

## Original Article

**Knowledge, attitudes, and practice toward tuberculosis in high school students in Qingdao, China**Xiaoqi Dai<sup>1#</sup>, Shuo Li<sup>2#</sup>, Song Song<sup>1#</sup>, Meng Chen<sup>1</sup>, Honghong Xu<sup>1</sup>, Xuekui Li<sup>1</sup>, Menghan Zhang<sup>1</sup>, Huaqiang Zhang<sup>1</sup>, Haiyan Sun<sup>1</sup>, Zhongdong Wang<sup>1</sup><sup>1</sup> Municipal Centre of Disease Control and Prevention of Qingdao, Qingdao Institute of Prevention Medicine, Qingdao, China<sup>2</sup> Department of Thoracic Surgery, The Affiliated Hospital of QingDao University, Qingdao, China

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**Abstract**

**Introduction:** The purpose of this study is to assess the levels of knowledge, attitude, and practice (KAP) related to TB, and to analyze the differences among various demographic groups.

**Methodology:** A total of 621 students enrolled in Qingdao High School, coming from high TB burden settings. The cross-sectional study was conducted from May to July of 2022. Participants completed an online questionnaire. Differences in knowledge and practice based on participant characteristics were analyzed using the Wilcoxon rank test and Kruskal-Wallis rank test. Group differences were assessed using a rank-based analysis of variance.

**Results:** The mean percentage of correct answers for TB knowledge and practice was 82.09% and 83.25%, respectively. Grade Three students showed higher knowledge and practice scores than Grade One or Grade Two students ( $t = -3.9935, p = 0.0002, t = 3.4537, p = 0.0018$ . 8.58 vs 7.94, 8.58 vs 8.23.  $t = 3.4562, p = 0.0018, t = -2.8688, p = 0.0128$ . 1.78 vs 1.61, 1.78 vs 1.64). A significant majority (78.42%) of students expressed fear of being affected by TB. 49.28% of the students would support and help TB patients. 88.08% of participants had heard of TB, with 72.94% learning about it at school, mainly through visual aids like posters. Information was predominantly obtained from online sources (websites, microblogs, WeChat, etc.).

**Conclusions:** It is recommended to develop a TB curriculum for lower-grade students to enhance awareness of TB prevention through various means, including the internet and social media.

**Key words:** Knowledge; attitude; practice; determinants; tuberculosis.*J Infect Dev Ctries* 2024; 18(3):427-434. doi:10.3855/jidc.18312

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Copyright © 2024 Dai *et al.* This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.**Introduction**

Tuberculosis (TB) is a contagious disease and remains one of the leading causes of death worldwide [1]. It is caused by *Mycobacterium tuberculosis* (MTB), and spreads when TB patients exhale or cough out bacteria into the air. Until the coronavirus (COVID-19) pandemic, TB was the leading cause of death from a single infectious agent, ranking above HIV/AIDS [2]. The 2022 TB Report published by the WHO revealed that 6.4 million people were newly diagnosed with TB. There were 30 countries with a high TB burden, collectively accounting for 87% of all estimated new TB cases worldwide. China accounted for 7.4% of the global new TB cases, ranking third in contribution behind Indonesia.

China encounters many challenges in the control of TB [3]. Managing TB among students stands out as a significant challenge. Students have become a high-risk

group for TB due to their densely populated environments and frequent person-to-person contact. These conditions result in heightened disease transmission, particularly for TB [4-5]. As an airborne disease, MTB infection is acquired by inhaling infectious aerosol particles released by close contacts [6]. Tuberculosis outbreaks frequently arise in settings characterized by relative overcrowding, including schools, prisons, and refugee camps [7].

A national TB epidemiology survey reported that the prevalence of TB is significantly higher in western China compared to central or eastern regions [8]. Two high schools in Qingdao annually enroll students from a western province. Clusters of TB outbreaks have occurred among students in these classes. Insufficient TB knowledge may heighten the risk of contracting the disease among students. This study was conducted in two high schools to survey all 621 students who came

from high TB burden settings and to assess their awareness of TB KAP. Our findings can provide fundamental information on TB KAP and aid in enhancing future TB prevention and control strategies in Qingdao.

