sputum, (ii) TB modes of transmission, (iii) curability of TB, (iv) location and services provided by TB local dispensaries, and (v) the national free TB treatment policy.

Data analysis

Epi-data 6.0 was used for data entry. Data analyses were conducted using the Statistical Package for Social Sciences version 18.0. To assess TB knowledge among the participants, we calculated the percentage of people who provided correct responses to questions about the 6 symptoms of TB, 3 ways of transmitting TB, 5 items related to TB treatment, and 5 core knowledge of TB. We used chi-square statistics (χ^2) to assess participants' responses by gender, year in medical school, and degree major. A binary logistic regression model which

included variables with statistical significance on the χ^2 test, were used to examine factors associated with core knowledge of TB among the respondents. We used a two-tailed probability level of <0.05 as the level of statistical significance.

RESULTS

Demographic characteristics of participants

A total of 1,486 undergraduate medical students participated in the survey. Of these, 617 were in their first year medical training, 399 in the second year, and 470 in the third year. A majority of the respondents (74.2%; n=1102) were male， and 68.4% students were majoring in clinical medicine. Only 54% of the students indicated having access to some kind of TB health information (Table 1).

Knowledge of TB symptoms

The respondents' knowledge of symptoms is shown in Table 2. About 18% (n=261) had no knowledge of any TB symptoms, and less than 10% (n=132) were able to identify all TB symptoms (Figure 2 A). As for overall knowledge of TB symptoms, 10.8% (n=119) of males and 3.4% (n=13) of female 3.4% (13) year had knowledge of all of these classic symptoms of TB (p≤0.05),). Slightly more than thirteen per cent (; 13.6%; n= (84) of students in the third year of medical school, , 4.3 % (17), 6.6% (31) students of third year, 4.3 % (n=17) of those in the second year, , second year and 6.6% (n=31) of first-year students had knowledge of all of these classic symptoms (p≤0.05). There were no statistically significant differences in

knowledge of TB symptoms between students in clinical and non-clinical degree majors （p>0.05） （Table 2).

Knowledge about TB transmission

Only 27.9% (n=414) of the respondents were aware that TB could be transmitted through exposure to droplet nuclei from the cough of an infected person (Table 2), and only 14.7% (n=218) knew the two main routes of TB transmission (Figure 2B). Overall, more females (88%; n=338) and third-year students (86.1%; n=531) knew the transmission routes of TB （p<0.05).

Knowledge about TB treatment and policies

Although 80% of the students knew that TB was curable, only 30% (n=446) knew the duration of TB treatment. Only 27.2% (n=404) knew TB control facilities (TB dispensaries); 34% and 14.5% had heard of the national free TB treatment policy and DOTS, respectively (Table 2). A greater proportion of female than male respondents had better knowledge about the duration of TB treatment, TB control facilities, free TB treatment policy, and DOTS (P≤0.05). Overall, third-year students had better knowledge of TB treatment except for knowledge on TB as a curable disease and free treatment policy. There were no significant differences between students in clinical and non-clinical majors (Table 2). Only 12% (n=178) of the respondents knew all the 4 items included in the free TB treatment policy (registration, sputum test, chest X-rays, and anti-TB drugs) (Figure 3A). Less than 10% (n=106) of the students were familiar with all 5 items of DOTS (Figure 3B).

Core knowledge of TB

With regard to core knowledge of TB, less than half students had knowledge of TB symptoms of cough/blood-tinged sputum, their local TB dispensaries, and the national free TB treatment policy (Figure 4A). Only 2.4% were familiar with all five core TB knowledge areas (Figure 4B). Multiple logistic regression analysis indicated that access to health education was associated with the five core TB knowledge: (OR [95%CI]: 0.5[0.4, 0.7]) for classic TB symptoms of cough/blood-tinged sputum, (OR [95%CI]: 0.4[0.3, 0.5]) for means of TB transmission, (OR [95%CI]: 0.6[0.5, 0.7]) for curability of TB, (OR [95%CI]: 0.6[0.5, 0.8]) for TB dispensaries, and (OR [95%CI]: 0.7[0.5, 0.8]) for the national free TB treatment policy. Males had poor knowledge related to transmission of TB, TB dispensaries and free TB treatment policy (OR [95%CI]: 1.8[1.3, 2.7], 1.7[1.3, 2.4], 1.9[1.5, 2.4]), respectively. Third year students had better knowledge of TB compared with students in the first and second years (Table 3).

