Is the tuberculosis knowledge awareness obstructing tuberculosis infection in rural areas of Anqing, China?

CURRENT STATUS: UNDER REVIEW

BMC Public Health  BMC Series

Yunfei Zou
Wannan Medical College

ORCiD: https://orcid.org/0000-0003-2661-9461

Zhiping Zhang
Anqing Center for Disease Control and Prevention

Huan Wu
Wannan Medical College

Ximei Wang
Wannan Medical College

Chenxu Wang
Wannan Medical College

Hui Xue
Wannan Medical College

Yufeng Wen
Wannan Medical College

wyf@wnmc.edu.cn Corresponding Author

DOI: 10.21203/rs.3.rs-22226/v1

SUBJECT AREAS
Health Economics & Outcomes Research  Infectious Diseases

KEYWORDS
Tuberculosis, Awareness, Influencing factors, Case-control study, Rural areas
Abstract

Background
Health education on tuberculosis is considered as one of the major measures for prevention of tuberculosis disease epidemic. This study is to assess the effects of tuberculosis awareness on tuberculosis infection in rural areas in China.

Methods
This study was conducted in rural areas of Anhui province, China. There 1118 newly diagnosed TB patients were selected as case group while 384 participants with no TB disease enrolled in control group. Univariate analysis and Multivariable logistic regression model were carried out to assess the effect of TB awareness on TB infection.

Results
The univariate analysis showed that four core knowledge items of TB, sex, age, education, domicile, smoking, drinking, income, contacting with TB patients, vaccination of bacillus calmette guerin and living area on TB were significantly different between the case and control groups ($P < 0.05$). The multivariate logistic regression analysis revealed that education (OR = 0.242, $P = 0.001$), income (OR = 0.555, $P = 0.016$) were protective factors and domicile (OR = 0.073, $P = 0.026$), contacting with TB patients (OR = 3.020, $P = 0.017$) were risk factors for TB infection. However, the awareness or any item of knowledge of TB were not found to be related to TB infection.

Conclusions
The awareness of TB is not the main influencing factor for TB infection in rural areas, the contents or forms of health education towards TB maybe modified in rural areas.

Background
Tuberculosis is a serious communicable disease around the world. In 2015, about 10.4 million people developed TB and 1.4 million died from this disease$^1$. Current studies revealed that gender and age, degree of education, smoking, contact with TB patients, income level, history of BCG vaccination and infection with HIV were probably associated to TB infection$^2$-$^8$. In addition to those factors, the lack of awareness about TB was considered to be the most important factor that increased the risk of exposure to TB$^9$. Especially, loss of knowledge on the cause, mode of transmission, and symptoms as
well as irregular treatment of TB would pose a great challenge to control the disease\textsuperscript{10-13}. Furthermore, poor awareness of TB was also an influencing factor of MDR-TB\textsuperscript{14}. Unfortunately, the awareness of TB was found to be very poor, especially in rural areas\textsuperscript{15,16}. Study from Sudan manifested that there was no significant difference of awareness about TB between TB cases and controls\textsuperscript{17}. As a consequence, in order to provide a scientific basis for TB prevention, we conducted this case-control study to assess the effects of awareness on TB infection and explore influencing factors for TB infection in Anqing area.

Methods

Study participants and sampling

This study was carried out between June 2014 and December 2015 in Anqing area. The study site was located in typical rural area of central China and in the southwest of Anhui province with relatively high prevalence of TB and the majority of the population were from rural areas with much lower economic level. Therefore, this area is well representing TB epidemic in rural areas of China. A total of 1502 participants were selected in the communities from eight counties, newly diagnosed TB patients were enrolled in the case group, and healthy controls was recruited randomly within the neighborhood or the household of the TB case. The diagnosis are strictly based on laboratory inspections such as chest X-ray examination, sputum smear examination and clinical symptoms. All participants were informed about the objectives of the study and provided verbal informed consent before the survey. Newly detected sputum smear positive pulmonary TB patients $>15$ years who had presented at local medical institutions were eligible for inclusion. People who refused to participate or worked in other city were excluded. The study population was finally gathered on the basis of 1118 cases and 384 controls.

