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Demographic and socioeconomic disparity in knowledge, attitude, and practice towards tuberculosis in Northwest, China: evidence from multilevel model study

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Abstract

Background Tuberculosis (TB) remains a serious global public health problem in China. The right knowledge, attitude, and practice (KAP) towards TB are indispensable to appropriate healthcare-seeking behaviors and treatment services timely. However, there are few studies that addressed the KAP towards TB in high-risk and under-developing regions in China. This study aims to evaluate the KAP towards TB in Ningxia Northwest, China, and identify factors that influence it. The findings can guide future health education and promotion interventions.

Methods A stratified multistage random sampling method was used to conduct a face-to-face questionnaire survey with 33 items for selected residents. The composite score of Knowledge, Attitudes, and Practices (KAP) was divided into two groups, which are poor (scores below the average) and good (scores above the average). A two-level logistic model with a random intercept equation accounted for the similarity of residents within communities to examine the association between individual-level KAP and demographic and socioeconomic factors.

Results A total of 2,341 residents were recruited, the mean age was 50, and 41.2% were female. The percentages of residents who were total awareness of TB knowledge and had positive attitudes and behavior toward TB were 51.9%, 75.3%, and 76.2%, respectively. The two-level logistic model demonstrated that residents with a high annual family income, urban living, primary school education or higher, occupation of teacher or doctor, a very good self-perceived status, medical insurance, knowing DOTS, and family members or friends with TB history had better knowledge of TB ($P < 0.05$). Residents living in urban areas, with junior and senior high school education, a very good self-perceived status, health insurance, knowing DOTS, and family members or friends with TB history had positive attitude of TB ($P < 0.05$). Residents living in urban areas, a primary school education or higher, occupation of teacher, doctor and workers, a very good self-perceived status, medical insurance, knowing DOTS, and family members or friends with TB history had positive practice of TB ($P < 0.05$).

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Conclusions Favorable demographic (higher education levels, teachers or doctors) and socioeconomic (high income, living in urban area) factors are associated to better knowledge, attitudes and practices toward TB in Northwest China. Interventions to improve KAP at the community level are required to speed up the TB reduction rate, which may benefit to ensure the End TB Strategy will be achieved.

Keywords Tuberculosis, Knowledge, Attitude, Practice, Multilevel model

Background

Tuberculosis (TB) remains a serious global public health problem which is one of the leading causes of death worldwide [1, 2]. According to the World Health Organization (WHO) Global Tuberculosis Report 2020, 30 high TB burden countries account for almost 90% of those who fall sick with TB each year [3]. WHO has defined the End TB Strategy, which targets to reduce the incidence rate of the disease by 90% in 2035. The Global Tuberculosis Report 2021 [4] showed that the COVID-19 pandemic has led to a drop in the number of people newly diagnosed with TB and reported in China, and reduced access to TB diagnosis and treatment increased TB deaths. In recent years, the burden of TB has declined with improvements in the TB epidemic in China. However, TB is a disease of poverty, and its magnitude is high in socially disadvantaged populations or people residing in poor living conditions, patients have to bear a huge financial burden [5, 6]. Thus, TB occurs in populations whose individuals differ in essential characteristics, ignoring individual heterogeneity may tend to underestimate the overall risk of TB and lead to over-optimistic expectations for prevention and control [7].

Existing studies demonstrated that the spatio-temporal distribution of TB in China with significant spatial clustering and the TB prevalence in underdeveloped western regions in China was higher than those in eastern and central regions, as well as higher in rural areas than in urban areas [8]. Understanding the knowledge, attitudes, and practice (KAP) and associated factors related to TB among older people is very important to the targeted development of TB prevention and treatment tasks in China. The right knowledge, attitude, and practice (KAP) towards TB are indispensable to appropriate healthcare-seeking behaviors and treatment services timely. Almost to a certain extent, a lack of knowledge about TB prevention may lead to failure to discover and treat it during the early stage [9]. Thapa et al. [10] found that community-level interventions for TB prevention and care have possibly contributed to the increased TB knowledge. In addition, Mary et al. revealed that the key point of community health education for TB should be focused on knowledge raising [11]. As a result, health education at the community level played an essential role in changing the perception of residents towards TB and early prevention of high-risk individuals with different demographic and socioeconomic characteristics.