Sources of TB Knowledge

With regard to how the respondents gained awareness and understanding of TB, survey results indicated that the most frequent source of information was textbooks, the second was the Internet, and the third was the media (newspaper and billboards) (Figure 5).

DISCUSSION

TB is still one of the most important global public health threats. If global control of the disease does not improve, the annual global incidence is expected to increase from the current

21% to 61% by 2020.[27] Early detection and adequate treatment are critical control measures. In spite of the fact that China carries one of the highest TB burdens in the world, lack of knowledge about the disease remains an abiding problem in the country, and thus, presents a barrier to control efforts.[2]

Medical students are China's future health professionals and clinical leaders. Thus, understanding their level of awareness about TB is important. Unfortunately, this survey revealed that these students had generally poor knowledge of TB. Surveys conducted in other countries have reported inadequate knowledge of TB among medical professions students. In Turkey for example,[28] a study of 828 fourth-year medical students found that they lacked skills in interpreting radiology and smears even in their last year of medical school. One study in Brazil found that although medical students had had good knowledge of biosafety norms, they engaged in risky behaviors in health care settings where TB patients were assisted[29] Similarly, a study in the United States reported that, prior to implementation of the National Tuberculosis Curriculum Consortium (NTCC) in U.S. medical schools, about one-third of medical students did not know the method for administering tuberculin skin test or that the BCG vaccine was not a contraindication for TB skin testing.[30]

The 2008 National Guideline for TB Control in China emphasizes five items of core knowledge of TB.[25] In the present study, it is of particular concern that the students scored very low in the TB core knowledge domain. The average knowledge base for all of the 5 core knowledge domains was only 2.4%, which was lower than the score (43.45%) reported in a

previous study in China's Hunan province.[31] We also found that only 24.1% knew the classic symptoms of TB (cough and blood stained sputum), which was similar to the report in Nanjing, China where only 26.3% students were familiar with TB symptoms.[32] This study observed that less than 30% of the respondents knew the course of TB treatment and were aware of TB control facilities in Southwest China which was lower than the rate observed in a previous study (36.66%).[32] We found that only 30% knew the free TB treatment policy in China, which was similar to that reported in a related study.[33] One-third of our respondents could not identify a mode of transmission for TB. A survey of final year medical students in China's Hunan province in 2000 concluded that knowledge and practical competencies regarding TB among final-year medical students were generally inadequate.[34] Results of our current study showed that the situation has not improved in the past 13 years.

TB education has been widely recognized as an effective way to promote TB knowledge among students. In 2003, the U.S. National Institutes of Health (NIH) perceived a need to strengthen the teaching of TB to health-profession students, and funded the National Tuberculosis Curriculum Consortium (NTCC) to help address this need.[30] Evidence shows that this has contributed to marked improvement in TB knowledge among students, nationally.[30, 35-36] Strong recommendations to strengthen TB knowledge of medical and other health-professions students through education have also been made by other countries.[37] Although the National Guideline for TB Control in China emphasizes TB health education and promotion for the public, TB patients, and students, TB health education and promotion in universities remain sub-optimal.[25] Findings from many studies have shown that

40%-63.7% of students reported "hearing from others" as their primary source of information about TB.[32,37] This study also found that only 54% students had ever received TB health education. Accessing TB health education was significantly associated with core knowledge of TB. Given that non-clinical students have less opportunity to learn about TB as part of their regular curriculum, school TB health education should be seen as a primary source of information on TB for them.