We defined cases as adults (aged 15 years and older) with sputum smear positive pulmonary TB. They were interviewed immediately after diagnosis. Those who did not have a sputum smear confirmed diagnosis were excluded from the study. We selected controls randomly that had a sputum smear negative TB from the database. All cases and the controls came from the same source population in this study.
Study Design And Data Collection

The data collection tool was a unified self-administered questionnaire which was designed according to the World Health Organization guidelines\(^\text{18}\), and then it was pre-tested among 100 people who did not participate in the study and was modified as necessary. Participants were interviewed face-to-face by investigators who had medical science background from local Centers for Disease Control and Prevention (CDC). All information about cases was inquired before their suffering from TB disease.

The questionnaire consists of questions on demographic and socioeconomic characteristics (sex, age, education, domicile, smoking-alcohol abuse, other respiratory system medical history, contact with TB patients, history of BCG vaccination, income and living space) of the study participants and their awareness of TB. The awareness section contained 6 questions (details in Table 1).

### Table 1

| Question                                      | Case (n = 1118)% | Control (n = 384)% | P-Value |
|-----------------------------------------------|------------------|--------------------|---------|
| Do you know relevant information about tuberculosis | 612(54.38)       | 219(56.25)         | 0.436   |
| Awareness                                     | 506(45.62)       | 165(43.75)         |         |
| Unawareness                                   |                  |                    |         |
| What is the main pathogen causing tuberculosis | 463(41.41)       | 199(51.82)         | 0.001   |
| Awareness                                     | 655(58.59)       | 185(48.18)         |         |
| Unawareness                                   |                  |                    |         |
| What is the cardinal symptom of TB patients   | 611(54.65)       | 187(48.70)         | 0.044   |
| Awareness                                     | 507(45.35)       | 197(51.30)         |         |
| Unawareness                                   |                  |                    |         |
| Is tuberculosis a contagious disease          | 881(78.80)       | 307(79.95)         | 0.634   |
| Awareness                                     | 237(21.20)       | 77(20.05)          |         |
| Unawareness                                   |                  |                    |         |
| What is the source of infection of tuberculosis| 384(34.35)       | 98(25.52)          | 0.001   |
| Awareness                                     | 734(65.65)       | 286(74.48)         |         |
| Unawareness                                   |                  |                    |         |
| What is the route of transmission of tuberculosis| 615(55.01)       | 188(48.96)         | 0.040   |
| Awareness                                     | 503(44.99)       | 196(51.04)         |         |
| Unawareness                                   |                  |                    |         |

Statistical Analysis

After the data was organized and edited to allow computer entry of all responses. Data was entered into database established using EpiData 3.0 with double entry. SPSS 18.0 was used for statistical analysis. Descriptive statistics with table of frequency distribution was used to summarize demographic and socioeconomic characteristics and the level of knowledge towards TB. Pearson chi-square test was conducted to evaluate the statistical significant of sex, age and other demographic
and socioeconomic variates with the outcome variables (TB infection) in univariate analysis. In the knowledge section, chi-square test was carried out to evaluate the association of the awareness of TB with the outcome variables. At last, multivariable logistic regression model was used to identify the influencing factors and odds ratio (OR) was used to report strength of association between the final variables and the target outcome variables. P < 0.05 was considered to indicate a statistically significant difference.

**Results**

**General information**

A total of 1118 cases averaged 50.98 ± 17.97 years of age, the youngest and the oldest of whom were 15 and 90 years of age respectively. 384 controls averaged 36.52 ± 18.01 years of age, the youngest and the oldest of whom were 8 and 93 years of age respectively. Male: female ratio in case and control groups were 2.58:1 and 1.26:1 respectively.

The study participants were classified into four age groups: 60 years of age or older, 40 to 59 years of age, 25 to 39 years of age, 15 to 24 years of age. Significant difference was detected in case and control groups (P < 0.001) and details have been presented in Table 2.
Table 2