## Methodology

### Study Design

Between 2019 and 2021, a total of 621 students enrolled in high school in Qingdao, originating from regions with a high burden of TB in western China. They were distributed across two schools. The cross-sectional study was conducted among them from May to July of 2022. Participants, hailed from areas with a high TB burden and were currently studying in Qingdao, completed an online questionnaire via the Wenjuanxing platform (WJX) (<https://www.wjx.cn/>, in Chinese). The questionnaire was anonymous, and logical verification was set up within the electronic questionnaire. Additionally, trained professionals cross-checked the responses. All participants provided their informed consent by signing a paper version of the consent form and agreed to take part in the survey.

### The questionnaire

The KAP questionnaire was formulated based on Chinese guidelines for tuberculosis prevention and control in school settings [9], as well as previously published surveys [10,11]. It encompassed sections on informed consent, demographics, knowledge, attitudes, and practices. Demographic information was collected, encompassing details such as sex, grade, nationality, census registration, Body Mass Index (BMI), TB contact history, BCG vaccination (at birth), Latent tuberculosis infection (LTBI), and other relevant factors.

### Data analysis

The data were analyzed using SAS 9.4. For the questionnaire responses, knowledge scores ranging

from 0 to 10 and practice scores ranging from 0 to 2 were computed. Categorical variables were presented as counts and percentages in tables and as percentages within the text, while continuous variables were presented as (Mean  $\pm$  SD). Variances in knowledge and practices across participant characteristics were analyzed using the Wilcoxon rank test and Kruskal-Wallis rank test, and the group differences were assessed using a rank-based analysis of variance. The significance level was set at 0.05 with two-tailed testing.

## Results

### Demographic characteristics, experiences of participants

A total of 621 students were involved in this study, with 217 males (34.94%). The mean age of the participants was 17 years old (SDs 1.12). Among them, 236 (38.00%) were in Grade One, 228 (36.71%) were in Grade Two, and 157 (25.28%) were in Grade Three. With regard to ethnic distribution, there were 367 (59.10%) Uygur students, 133 (21.42%) Han students, and 121 (19.48%) from other ethnic backgrounds. Additionally, 49 (7.89) students reported a history of TB contact, 105 (16.91) had not been vaccinated with BCG at birth, and 129 (20.77) were found to have latent tuberculosis infection.

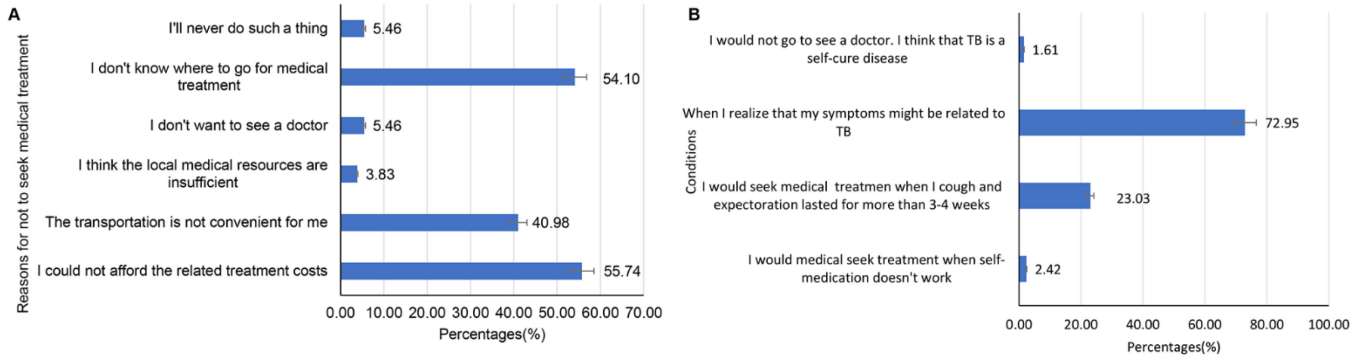
### Knowledge about TB

The total mean percentage of correct answers for TB knowledge was 82.09% (SDs 16.90%). Findings revealed that 86.47% (537/621, 95% CI: 83.55%-88.94%) of students knew TB was infectious, while only 69.08% (429/621, 95% CI: 65.34%-72.59%) knew that TB was curable. Moreover, a majority of students correctly identified the lung as the primary organ affected by MTB (94.20%, 585/621, 95% CI: 92.08%-95.78%). Additionally, it was observed that 96.62% (600/621, 95% CI: 94.89%-97.78%) of the students knew to seek treatment from designated medical