Numerous studies have shown that knowledge of TB and the availability of services are often found to be unsatisfactory among underprivileged social groups, and illiterate, inaccessible, rural, and impoverished communities. Misconceptions about the symptoms, transmission, and prevention of TB lead to negative attitudes and stigma toward TB [12]. Therefore, it is urgent to promote the correct understanding of people and comprehensive knowledge of TB through increasing community mobilization and advocacy, changing negative attitudes, and concepts, and forming health behaviors, which are beneficial to individuals to reduce the risk of TB.

Ningxia Hui Autonomous Region, located in the northwest, is one of the underdeveloped provinces in China [13]. Motivated by the above, the purpose of this study is to assess the status of KAP towards TB and associated influencing factors in Ningxia Northwest, China, which can provide a reliable reference for further health education and promotion interventions of TB in high-risk and economically underdeveloped regions.

Methods

Study population and sampling method

There are five prefecture-level cities in Ningxia region, and due to the economic and social development status, population composition, geographic distribution and other factors, the rural areas are clustered in towns and the urban areas are clustered in streets. Therefore, this study uses stratified multistage random sampling method for sampling. (Stage 1): Based on PPS (Probability Proportional to population Size), 23 towns and streets were randomly chosen from Yinchuan and Guyuan cities; (Stage 2): 82 communities and villages were chosen from the 23 towns and streets level using the PPS method; (Stage 3): residents aged 16 years and above were randomly selected from each village or community for face-to-face questionnaire surveys using the simple random sampling method. Inclusion exclusion criteria: (1) lived locally for more than six months within the past 12 months; (2) willingness to participate in this survey; (3) aged 16 years and older; (4) had basic word reading and communication skills; (5) no serious mental illness affecting the investigation. Those who met the above requirements were included in the investigation, and those who did not meet were excluded. (See the Fig. 1).

The estimation of sample size (n) in cluster sampling is due to the existence of intracluster correlation coefficient

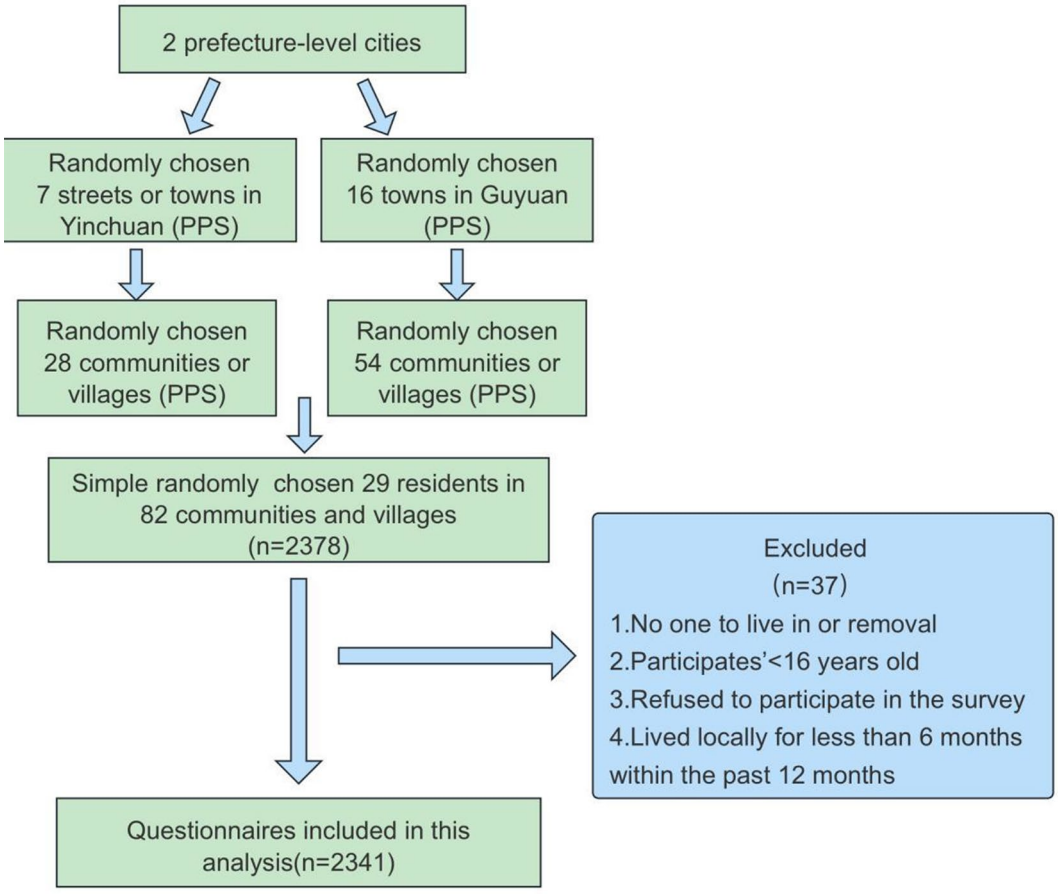

Fig. 1 The study flowchart

(ICC), and the individuals in the same group are often non-independent, so more sample size is often needed when the test power is certain, a two-steps calculation process were performed [14]. First, the sample size of the traditional cross-sectional study was estimated according to the formula,