| Characteristics                  | Case (n = 1118)% | Control (n = 384)% | P-Value |
|----------------------------------|-----------------|-------------------|---------|
| Sex                              |                 |                   |         |
| Male                             | 806 (72.09)     | 214 (55.73)       | < 0.001 |
| Female                           | 312 (27.91)     | 170 (44.27)       |         |
| Age group (yr)                   |                 |                   |         |
| 8–24                             | 146 (13.06)     | 117 (30.47)       | < 0.001 |
| 25–39                            | 158 (14.13)     | 99 (25.78)        |         |
| 40–59                            | 354 (31.66)     | 123 (32.03)       |         |
| ≥ 60                             | 460 (41.15)     | 45 (11.72)        |         |
| Education                        |                 |                   | < 0.001 |
| Primary Schooling or below       | 655 (58.59)     | 96 (25.00)        |         |
| High school                      | 409 (36.58)     | 228 (59.38)       |         |
| College degree or above          | 54 (4.83)       | 60 (15.62)        |         |
| Domicile                         |                 |                   | < 0.001 |
| Urban dwellers                   | 133 (11.90)     | 86 (22.40)        |         |
| Rural dwellers                   | 985 (88.10)     | 298 (77.60)       |         |
| Smoking                          |                 |                   | < 0.001 |
| Yes                              | 262 (23.43)     | 71 (18.32)        |         |
| Quit                             | 236 (21.11)     | 26 (6.54)         |         |
| No                               | 620 (55.46)     | 287 (75.13)       |         |
| Drinking                         |                 |                   | 0.071   |
| Yes                              | 310 (27.73)     | 88 (22.91)        |         |
| No                               | 808 (72.27)     | 296 (77.09)       |         |
| Average annual income (RMB)      |                 |                   | < 0.001 |
| < 4000                           | 421 (37.66)     | 120 (31.25)       |         |
| 4000–11000                       | 509 (45.53)     | 133 (34.64)       |         |
| > 11000                          | 188 (16.82)     | 131 (34.11)       |         |
| Contact with TB patients         |                 |                   | 0.004   |
| Yes                              | 151 (13.51)     | 72 (18.75)        |         |
| No                               | 491 (43.92)     | 182 (47.40)       |         |
| Have no idea                     | 476 (42.57)     | 130 (33.85)       |         |
| BCG vaccination                  |                 |                   | < 0.001 |
| Yes                              | 421 (37.66)     | 275 (71.61)       |         |
| No                               | 697 (62.34)     | 109 (28.39)       |         |
| Living area (m²)                 |                 |                   | 0.028   |
| < 30                             | 391 (34.97)     | 165 (42.97)       |         |
| 30–60                            | 613 (54.83)     | 183 (47.66)       |         |
| > 60                             | 114 (10.20)     | 36 (9.37)         |         |

Univariate Analysis Of Knowledge Awareness On Tb Infection

Table 1 showed that questions of “What is the main pathogen causing tuberculosis”, “What is the cardinal symptom of TB patients”, “What is the source of infection of tuberculosis” and “What is the route of transmission of tuberculosis” differed significantly compared with control group (P < 0.05); while there were no significant differences at the questions of “Do you know relevant information about tuberculosis” and “Is tuberculosis a contagious disease” compared with the control group.

Univariate Analysis Of General Influencing Factors

Table 2 showed that sex, age group, education, domicile, smoking, drinking, average annual income, contact with TB patients, BCG vaccination and living area differed significantly compared with the control group (P < 0.05); while there were no significant differences in drinking.

Multivariate logistic regression analysis of knowledge awareness for TB infection
Table 3 showed the results of the multivariable analysis. Four questions above, sex, age, education, domicile, smoking, average annual income and contact with TB patients were put into multivariate logistic regression model to identify the influencing factors for TB. After adjustment for age, education, domicile, smoking status, income, contact with TB patients, the following variables remained in the final model: education (OR = 0.242, P = 0.001), income (OR = 0.555, P = 0.016), domicile (OR = 0.073, P = 0.026), contacting with TB patients (OR = 3.020, P = 0.017).

### Table 3

Multivariate logistic regression analysis for knowledge awareness

| Factors               | B     | S.E.   | Waldy²  | OR   | 95%CI       | P     |
|-----------------------|-------|--------|---------|------|-------------|-------|
| Education             | -1.420| 0.330  | 18.473  | 0.242| 0.126-0.462 | 0.001 |
| Domicile              | 0.928 | 0.417  | 4.958   | 0.073| 0.006-0.821 | 0.026 |
| Income                | -0.589| 0.245  | 5.795   | 0.555| 0.344-0.896 | 0.016 |
| Contact with TB patients | 1.105 | 0.462  | 5.737   | 3.020| 1.222-7.463 | 0.017 |