**Table 1.** Number of correctly answered knowledge questions among participants (n = 621).

No.	Correct Answer	Frequency	%
1	Lung is the main organ of <i>Mycobacterium tuberculosis</i> infection.	585	94.20
2	TB is infectious.	537	86.47
3	TB transmitted via airborne.	520	83.74
4	Cough that lasts for 2–3 weeks is common TB symptoms and signs	436	70.21
5	TB is a chronic infectious disease that seriously endangers people's health.	496	79.87
6	Not spitting, covering your mouth and nose when coughing or sneezing, and wearing a mask can reduce the spread of tuberculosis.	591	95.17
7	if you occur suspicious symptoms of TB or be diagnosed with TB, you should report it to the teacher and do not go to class with the disease.	603	97.10
8	TB is curable.	429	69.08
9	TB patients couldn't infect others after being cured.	301	48.47
10	If you suspect that you have tuberculosis, you should go to designated medical institutions for treatment.	600	96.62
<b>Total</b>		<b>5098</b>	<b>82.09</b>

**Figure 1.** Practice of participants. **A:** what are the reasons, if you do not seek medical treatment?; **B:** When would you seek medical treatment?



institutions if they suspected they had TB. Furthermore, in the event of experiencing suspicious symptoms of TB or receiving a TB diagnosis, students were aware that they should report it to their teacher and refrain from attending class while infected (97.10%, 603/621, 95% CI: 95.46%-98.16%). The majority of participants demonstrated knowledge of various preventive measures for TB, such as refraining from spitting, covering their mouth and nose when coughing or sneezing, and wearing a mask to reduce the spread of TB. However, only 48.47% (301/621, 95% CI: 44.56%-52.40%) of students were aware that TB patients couldn't infect others after being cured (Table 1).

*Practice of participants*

The total mean percentage of correct answers for TB practice was 83.25% (SDs 49.53%). The study found that the majority of participants (70.53%, 438/621, 95% CI: 66.83%-73.98%) indicated they would seek medical treatment if they suspected they might have TB. Among those who would not seek medical treatment, 55.74% (102/183, 95% CI: 48.50%-62.74%) believed they could not afford the related treatment costs, while 54.10% (99/183, 95% CI: 46.87%-61.16%) didn't know where to go for medical treatment (Figure 1A). Moreover, it was observed that 72.95% (453/621, 95% CI: 69.32%-76.29%) of participants would seek medical treatment upon realizing that their symptoms might be related to TB (Figure 1B).

**Table 2.** Demographic variables associated with better TB Knowledge and Practice.

Category	N (%)	Knowledge			Practice		
		Mean Score	Z/X <sup>2</sup>	p value	Mean Score	Z/X <sup>2</sup>	p value
<b>Total</b>	<b>621 (100.00)</b>	8.21			1.67		
<b>Sex</b>							
Male	217 (34.94)	8.08			1.67		
Female	404 (65.06)	8.28	-1.1199	0.2627	1.66	0.1868	0.8516
<b>Age (SDs)</b>	17 (1.12)						
<b>Grade</b>							
Grade One	236 (38.00)	7.94			1.61		
Grade Two	228 (36.71)	8.23	17.2935	0.0002	1.64	12.7329	0.0017
Grade Three	157 (25.28)	8.58			1.78		
<b>Nationality</b>							
Uyghur nationality	367 (59.10)	8.03			1.67		
Han nationality	133 (21.42)	8.62	13.9964	0.0009	1.67	0.1952	0.9070
Others	121 (19.48)	8.31			1.64		
<b>Census registration</b>							
Urban	207 (33.33)	8.50			1.71		
Rural	414 (66.67)	8.06	3.3218	0.0009	1.64	1.4535	0.1460
<b>TB contact history</b>							
No	572 (92.11)	8.22			1.59		
Yes	49 (7.89)	8.12	-0.6778	0.4976	1.67	-1.2407	0.2145
<b>BCG vaccination (at birth)</b>							
Vaccination	516 (83.09)	8.21			1.65		
Unvaccinated	105 (16.91)	8.22	-0.2616	0.7934	1.72	1.2111	0.2257
<b>LTBI</b>							
Yes	129 (20.77)	8.33			1.60		
No	492 (79.23)	8.18	1.1832	0.2366	1.68	-1.5465	0.1219