$$N = \frac{(Z/\delta)^2}{p(1-p)} \tag{1}$$

,where Z is the critical value, δ is the allowable error, p is the overall awareness percentage. This study was based on the overall awareness percentage of 72.4% about the prevention and treatment of TB among residents in Ningxia Region [15], we set that p=0.724, Z=1.96, δ=0.07 (typically 0.1 times the overall rate), and N was calculated equals to 159 participants.

Second, the sample size of the cluster sampling study was estimated according to the formula,

$$n = N(1 + (m-1) * ICC), \tag{2}$$

where m is the number of individuals in a group, We can calculate that $ICC = \sigma^2_{\mu_0}/[\sigma^2_{\mu_0} + (\pi^2/3)] = 0.268$, and thus we can obtain the sample size n=1353 participants. We also considered a non-response rate of 10% and a final sample size n of approximately 1490. Thus, the sample size was sufficient for our study.

This study was approved by the ethics committee of the review board of Ningxia Medical University, and informed consent was obtained from all survey participants.

Questionnaire design and survey

The questionnaire was designed regarding WHO's Information, Communication and Social Mobilization for Tuberculosis Control: Guidelines for conducting surveys of Knowledge [16], Attitudes and Practice, National Questionnaire on Public Knowledge, Belief and Behavior in Tuberculosis Control 2006 [17] and the actual situation of the study area, formed through two pre-survey modifications. The questionnaire includes (1) demographic characteristics: gender, age, education level, occupation, self-perceived health status, etc.; (2) TB knowledge; (3) TB attitude; (4) TB practice. TB KAP survey consists of

18 questions, including symptoms of TB, how to prevent TB, willingness to participate in health education and medical treatment behavior. In the single choices, 1 point for the right or appropriate answer, while 0 points for choosing the wrong or uncertain response. In multiple-choice questions, 1 point for 60% or more of the right answer, and 0 was denoted by do not know or less than 60%. Respondents with scores equal or higher than the mean score on each of the knowledge, attitude, and practice dimensions were considered knowledgeable about TB, had a positive attitude and practice, and were assigned a value of 1 in the logistic regression model. (See Tables A1 and A2). Respondents who did not know about TB and had negative attitudes and practices were assigned a value of 0. To calculate the single and total proportions of TB knowledge, attitude and practice of residents. The formula for calculating the single positive attitude and practice proportion and the total proportion of attitude and practice is the same as below.

Single-knowledge awareness (%):

$$\frac{the\ number\ of\ people\ who\ answered\ a\ knowledge\ correctly}{the\ number\ of\ people\ surveyed} \times 100\% \quad (3)$$

Total knowledge awareness (%) :

$$\frac{Total\ number\ of\ correct\ answers\ to\ n\ items\ of\ knowledge}{number\ of\ respondents\ \times\ n} \times 100\% \quad (4)$$

Quality control

Investigators received uniform and rigorous training to familiarize themselves with the survey requirements and methodology and were familiarized with the entire survey process through a survey exercise and pre-surveys. Professionals from government health departments acted as quality controllers for this study. The survey was conducted face-to-face, and the questionnaire was collected and checked on-site. Data were entered into the database by two researchers using EpiData 3.02 software in a double-blind manner to ensure accuracy. The sampling of the study population followed the designed sampling frame, the questionnaire design and survey followed the WHO guidelines on knowledge, attitudes and behaviors for TB control, and the multilevel model analysis strategy followed the MLwiN 2.0 Command Manual.