Adjustment for age, education, domicile, smoking status, income, contact with TB patients

**Discussion**

The results of this study showed that most of the community’s members of rural area have information about TB disease. The finding is similar to the results of studies from Afar Region\(^\text{19}\), South West Ethiopia\(^\text{20}\) and North Ethiopia\(^\text{21,22}\), Malaysia\(^\text{23}\) and rural China\(^\text{24}\). In our study, about 44.07% of the respondents (41.41% for case and 51.82% for control) knew that TB was caused by *Mycobacterium tuberculosis*, which was higher than 3.3% in Itang special district, South West Ethiopia\(^\text{25}\). More than half of the participants (53.13%) responded correctly to the question that main symptoms of tuberculosis, which was inferior to high-school learners (63.0%) in South African\(^\text{26}\) and members (72.4%) in Somali Regional State (SRS) of Ethiopia\(^\text{27}\). A majority of people (79.09%) identified that TB was a communicable disease and 53.46% were aware of its transmission route, which was in accordance with the study in Ethiopia (80.0%)\(^\text{27}\). Univariate analysis showed that the second, third, fifth and the sixth core information differed significantly compared with the control group. In Esmael A and Obuku EA’s research, lack of knowledge and erroneous beliefs about TB are common amongst TB patients\(^\text{15,28}\). In view of demographic and socioeconomic factors, our findings showed that males have higher risk of TB than females, which was in line with previous studies of tuberculosis\(^\text{29,30}\). The risk of TB increased progressively with age in the case group\(^\text{31}\), probably
because of low immune level among aged. We found that the risk of TB in cases with higher education background were much lower than those with less education, in another words, high degree of education was the protective factor of TB\textsuperscript{29}, it may be because higher-educated people know how to protect themselves better. Findings from some studies\textsuperscript{32-34} revealed that smoking was independently associated with TB, which was consistent with our findings. Our results were in line with previous studies\textsuperscript{35} in that a higher income was consistently associated with reduced TB risk. It is likely that people with higher income will have higher medical assurance level. Close contact with TB patients was another well described risk factor for TB\textsuperscript{36,37}. This study showed that BCG vaccination differs significantly from the control group\textsuperscript{38}. In Lienhardt C’ research\textsuperscript{9}, overcrowding has been previously documented as a strong risk for TB, which was in line with our results. In multivariate analysis, we put demographic and socio-economic factors with significant differences in univariate analysis and four core TB information into logistic regression equation. However, four core TB information was not as significant as other studies on TB infection. It reveals that the awareness of TB don’t play an important role as expected in Anqing, China or probably suggests that health education was not far from enough in the region. In other words, the results at least guide us to change the direction of TB prevention in this area.

Limitations
In this study, there are several limitations. Firstly, this research was conducted in the specified region of Anqing area, which may not be representative of those at the national level. Secondly, the questionnaire did not contain the information on occupation and HIV status.

Conclusions
In summary, our study identified some influencing factors associated with TB infection, of which education, average annual income were protective factors for TB infection, while domicile, contact with TB patients were risk factors. However, it turned out that knowledge awareness of TB has little relationship with TB infection. The contents and forms of health education towards TB maybe modified in rural areas.

Abbreviations
Declarations

Ethical considerations

The study was carried out in compliance with the Declaration of Helsinki of the World Medical Association, and according to a protocol approved by Medical Ethics Committee of Wannan Medical College. The objectives of the study were explained to the study participants and verbal consent was obtained before interviewing each participant.

Conflict of Interest:
No conflict of interest was declared by the authors.

Funding
This work was supported by the Key Research and Development Program of Anhui Province of China (grant number 1704a0802154).

Authors’ contributions
YFZ analyzed and interpreted the data, drafted and revised the manuscript. YFW conceived and designed the study, participated in data collection and critically reviewed the manuscript. ZPZ, HW, XMW, CXW, and HX participated in data collection and reviewed the manuscript. All authors read and approved the final manuscript version for publication.

Acknowledgements:
We would like to extend our thanks to the cooperator of Anqing Center for Disease Control and Prevention. We also thank the study respondents and the whole community at large for their wholesome effort and contribution in provision of the information. And at last but not least, we would like to thank the survey supervisor and data collectors for their effort to accomplish data collection.