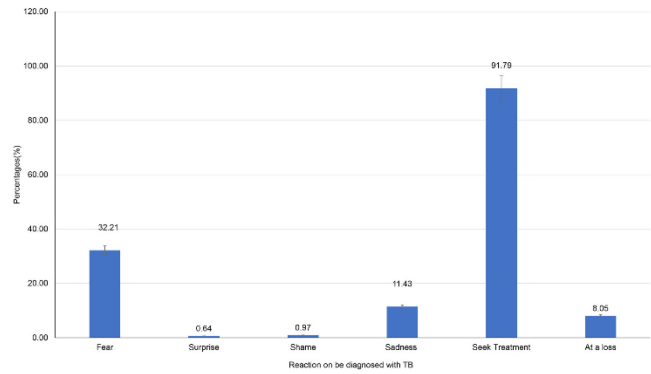
*Characteristics associated with better TB knowledge, practice*

Analysis revealed notable variations in both knowledge and practice scores across different student grades ( $\chi^2 = 17.2935, p = 0.0002, \chi^2 = 12.7329, p = 0.0017$ , Table 2). Further examination through rank-based ANOVA indicated that Grade Three students exhibited higher levels of knowledge and displayed better practices compared to their Grade One or Grade Two counterparts ( $t = -3.9935, p = 0.0002, t = 3.4537, p = 0.0018, 8.58$  vs  $7.94, 8.58$  vs  $8.23, t = 3.4562, p = 0.0018, t = -2.8688, p = 0.0128, 1.78$  vs  $1.61, 1.78$  vs  $1.64$ ). There were significant differences in knowledge scores among students of different nationalities and census registrations ( $\chi^2 = 13.9964, p = 0.0009, Z = 3.3218, p = 0.0009$ ). The results of rank-based ANOVA showed that the knowledge score of Han nationality students was higher than that of Uyghur nationality students ( $t = -3.6625, p = 0.0008, 8.62$  vs  $8.03$ ).

*Attitude towards TB*

Most students were afraid of being affected by TB (78.42%, 487/621, 95% CI: 75.02%-81.48%). It was found that 95.65% (594/621, 95% CI: 93.75%-96.99%) of participants would not conceal their illness, but only half of participants (56.04%, 348/621, 95% CI: 52.11%-59.89%) believed that their illness would not affect social relationships. Moreover, the majority of participants indicated that they would seek treatment if they were diagnosed with TB (91.79%, 570/621, 95% CI: 89.37%-93.70%). Approximately one-third (32.21%, 200/621, 95% CI: 28.65%-35.98%) of respondents reported experiencing fear (Figure 2).