Statistical analysis

Descriptive analyses used the mean and standard deviation (SD), for continuous variables and percentages for categorical data. The count data were expressed by the number of cases (N) and the percentage (%). Considering the hierarchical structure of individuals nested in communities or villages and communities or villages nested in streets or towns in the study area, the data are not independent, and the results of the null model are used to judge whether the multi-level model should be used. A two-level logistic model with a random intercept equation to account for the residents' dependence within communities and individuals to examine the association between individual-level KAP and demographic and socioeconomic factors. Thus, we proposed the two-level variance component model as follows [18]:

$$\begin{aligned} Y_{ij} \sim \log it(P_{ij}) &= (\beta_0 + \mu_{0j}) + \beta_1 \sum_{k=1}^{14} x_{ijk} \\ \mu_{0j} &= \beta_{0j} - \beta_0 \\ \mu_{0j} &\sim N(0, \sigma^2_{\mu_0}) \end{aligned} \quad (5)$$

here i is the level 1 unit (individual level), j is the level 2 unit (community level), and logit is the link function. β_1 is the regression coefficient of the explanatory variables, μ_{0j} is the logarithmic difference between the mean of β_{0j} for level 2 units and the total mean β_0, denoted by the high-level residuals with variance $\sigma^2_{\mu_0}$, which reflected the ratio difference between high-level units. The two-level variance component model was constructed by MLwiN 2.30 software, and the test level α=0.05 was viewed as statistically significant.

With the individual as a level 1 unit and the community or village where the individual lives as a level 2 unit, the null model test was performed. In the three dimensions of TB knowledge, attitude and behavior, the 2-level variance results were all statistically significant (P<0.001). Thus, there is clustering in 2-level horizontal units, and a multi-level model should be better used for fitting (Table 1). The variables were further analyzed in the null model, and three 2-level variance component models of TB knowledge, attitude, and behavior were established respectively. (Variable assignments were listed in Table 2).

Results

Basic characteristics

A total of 2,378 subjects were enrolled and 2,341 valid questionnaires were obtained (record rate of 98%). Among 2,341 participants, 964 (41.2%) were female and 1,377 (58.8%) were male. Most people had a primary school education or lower (43.7%) and junior high school or senior high school education (37.7%). Married people accounted for the majority (83.8%). (See Table 3).

Regarding knowledge of TB, the majority of people (83.9%) knew that TB was an infectious disease, and more than 80% of them knew the single symptom (87.5%), transmission route (84.6%), and prevention

Table 1 Two-level logistic regression analysis of KAP regrading TB (cutoff value = average value)

Variables	Knowledge			Attitude			Practice		
	Estimate	*P*	OR(95%CI)	Estimate	*P*	OR(95%CI)	Estimate	*P*	OR(95%CI)
Annual family income	0.024	**0.028**	1.024 (1.002 to 1.047)	-	-	-	-	-	-
Area (Ref. Rural)									
Urban	0.604	**0.001**	1.829 (1.273 to 2.629)	1.677	**< 0.001**	5.349 (3.643 to 7.855)	0.994	**< 0.001**	2.702 (1.877 to 3.891)
Education level (Ref. Illiteracy/ primary school)									
Junior high school/senior high school	0.404	**0.001**	1.498 (1.170 to 1.917)	0.454	**< 0.001**	1.575 (1.204 to 2.060)	0.710	**< 0.001**	2.034 (1.586 to 2.609)
University or higher	0.832	**< 0.001**	2.298 (1.413 to 3.736)	0.605	0.070	1.831 (0.952 to 3.524)	0.972	**0.002**	2.643 (1.445 to 4.834)
Occupation (Ref. Farmers)									
Workers/administrators	0.157	0.330	1.170 (0.852 to 1.607)	-	-	-	0.447	**0.011**	1.564 (1.107 to 2.208)
Teacher/medical workers	0.635	**0.021**	1.887 (1.101 to 3.235)	-	-	-	1.208	**0.004**	3.347 (1.484 to 7.549)
Students/others	0.193	0.177	1.213 (0.916 to 1.605)	-	-	-	0.202	0.171	1.224 (0.917 to 1.633)
Self-perceived health status (Ref. Very good)									
Good	-0.513	**< 0.001**	0.599 (0.467 to 0.768)	-0.362	**0.016**	0.696 (0.518 to 0.936)	-0.198	0.152	0.820 (0.626 to 1.075)
Fair	-0.411	**0.002**	0.663 (0.511 to 0.860)	-0.182	0.249	0.834 (0.612 to 1.136)	-0.077	0.591	0.926 (0.698 to 1.228)
Poor	-0.652	**0.001**	0.521 (0.351 to 0.774)	-0.521	**0.012**	0.594 (0.395 to 0.893)	-0.621	**0.002**	0.537 (0.363 to 0.795)
Very poor	-0.448	0.179	0.639 (0.333 to 1.227)	-0.301	0.336	0.740 (0.401 to 1.367)	0.170	0.582	1.185 (0.648 to 2.168)
Medical insurance (Ref. Yes)									
No	-0.717	**0.004**	0.488 (0.300 to 0.794)	-0.894	**< 0.001**	0.409 (0.244 to 0.686)	-0.803	**< 0.001**	0.448 (0.279 to 0.720)
Whether to know the DOTS (Ref. Yes)									
No	-1.459	**< 0.001**	0.232 (0.168 to 0.322)	-0.492	**0.014**	0.611 (0.413 to 0.905)	-1.666	**< 0.001**	0.189 (0.121 to 0.295)
Family members or friends with TB history (Ref. Yes)									
No	-0.617	**0.011**	0.540 (0.336 to 0.867)	-0.636	**0.010**	0.529 (0.327 to 0.857)	-0.493	**0.040**	0.611 (0.381 to 0.980)
Parameter	**Estimate**	***SE***	χ^2	***P***					
Random effect parameter of knowledge (Two-level $\sigma^2_{\mu_0}$)	0.688	0.138	24.977	< 0.001					
Random effect parameter of attitude (Two-level $\sigma^2_{\mu_0}$)	1.203	0.224	28.809	< 0.001					
Random effect parameter of practice (Two-level $\sigma^2_{\mu_0}$)	0.970	0.182	28.536	< 0.001					