References
1. World Health Organization (WHO). Global tuberculosis report. Geneva. 2016;
   Available at: .
2. Rhines AS. The role of sex differences in the prevalence and transmission of tuberculosis. Tuberculosis. 2013;93(1):104-7.
3. Graciani Rodrigues CC, Espíndola AL, Penna TJP. An agent-based computational model
for tuberculosis spreading on age-structured populations. Physica A. 2015;428:52–9.

4. Zhu SY, Hou YC, Shu W, Zhang GL, Nie SF, Chen W, et al. Study on the risk factors of tuberculosis in four cities and provinces in China. Zhonghua liu xing bing xue za zhi. 2013;34(2):129–32.

5. Yen YF, Yen MY, Lin YS, Lin YP, Shih HC, Li LH, et al. Smoking increases risk of recurrence after successful anti-tuberculosis treatment: a population-based study. The international journal of tuberculosis lung disease: the official journal of the International Union against Tuberculosis Lung Disease. 2014;18(4):492–8.

6. Morrison J, Pai M, Hopewell PC. Tuberculosis and latent tuberculosis infection in close contacts of people with pulmonary tuberculosis in low-income and middle-income countries: a systematic review and meta-analysis. The Lancet Infectious diseases. 2008;8(6):359–68.

7. Lienhardt C, Fielding K, Sillah JS, Bah B, Gustafson P, Warndorff D, et al. Investigation of the risk factors for tuberculosis: a case-control study in three countries in West Africa. Int J Epidemiol. 2005;34(4):914–23.

8. Lonnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. Tuberculosis control and elimination 2010-50: cure, care, and social development. Lancet. 2010;375(9728):1814–29.

9. Lienhardt C. From exposure to disease: the role of environmental factors in susceptibility to and development of tuberculosis. Epidemiol Rev. 2001;23(2):288–301.

10. Gele AA, Bjune G, Abebe F. Pastoralism and delay in diagnosis of TB in Ethiopia. BMC Public Health. 2009;9(1):187–8.

11. Yimer S, Bjune G, Alene G. Diagnostic and treatment delay among pulmonary tuberculosis patients in Ethiopia: a cross sectional study. BMC Infect Dis.
11. Melaku S, Sharma HR, Alemie GA. Pastoralist Community's Perception of Tuberculosis: A Quantitative Study from Shinille Area of Ethiopia. *Tuberculosis research and treatment*; 2013:475605.

12. Sreeramareddy CT, Harsha Kumar HN, Arokiasamy JT. Prevalence of self-reported tuberculosis, knowledge about tuberculosis transmission and its determinants among adults in India: results from a nation-wide cross-sectional household survey. *BMC Infect Dis.* 2013;13(1):46.

13. Liang L, Wu Q, Gao L, Hao Y, Liu C, Xie Y, et al. Factors contributing to the high prevalence of multidrug-resistant tuberculosis: a study from China. *Thorax.* 2012;67(7):632–8.

14. Obuku EA, Meynell C, Kiboss-Kyeyune J, Blankley S, Atuhairwe C, Nabankema E, et al. Socio-demographic determinants and prevalence of Tuberculosis knowledge in three slum populations of Uganda. *BMC Public Health.* 2012;12(1):536.

15. Mushtaq MU, Majrooh MA, Ahmad W, Rizwan M, Luqman MQ, Aslam MJ, et al. Knowledge, attitudes and practices regarding tuberculosis in two districts of Punjab, Pakistan. *The international journal of tuberculosis lung disease: the official journal of the International Union against Tuberculosis Lung Disease.* 2010;14(3):303–10.

16. Suleiman MM, Sahal N, Sodemann M, et al. Tuberculosis awareness in Gezira, Sudan: knowledge, attitude and practice case-control survey.[J]. *East Mediterr Health J.* 2014;20(2):120–9.

17. World Health Organization (WHO). *Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys.* Geneva. 2008; Available at: .

18. Legesse M, Ameni G, Mamo G, Medhin G, Shawel D, Bjune G, et al. Knowledge and
perception of pulmonary tuberculosis in pastoral communities in the middle and Lower Awash Valley of Afar region, Ethiopia. BMC Public Health. 2010;10(1):187.