**Figure 2.** What would you be your reaction on getting TB?



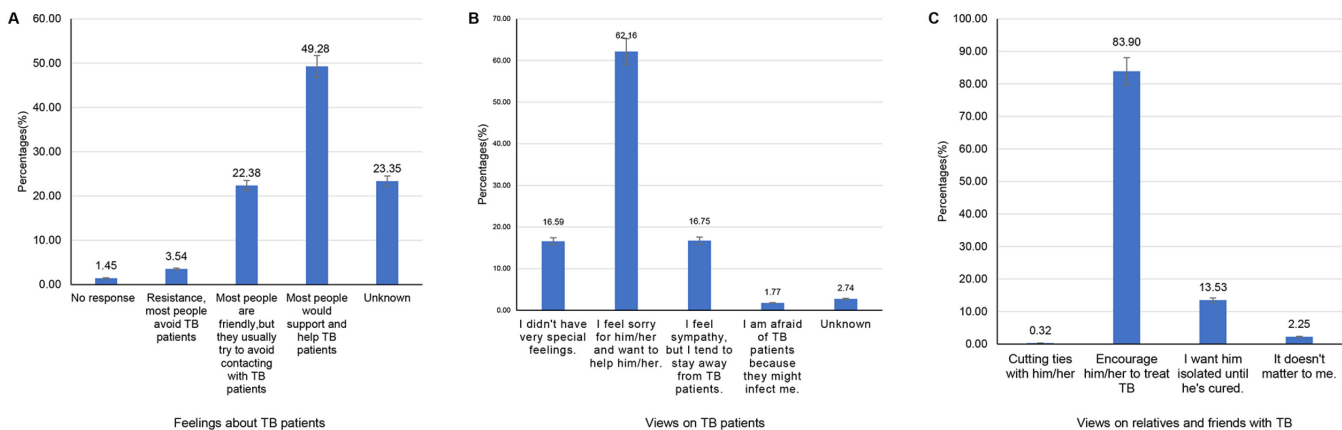
*Attitude towards TB patients*

Half of the students expressed willingness to provide support and assistance to TB patients (49.28%, 306/621, 95% CI: 45.36%-53.20%). 22.38% (139/621, 95% CI: 19.28%-25.82%) of students exhibited a friendly attitude towards TB patients, although they typically attempted to avoid direct contact with them (Figure 3A). More than half of the students conveyed feelings of empathy toward TB patients and expressed a desire to offer help (Figure 3B). Most students indicated that they would encourage a classmate, colleague, or friend with TB to seek treatment (83.90%, 521/621, 95% CI: 80.80%-86.58%) (Figure 3C).

*Attitude towards the risk of infecting TB*

Participants thought that the risk of infecting TB was higher at school (39.61%, 246/621, 95% CI: 35.84%-43.51%), compared to in the community (34.78%, 216/621, 95% CI: 31.14%-38.61%) (Figure 4A). They identified large population density as the primary factor contributing to contagion in both settings (90.24% and 82.41%, respectively), and a higher likelihood of suffering from malnutrition or lack of

**Figure 3.** Attitude towards TB patients. **A:** What are your feelings about TB patients? **B:** Which choice is closest to your view on TB patients? **C:** How would you treat a classmate, colleague or friend with TB?



medical resources at school compared to in the community (29.67% vs. 4.17%, 26.02% vs. 12.50%), along with the presence of infectious patients (Figure 4B).

*Sources of information about TB*

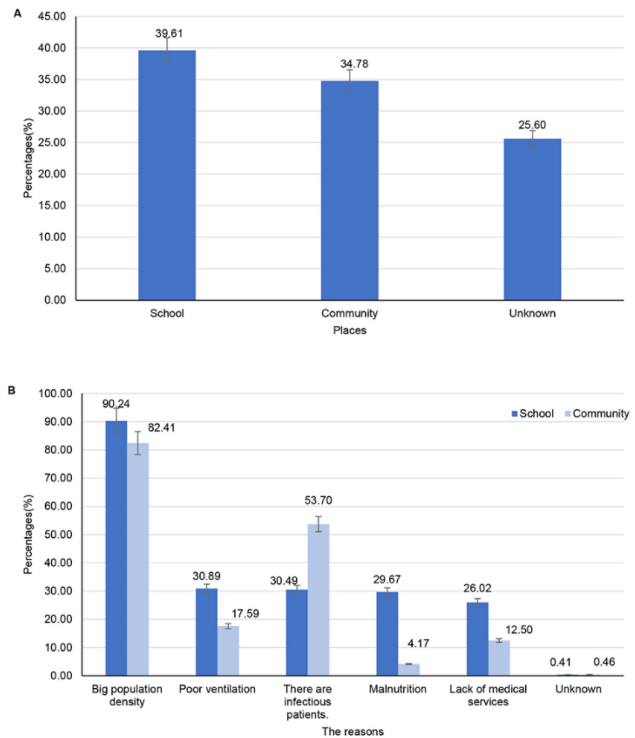
The majority of participants displayed awareness of TB (88.08%, 547/621) and had gathered information about it from diverse channels. 72.94% acquired knowledge of TB from school, 44.42% via TV, and 42.05% through sources such as bulletin board, blackboards, newspapers, etc. (Figure 5A). When it comes to learning about information on TB prevention and control, most participants expressed a preference for learning through formal education (58.78%, 356/621) or the Internet (43.80%, 242/621) (Figure 5B). 49.60% (308/621) preferred visual formats such as posters or folding pamphlets, while 41.71% (259/621) preferred digital formats like websites, microblogs, and WeChat (Figure 5C).