Abbreviations TB = tuberculosis, DOTS = Directly-Observed Treatment Strategy, " - " indicates that the variable was not included in the model

The bold values indicate significance of *P* values ($P < 0.05$)

(85.7%) of TB, but the comprehensive understanding was insufficient. 1,548 (66.1%) people knew that TB could be cured, and 1,391 (59.4%) people knew that the early treatment for TB was free. In terms of attitude, most people are very willing to learn about TB (86.9%), participate in health education (87.9%), complete treatment (94.6%) and screening (94.3%), and hold a non-discriminatory attitude towards TB patients (80.6%). However, there was

Table 2 Variables assignment rules

Variables	Types	Assignment rules
Knowledge	Dependent variable	0 = unaware, 1 = awareness
Attitude	Dependent variable	0 = negative, 1 = positive
Practice	Dependent variable	0 = negative, 1 = positive
Age	Independent variables	measured value
Annual family income (RMB)	Independent variables	measured value
Area	Independent variables	1 = Rural, 2 = Urban
Gender	Independent variables	1 = Male, 2 = Female
Marital status	Independent variables	1 = Unmarried/Divorce/widowed, 2 = Married
Education level	Independent variables	1 = Illiteracy/Primary school, 2 = Junior high school/ Senior high school, 3 = University or higher
Occupation	Independent variables	1 = Farmers, 2 = Workers/Administrators, 3 = Teacher/ medical workers, 4 = Students/others
Transient population	Independent variables	1 = No, 2 = Yes
Smoking status	Independent variables	1 = Yes, 2 = Never
Alcohol consumption status	Independent variables	1 = Yes, 2 = Never
Self-perceived health status	Independent variables	1 = Very good, 2 = Good, 3 = Fair, 4 = Poor, 5 = Very poor
Medical insurance	Independent variables	1 = Yes, 2 = No
TB patient	Independent variables	1 = Yes, 2 = No
Whether to know the DOTS (Directly-Observed Treatment Strategy)	Independent variables	1 = Yes, 2 = No
Family members or friends with TB history	Independent variables	1 = Yes, 2 = No

still have 7.6% (177) of residents did not consider TB to be a severe disease. In the behavioral part, less than 46.5% of people will actively obtain information about TB. Most of the residents (92.3%, 86.0%, and 77.8%) took the initiative to seek medical help or medical institutions when they had suspected symptoms and could persist in completing treatment. When a family member or friend showed suspected symptoms, the majority (86.3%) helped them seek medical attention. 68.1% (1594) of the participants covered their noses and mouth when coughing or sneezing. The proportion of subjects who knew about TB knowledge and had positive attitudes and practices were 42.8%, 87.9%, and 80.6%. The total knowledge awareness of TB was 51.9%. The highest single item of knowledge was whether TB is infectious or not, while the knowledge of TB symptoms and prevention was only 28.1% and 21.4%. The percentage of having a positive attitude towards TB was 75.3%, while only 7.5% of the respondents answered the question 'Do you think TB is a severe disease?'. Most of the participants agreed that TB is still a serious disease. The percentage of having positive behaviors was 76.2%. Most of the participants had positive behavior toward TB, but only a few (46.5%) took the initiative to learn about TB. (See Table 4 for more details).