CONCLUSION

In countries with high TB burden, it is important that all opportunities to raise population awareness about the disease are used to the optimum. In line with the WHO settings approach to health promotion,[20] schools should be seen as important avenues for TB health education given the multiplier effect of such intervention is likely to have on the students, their families, communities and others in their social networks.[20] Unfortunately, there is the tendency to focus promotion of TB awareness on national/global TB Control Days to the neglect of a plethora of opportunities for ongoing promotion in diverse settings. The overall poor knowledge of TB among medical demonstrated by this study supports the need to increase school TB health promotion, especially in the light of recent outbreaks of TB in universities in Southwest China.[13,17] Given the high burden of TB in southwest China, especially in rural provinces, TB health promotion in schools should be strengthened on an ongoing basis and in coordination with local TB control departments and district-level Centers for Disease Control and Prevention (CDC). There is a need for targeted efforts to educate students about TB since

the students can be a major source of information to rural dwellers, including their own families and others in their circles of influence.

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Contributors YL designed this survey, JE guided the questionnaire design and data collection, YZ, DL and XL collected data, DL managed data, YZ analyzed data. YZ and YL drafted the manuscript; JE edited the manuscript. All authors interpreted the results, revised the report and approved the final version.

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Competing interests None.

Ethics approval The ethics committees of the two study universities approved the study

protocol prior to its implementation.

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Tables

Table1 Demographic characteristics of undergraduates surveyed in medical universities in southwest China (n=1486)

Demographic factors		N	%
Sex	Male	1102	74.2
	Female	384	25.8
Grade	Year 1	617	41.5
	Year 2	399	26.9
	Year 3	470	31.6
Major	Clinic medicine	1017	68.4
	Non-clinic medicine	469	31.6
Access to TB health education	Yes	802	54
	No	684	45

Table 2 Knowledge of TB signs/symptoms, transmission, and treatment among undergraduates in medical universities in Southwest China†

Knowledge of TB	Total n(%)	Sex n（%）		Grade n（%）			Major n（%）	
		Male	Female	Year 3	Year 2	Year 1	Clinical medicine	Non-clinical medicine
Students had knowledge of TB signs/symptoms								
Chronic cough	597(40.2)	501(45.5)	96(25.0)*	262(42.5)	118(29.6)	217(46.0)*	399 (39.2)	198 (42.2)
Haemoptysis	756(50.9)	608(55.2)	148(38.5)*	332 (53.8)	176 (44.2)	248 (52.9)*	509 (50.0)	247 (52.8)
Fever	371(25.0)	298(27.1)	73(19.0)*	204 (33.1)	73 (18.4)	94 (20.0)*	269 (26.5)	102 (21.7)
Night sweats	328(22.1)	265(24.1)	63(16.4)*	209 (33.9)	54 (13.6)	65 (13.8)*	235 (23.1)	93 (19.8)
Weakness	398(26.8)	348(31.6)	50(13.0)*	212 (34.4)	73 (18.3)	113 (24.0)*	270 (26.5)	128 (27.3)
Weight loss	318(21.4)	286(26.0)	32(8.3)*	190 (30.8)	43 (10.8)	85 (18.1)*	220 (21.7)	98 (20.9)
All above TB signs/symptoms	132(8.9)	119(10.8)	13(3.4) *	84 (13.6)	17 (4.3)	31 (6.6) *	88(8.7)	44(9.4)
Students had knowledge oof TB transmission								
TB is an infectious disease	1231(82.8)	893(81.0)	338(88.0)*	531(86.1)	316 (79.4)	384(81.5)*	854(84.0)	377(80.4)
Transmitted by cough	414(27.9)	338(30.7)	76(19.8)*	186(30.1)	92(23.1)	136(29.0)	293(28.8)	121(25.8)
Transmitted by sneezing & talking loudly	841(56.6)	607 (55.1)	234 (60.9)*	386 (62.6)	191(48.0)	264 (56.3)*	597 (58.8)	244 (52.0)*
Students had knowledge of TB treatment								
TB is a treatable disease	1183(79.6)	891(81.0)	292(76.0)*	477(77.3)	318(80.1)	388(82.6)*	802(79.0)	381(81.4)
Duration of treatment	439(29.5)	313(28.5)	126(32.8)*	207(33.5)	109(27.5)	123(26.2)*	304(30.0)	135 (28.8)
Aware of TB dispensary	404(27.2)	267(24.4)	137(35.7)*	169(27.4)	108(27.1)	127(27.0)	270(26.5)	134 (28.6)
Aware of free treatment policy	506(34.1)	345(31.4)	161(41.9)*	197(31.9)	123(31.1)	186(39.5)*	356(35.1)	150(32.0)
Aware of DOTS	215(14.5)	142(12.9)	73(19.0)*	110(17.8)	55(13.9)	50(10.8)*	148(14.6)	67(14.3)