**Discussion**

Within this study, most students demonstrated knowledge of TB, with a mean knowledge score was 8.21 out of 10, representing an average correct response rate of 82.09%. Although this figure is lower compared to the awareness rate among students in Qingdao (93.34%) [12], more than 90% of the students correctly identified the lung as the primary organ affected by TB and recognized the efficacy of wearing a mask could help reduce its spread.

Less than 50% of the students knew that TB is a curable disease. Upon comparative analysis with prior studies [10,13,14], it was revealed that our study boasted a higher percentage of correct responses related to preventative TB knowledge (94.20% vs. 53.7, 95.17% vs. 66.9%). However, our results regarding

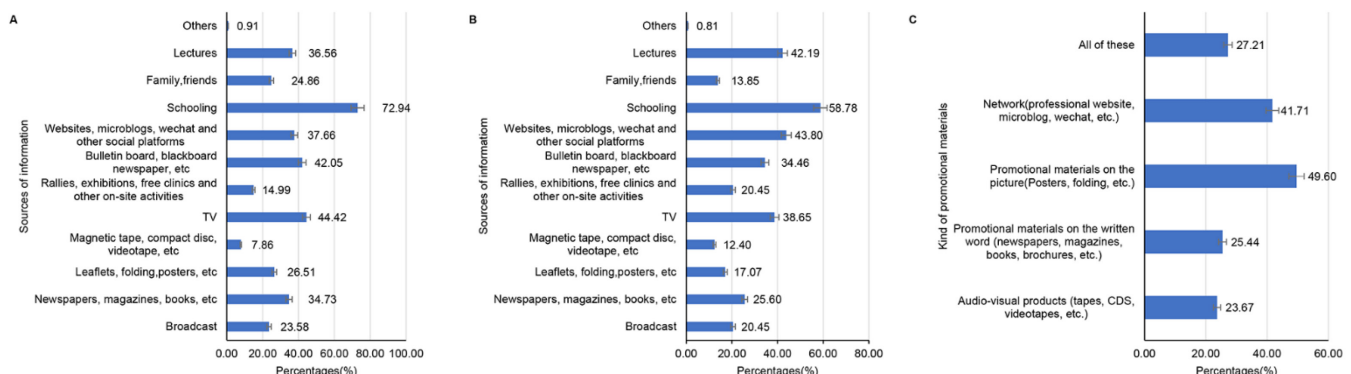
**Figure 4.** Attitude towards the risk of infecting TB. **A:** Where do you think the risk of catching TB is higher, in school or in the community? **B:** What is the reason, if you think that the risk of infection is higher at school/in the community?



treatment were lower (69.08% vs. 97.2%). The results showed that students may lack sufficient knowledge about TB. To reduce their risk of infection or developing TB, it is imperative to devise comprehensive initiatives aimed at enhancing students' understanding of TB, especially regarding MTB infection and appropriate preventive measures.

Our study also found that the primary deterrents to seeking medical care were mainly related to economic and geographical factors. Most participants expressed

**Figure 5.** Sources of information. **A:** What are the main sources of information about TB? (Multi-choice); **B:** The methods of learn about information on TB prevention and control; **C:** The kind of promotional materials which was the participants prefer.



their willingness to seek medical treatment when they realized that their symptoms might be linked to TB. These findings align with the outcomes of Abu-Huainan *et al.* [15]. Although the practice score was satisfactory in this study, it was found that around 23.03% of participants would seek medical attention when their cough and expectoration lasted for more than 3-4 weeks, which is very similar to another study conducted among Jordanian university students [16]. Addressing this issue could be achieved through educational interventions providing information on appropriate practice related to TB, particularly among students hailing from regions burdened with high TB prevalence.