20. Abebe G, Deribew A, Apers L, Woldemichael K, Shiffa J, Tesfaye M, et al. Knowledge, health seeking behavior and perceived stigma towards tuberculosis among tuberculosis suspects in a rural community in southwest Ethiopia. PloS one. 2010;5(10):e13339.

21. Mengiste MM, Tesfay WT, Israel GT, Girmai WMM, Richard MJ. Community knowledge, attitudes and practices on pulmonary tuberculosis and their choice of treatment supervisor in Tigray, northern Ethiopia. Ethiopian Journal of Health Development. 2005;19(4):21–7.

22. Yimer S, Holm-Hansen C, Yimaldu T, Bjune G. Health care seeking among pulmonary tuberculosis suspects and patients in rural Ethiopia: a community-based study. BMC Public Health. 2009;9(1):454.

23. Koay TK. Knowledge and attitudes towards tuberculosis among the people living in Kudat District, Sabah. Med J Malay. 2004;59(4):502–11.

24. Wang J, Fei Y, Shen H, Xu B. Gender difference in knowledge of tuberculosis and associated health-care seeking behaviors: a cross-sectional study in a rural area of China. BMC Public Health. 2008;8(1):354.

25. Bati J, Legesse M, Medhin G. Community's knowledge, attitudes and practices about tuberculosis in Itang Special District, Gambella Region, South Western Ethiopia. BMC Public Health. 2013;13(1):734.

26. Naidoo S, Taylor M. Association between South African high-school learners' knowledge about tuberculosis and their intention to seek healthcare. Global health action. 2013;6:21699.

27. Tolossa D, Medhin G, Legesse M. Community knowledge, attitude, and practices
towards tuberculosis in Shinile town, Somali regional state, eastern Ethiopia: a cross-sectional study. BMC Public Health. 2014;14(1):804.

28. Esmael A, Ali I, Agonafir M, Desale A, Yaregal Z, Desta K. Assessment of patients' knowledge, attitude, and practice regarding pulmonary tuberculosis in eastern Amhara regional state, Ethiopia: cross-sectional study. Am J Trop Med Hyg. 2013;88(4):785-8.

29. Codlin AJ, Khowaja S, Chen Z, Rahbar MH, Qadeer E, Ara I, et al. Short report: Gender differences in tuberculosis notification in Pakistan. Am J Trop Med Hyg. 2011;85(3):514–7.

30. Hudelson P. Gender differentials in tuberculosis: the role of socio-economic and cultural factors. Tubercle lung disease: the official journal of the International Union against Tuberculosis Lung Disease. 1996;77(5):391–400.

31. Korzeniewska-Kosela M. Tuberculosis in Poland in 2013. Przegląd epidemiologiczny; 2005; 69(2):277–282, 389-393.

32. Gambhir HS, Kaushik RM, Kaushik R, Sindhwani G. Tobacco smoking-associated risk for tuberculosis: a case-control study. International health. 2010;2(3):216–22.

33. Basu S, Stuckler D, Bitton A, Glantz SA. Projected effects of tobacco smoking on worldwide tuberculosis control: mathematical modelling analysis. BMJ (Clinical research ed). 2011;343:d5506.

34. Ryan H, Trosclair A, Gfroerer J. Adult current smoking: differences in definitions and prevalence estimates–NHIS and NSDUH, 2008. Journal of environmental and public health; 2012; 918368.

35. Pantoja A, Floyd K, Unnikrishnan KP, Jitendra R, Padma MR, Lal SS, et al. Economic evaluation of public-private mix for tuberculosis care and control, India. Part I. Socio-economic profile and costs among tuberculosis patients. The international journal of
36. Fox GJ, Barry SE, Britton WJ, Marks GB. Contact investigation for tuberculosis: a systematic review and meta-analysis. Eur Respir J. 2013;41(1):140-56.

37. Xu C, Hu B. Prevalence of active pulmonary tuberculosis among household contacts of recently diagnosed pulmonary tuberculosis patients with positive sputum-smear. Zhonghua liu xing bing xue za zhi. 2008;29(7):693-5.

38. Kirenga BJ, Sengooba W, Muwonge C, Nakiyingi L, Kyaligonza S, Kasozi S, et al. Tuberculosis risk factors among tuberculosis patients in Kampala, Uganda: implications for tuberculosis control. BMC Public Health. 2015;15(1):13.