Multilevel model

Table 1 presented the results of the 2-level variance component models, which found that annual family income, area, education level, occupation, self-perceived health status, medical insurance, whether to know the DOTS and family members or friends with TB history were associated with the knowledge towards TB. Especially, the residents may have higher TB knowledge as education level improve (Junior/Senior high school: $OR=1.498$; University or higher: $OR=2.298$), people living in urban have higher TB knowledge ($OR=1.829$), those people who work as teacher or medical doctors possess high TB knowledge ($OR=1.887$). Compared with "Very good", worse of self-perceived health may have lower TB knowledge (Good: $OR=0.559$; Fair: $OR=0.663$; Poor: $OR=0.521$). While, those without medical insurance may have a 0.488 times risk of aware of TB knowledge than those have medical insurance ($OR=0.448$). Residents who didn't know the DOTS may have 0.232 times risk of aware of TB knowledge than those know the DOTS ($OR=0.232$), and people with family members or friends with TB history have a lower proportion of knowledge ($OR=0.540$).

Significant differences in attitudes towards TB were found across education level, area, self-perceived health status, family members or friends with TB history, medical insurance, and whether to know the DOTS towards TB ($P<0.05$). More precisely, residents living in urban have a higher positive TB attitude ($OR=5.349$), people with "Good" and "Poor" self-perceived health status more likely to have a negative TB attitude (Good: $OR=0.696$; Poor: $OR=0.594$). People with family members or friends with TB history may have a higher risk of negative attitude ($OR=0.529$), those without health insurance were more likely to have negative TB attitude ($OR=0.409$), and residents who didn't know the DOTS may be more susceptible to negative attitude ($OR=0.611$).

Table 3 The characteristics of study populations

Variables		N/mean	%/SD
Age		50.00	14.67
Annual family income (RMB)(ten thousand)		4.96	5.34
Area	Rural	1021	43.61
	Urban	1320	56.39
Gender	Male	1377	58.82
	Female	964	41.18
Marital status	Unmarried/Widowed/Divorced	379	16.19
	Married	1962	83.81
Education level	Illiteracy/Primary school	1024	43.74
	Junior high school/Senior high school	882	37.68
	University or higher	435	18.58
Occupation	Workers/Administrators	360	15.38
	Teacher/Medical workers	99	4.23
	Farmers	1152	49.21
	Students/Others	730	31.18
Transient population	No	2246	95.94
	Yes	95	4.06
Smoking status	Yes	525	22.43
	Never	1816	77.57
Alcohol consumption status	Yes	113	4.83
	Never	2228	95.17
Self-perceived health status	Very good	605	25.84
	Good	756	32.29
	Fair	703	30.03
	Poor	215	9.18
	Very poor	62	2.65
Medical insurance	Yes	2247	95.98
	No	94	4.02
TB patient	Yes	78	3.33
	No	2263	96.67
Channel for acquiring TB knowledge	Television	1297	55.40
	Newspaper	859	36.69
	Internet	631	26.95
	Medical workers	557	23.79
	Family members or friends	980	41.86
Whether to know the DOTS (Directly-Observed Treatment Strategy)	Yes	259	11.06
	No	2082	88.94
Family members or friends with TB history	Yes	100	4.27
	No	2241	95.73

Abbreviations TB=tuberculosis

In addition, we found that people who living in urban (OR=2.702) and possess higher education level have higher positive TB practice (Junior/Senior high school: OR=2.034; University or higher: OR=2.643), residents with jobs such as teachers, doctors have more positive TB practices (OR=3.347). People with "Poor" self-perceived health status may have 0.537 times more likely to adopt positive practice than those with "Very good" self-perceived (OR=0.537), while those without medical insurance may have 0.448 times possible of the proportion of positive TB practice than those have medical insurance (OR=0.448), and people who didn't know DOTS have lower positive TB practice than those know (OR=0.189).

Figure 2 demonstrates the common factors of TB in three dimensions. The center number 6 in the plot indicates that there are six common factors belonging to knowledge, attitude, and practice, including area, education level, self-perceived health status, medical insurance, whether to know the DOTS and family members or friends with TB history. Occupation is a common factor of knowledge and practice. Annual family income is an independent influence factor of knowledge.