Our observations indicated that senior students had greater knowledge and better preventative practice compared to the juniors. This finding aligns with previous studies [5,16] which have highlighted that students' educative level influences their knowledge, attitudes, and behavior toward TB prevention and treatment. Senior students generally possess more comprehensive TB knowledge and engage in more positive practice. Similarly, Montagna *et al.* [17] revealed that advanced age was associated with higher rates of correct answers regarding TB-related inquiries. This trend could be attributed to the fact that senior students have received more formal education and often exhibit more mature personalities.

Moreover, we observed that Han nationality students demonstrated a higher level of knowledge compared to Uyghur nationality students, and the students from urban areas had better knowledge than students from rural areas. This disparity may be influenced by differences in living environments and habits. Han nationality students or urban students may have greater exposure to knowledge about TB. However, this gap tends to diminish as students progress through high school. The knowledge and practice scores of the Grade Three students were higher than those of the Grade One or Grade Two students. These results highlight the importance of enhancing TB education among students in lower grades. Additionally, it is crucial to focus on improving preventive behaviors among students in lower grades.

We found that most students were afraid of being affected TB, which was similar to the findings of other studies [18-20]. In terms of attitudes towards TB patients, participants in this study demonstrated satisfactory responses. 49.28% of participants expressed their willingness to support and help TB patients, while 62.16% felt empathy towards TB patients and expressed a desire to assist them. These

figures are better than the findings presented by Harstad *et al.* [18]. Notably, an encouraging 83.90% of participants stated they would encourage a classmate, colleague, or friend with TB to seek treatment. Students believed that TB could be transmitted both at school and in the community (39.61% vs. 34.78%), with similar reasons attributed to the high population density and a higher likelihood of suffering from malnutrition or lack of medical resources at school compared to the community. Additionally, more students believed that the presence of infectious patients contributed to the higher risk in the community. These findings signal the need for attention to be given to medical and nutritional supplies in schools.

The current study identified schools and television as primary sources of information on TB. However, the specific sources of information may vary across different countries. For instance, in Bhutan, friends, family, and teachers are prominent sources [21]. In China, textbooks and online websites play a significant role [22]. In Korea, posters are a common source [23]. These disparities may stem from differences in participants, education level as well as social background [21]. In our study, the participants were students, hence, school emerged as the predominant source of information. Most participants expressed a preference for learning about TB through schooling or the Internet, with a preference for visual materials such as pictures or websites, microblogs, and WeChat for dissemination. Therefore, our findings underscore the need to innovate modern educational approaches for enhanced knowledge dissemination.

Our study has several limitations. Firstly, we only collected information from students in high TB burden settings, which restricts our ability to compare with students from other settings or regions. Secondly, the information gathered relied on a self-administered questionnaire, which makes it challenging to assess the quality and accuracy of the responses.

## Conclusions

The primary objective of this study was to evaluate the KAP of students studying in Qingdao who originate from regions with high TB burden settings. Our analysis revealed that factors such as grade level, nationality, census registration, and LTBI status significantly influence participants' understanding and behaviors related to TB. These findings should be taken into account when developing TB education programs, especially for lower-grade students, to enhance awareness about TB prevention among individuals. Additionally, integrating TB education into school

curricula and utilizing internet resources and social media platforms represent promising strategies for effectively educating students about TB.

### Authors' contributions

Xiaoqi Dai, Shuo Li, Song Song, Meng Chen, and Honghong Xu contributed to the literature search, study design, data collection, drafting and editing of the manuscript. Xiaoqi Dai, Shuo Li, and Song Song performed data analyses. Xuekui Li and Menghan Zhang contributed to the literature search, drafting, and editing. Zhongdong Wang, Huaqiang Zhang, and Haiyan Sun had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All text, tables and figures are original and have not been previously published.

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