†χ^2 test used to compare between males and females, different grades, and different majors.

*P ＜0.05

Table 3 Factors associated with the core knowledge of TB among undergraduates in medical university in Southwest China

Factors	OR (95%CI)				
	TB symptoms of cough and blood-tinged sputum	TB as one infectious disease	TB as one curable disease	TB dispensary	TB free policy
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	0.1(0.1, 0.2)	1.8(1.3, 2.7)	0.8(0.6, 1.1)	1.7(1.3, 2.4)	1.9(1.5, 2.4)
Grade					
Year 1	Reference	Reference	Reference	Reference	Reference
Year 2	1.6(1.5, 1.9)	1.7(1.5, 1.9)	1.3(0.9, 1.8)	1.1(0.8, 1.5)	1.6(1.2, 2.0)
Year 3	1.8(1.2,2.6)	1.2(0.8,1.7)	1.1(0.7, 1.5)	1.1(0.8, 1.6)	1.7(1.2, 2.3)
Major					
Clinic medicine	Reference	Reference	Reference	Reference	Reference
Non-clinic medicine	1.1(0.8, 1.4)	1.7(0.5, 1.9)	1.2(0.9, 1.6)	1.1(0.8, 1.4)	0.8(0.6, 1.1)
Access to TB health education					
Yes	Reference	Reference	Reference	Reference	Reference
No	0.5(0.4, 0.7)	0.4(0.3, 0.5)	0.6(0.5, 0.7)	0.6(0.5, 0.8)	0.7(0.5, 0.8)

Figure legends

Fig. 1: The Southwestern People's Republic of China.

In this this figure demonstrated Southwest China. The place marked with red color is Southwest China which includes the municipality of Chongqing, the provinces of Sichuan, Yunnan and Guizhou, and the Tibet Autonomous Regions.

Fig. 2: Knowledge of TB symptoms and transmission among undergraduate medical students in Southwest China.

Figure 2A presents undergraduate medical students' knowledge of classical symptoms of TB; Figure 2B presents students' knowledge of means of TB transmission.

Fig. 3: Knowledge of TB free policy and DOTS among undergraduate medical students in Southwest China.

Figure 3A presents undergraduate medical students' knowledge of the free TB treatment policy in China; Figure 3B presents undergraduate medical students' knowledge of the contents of the Directly Observed Therapy-Short Course (DOTS) program.

Fig. 4: Knowledge of core TB knowledge among undergraduate medical students in Southwest China.

Figure 4A presents the percentage of undergraduate medical students correctly answered each question for core TB knowledge; Figure 4B presents percentage of undergraduate medical students correctly answered none, only one question, any 2, any 3, any4 and any 5 questions for core TB knowledge.

This figure presents undergraduate medical students' knowledge of core TB symptoms

Fig. 5: Sources of TB knowledge among undergraduate medical students in Southwest China.

This figure presents undergraduate medical students' major sources of information on TB.