Table 4 The distribution of participants' responses regarding KAP of TB

Questions	Responses	*n*	%	*n* (correct)	%
Knowledge					
Infectivity of TB				1965	83.9
Yes		1965	83.94		
No		376	16.06		
Symptoms of TB				658	28.1
Coughing or coughing for more than 2 weeks		1500	32.95		
Fever or fever for more than 7 days		552	12.13		
Chest pain or hemoptysis		1094	24.03		
Shortness of breath or persistent weakness		839	18.43		
Do not know		567	12.46		
Route of transmission of TB				1228	52.4
Droplets from coughing or sneezing		1594	38.94		
Eating together or sharing utensils		1220	29.80		
Touching items in public places		651	15.90		
Do not know		629	15.36		
Prevention of TB				501	21.4
Cover nose and mouth by coughing or sneezing		1571	35.92		
Wash hands after touching things		1284	29.36		
Ventilation in the home		418	9.56		
Good nutrition		477	10.91		
Do not know		624	14.27		
Cure of TB				1548	66.1
Yes		1548	66.13		
No		158	6.75		
Do not know		635	27.13		
Free treatment of TB				1391	59.4
Yes		1391	59.42		
No		151	6.45		
Do not know		799	34.13		
Total knowledge awareness		—	—	—	51.9
Attitude					
Do you think TB is a severe disease?				177	7.6
Yes		1890	80.73		
No		177	7.56		
Do not sure		274	11.71		
Would you like to learn about TB?				2035	86.9
Yes		2035	86.93		
No		140	5.98		
Do not sure		166	7.09		
Would you like to participate in the TB health education activities?				2057	87.8
Yes		2057	87.87		
No		121	5.17		
Do not sure		163	6.96		
If you have TB, would you be willing to complete the treatment?				2215	94.6
Yes		2215	94.62		
No		36	1.54		
Do not sure		90	3.84		
Would you like to be screened if you have suspected symptoms of TB?				2208	94.3
Yes		2208	94.32		
No		45	1.92		
Do not sure		88	3.76		
Do you think TB is a shameful disease?				1887	80.6
Yes		163	6.96		

Table 4 (continued)

Questions	Responses	*n*	%	*n* (correct)	%
No		1887	80.61		
Do not sure		291	12.43		
Total positive attitude		—	—	—	75.3
Practice					
Have you ever volunteered for information about TB?				1089	46.5
Yes		1089	46.52		
No		1252	53.48		
Would you help family member or friend with suspected TB symptoms to go to the hospital?				2021	86.3
Yes		2021	86.33		
No		96	4.10		
Do not sure		224	9.57		
Will you seek medical help if you have suspected symptoms of TB?				2160	92.2
Yes		2160	92.27		
No		41	1.75		
Do not sure		140	5.98		
Will you choose to go to medical institution if you suspect have TB?				2014	86.0
Yes		2014	86.03		
No		99	4.23		
Do not sure		140	5.98		
Do you cover your mouth and nose when you cough or sneeze?				1594	68.1
Yes		1594	68.09		
No		118	5.04		
Do not sure		629	26.87		
If you have TB, will you adhere to treatment?				1821	77.8
Yes		1821	77.79		
No		79	3.37		
Do not sure		441	18.84		
Total positive practice		—	—	—	76.2

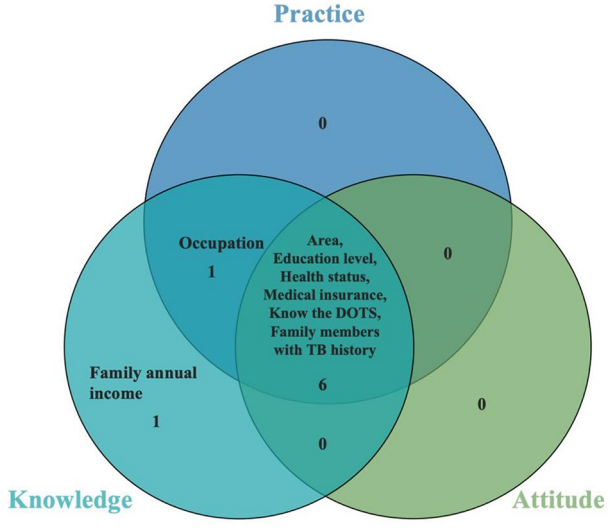

Fig. 2 Venn plot of TB KAP, where center 6 indicates the common factors that are area, education level, self-perceived health status, medical insurance, whether to know the DOTS and family members or friends with TB history

Discussion

TB remains a serious global public health problem, and reaching WHO's TB End goal requires collaboration between policymakers, practitioners and communities. The right knowledge, attitude, and practice (KAP) towards TB are indispensable to appropriate healthcare-seeking behaviors and treatment services timely. However, there are few studies that addressed the KAP from underdeveloped regions in China. This study assessed the status of KAP towards TB and associated influencing factors in Ningxia Northwest, China may provide targeted guidance for improving health policies.

These results indicated that the status of KAP towards TB of residents in northwest China is insufficient. People's knowledge about TB is seriously lacking, and the total knowledge awareness proportion of TB prevention and control is only 51.9%, which is lower than the Shenzhen elderly people [19], Nigeria community population [20], Oman residents [21], and Somali population [22]. Meanwhile, nearly half of residents are unaware that TB can be treated free of charge. These misconceptions and under-recognition may be associated with the causes of new and recurrent TB infections. Conversely, the proportion of people with more positive attitudes and behaviors

toward TB was higher than Ethiopia residents [5], Shenzhen elderly people [19], and Cameroon community residents [23]. In addition, we found that the residents of Ningxia remained hostile posture towards the severity of TB, which is consistent with the study in Shenzhen [19] and contrary to the findings in Oman [21]. This might be related to the prevalence conditions and policy variations of TB among different countries and regions. Although the situation of TB in China remains grim, benefiting from the close attention of the government and society along with the implementation of various strategies for prevention and control, the severity of TB has been controlled and the attitude of people towards TB has changed as they no longer consider it as a severe disease.

The multilevel logistic model demonstrated that area, education level, whether having health insurance, self-perceived health status, whether to know the DOTS, and family members or friends with TB history were common factors influencing knowledge, attitude, and behavior toward TB. The level of education determines people's knowledge of the prevention information of TB, let alone their attitudes and actions. While health insurance guarantees the degree of treatment expenditure and medical burden on the individual, the less financial burden, the more motivated people are to respond with positive attitudes and behaviors. Although the government has a free treatment strategy, the later financial expenses still need to be loaded by the individual. Still, reimbursement of medical insurance greatly reduces the pressure on TB patients [24], who are more inclined to cooperate with doctors and do not have to conceal their illness and delay treatment due to financial concerns. It was found that there was a community-level aggregation of KAP towards TB among residents in Ningxia, hence health education and health promotion at the community level may greatly help increase the population's health knowledge of TB and promote early detection, diagnosis, and treatment to reduce the risk of TB [25].

This study fills a gap in the study of TB KAP in the population of northwest China, giving evidence from multilevel models. However, there are some limitations in this study. First, the study population was only the general population in the Ningxia region, and the results are not representative of other areas and China as a whole. Second, this study is a cross-sectional survey, which limits the inference and interpretation of causality. Third, other potentially influential factors were not included in the study, such as the intensity and frequency of TB education in each community, and the accessibility of health services which require more comprehensive and scientific investigation and research. Fourth, we only used a single question to assess the self-perceived status, which may result in a bias to result. Thus, reliable measurement indexes or specific questionnaires should be used.

Conclusion

Residents of Ningxia in Northwest China have lower TB knowledge and higher positive attitudes and practices. The total awareness of TB knowledge was 51.9%, and the total proportions of positive attitude and practice were 75.3% and 76.2%. Favorable demographic (higher education levels, teachers or doctors) and socioeconomic (high income, living in urban area) factors are associated to better knowledge, attitudes and practices toward TB in Northwest China. It is essential to increase the intensity and frequency of health education for residents in the community. Interventions to improve KAP at the community level are required to speed up the TB reduction rate, which may benefit to ensure the End TB Strategy will be achieved.

Abbreviations

TB	Tuberculosis
KAP	Knowledge, Attitude, Practice
DOTS	Directly-Observed Treatment Strategy
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1

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Author contributions

Ning Ma: Formal analysis, Writing original draft. Lu Zhang: Formal analysis, Writing original draft. Linlin Chen: Data acquisition, Writing-review & editing. Jiayu Yu: Data acquisition, Writing-review & editing. Yaogeng Chen: Writing-review & editing. Yu Zhao: Methodology, Supervision, Writing - review & editing. All authors reviewed the manuscript.

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Data availability

Data may be made available by contacting the corresponding author.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Ningxia Medical University Institutional Review Board, Yinchuan, China. Informed consent was obtained from all survey participants. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

The participants gave their consent to participate in the study. Informed consent was obtained from all participants.

Competing interests

The authors declare no competing interests.

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