The effect of WeChat-based training on improving the knowledge of tuberculosis management of rural doctors

Henan Xin [a,1], Haoran Zhang [a,1], Dakuan Wang [b,1], Bin Zhang [b], Xuefang Cao [a], Boxuan Feng [a], Zhusheng Quan [a], Ying Du [a], Yijun He [a], Ling Guan [c], Fei Shen [c], Jianmin Liu [c], Zisen Liu [b], Shouguo Pan [b], Qi Jin [a], Lei Gao [a,*]

[a] NHC Key Laboratory of Systems Biology of Pathogens, Institute of Pathogen Biology, and Center for Tuberculosis Research, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100730, China
[b] Center for Diseases Control and Prevention of Zhongmu, Zhengzhou 451450, China
[c] The Sixth People's Hospital of Zhengzhou, Zhengzhou 400060, China

ARTICLE INFO

ABSTRACT

Background: In China, rural doctors played a crucial role in TB cases referral and management. The current study aimed to evaluate the effect of WeChat-based training program on improving the rural doctors' knowledge on TB management.

Methods: A One-year WeChat-based training was conducted among registered rural doctors from Zhongmu County, located in middle China, by means of releasing original contents (in forms of text, poster, video or cartoon) through WeChat subscription account (WeChat SA) once a week. Pre-and-post-training offline tests were hold using the same self-administered questionnaire to evaluate the training effect.

Results: A total of 467 rural doctor were included in the study. During the training, 60 original articles were posted through WeChat SA. With respect to the two tests, the median score increased from 50 (40.0–60.0) to 60 (53.0–70.0) (p < 0.001) after training. As compared with posters, the median readings were significantly higher for released contents in forms of text, video and cartoon (p < 0.001). Female's test performance improved better than male's. In addition, a positive relation was observed between education level and the test performance regardless of training.

Conclusions: Our results indicated that WeChat-based training improved the knowledge of rural doctors on TB management to a certain extent. It is worthy to explore more effective new media-based training methods to promote TB control in rural China.

1. Background

According to the latest Global TB Report released by the World Health Organization (WHO), an estimated 10 million people developed active tuberculosis (TB) in 2019, and 1.40 million died of the disease. TB continues to be a major cause of morbidity and mortality, primarily in low-income and middle-income countries [1]. As the high burden country for both TB and latent tuberculosis infection (LTBI), China contributed nearly 10% of the new TB cases to the world and there were 350 million people living with *Mycobacterium tuberculosis* (MTB) infection [1,2]. In addition, around 71% active TB patients were occurred in rural China where with less developed public health infrastructure [3,4]. There are around 700 million farmers living in China, most of the healthcare works and primary medical services in rural areas are mainly provided by rural doctors [5–7]. Therefore, rural doctors are main forces responsible for TB management in rural China.

It has been reported that 62.6% of Chinese rural doctors had contacted with suspected pulmonary TB patients [8]. Although rural doctors

---

https://doi.org/10.1016/j.jctube.2021.100266

Available online 11 August 2021

are front-line healthcare providers in rural areas and play a crucial responsibility in TB case referral and management, their knowledge on TB control is relatively poor due to lacking sufficient practitioner training [5,7,9]. Their capability and awareness to differentiate TB from the other common respiratory diseases need to be strengthened as well, which will greatly benefit reducing misdiagnosis and delayed diagnosis. Therefore, to improve the rural doctors' TB management capability is crucial for strengthening TB control in rural China [10]. Routine offline in-service trainings, especially on TB control, were generally insufficient for rural doctors [11]. Furthermore, such trainings were usually given by teachers or experts through lectures, which were always nonsystematic because of venue, time and human resource constraint [12]. In recent years, with the development of mobile communication and new media, E-health, a healthcare practice supported by electronic processes came into being. Among them, WeChat is a multi-functional social networking application covering 90% of mobile phones in China [13]. WeChat users could obtain information and browse resources from all kinds of WeChat platforms easily. WeChat-based training combining with synchronous communication, video, picture, and article were widely used because of its feasibility, acceptability and efficacy [14,15]. The current study aimed to explore the effect of one-year WeChat-based training program on improving the knowledge of TB management for rural doctors through a pre-and-post study design.

2. Methods

2.1. Study design and participants

A one-year WeChat-based training program was conducted among rural doctors of Zhongmu County, Henan Province, which locates in middle China with a national average TB epidemic level. Two offline tests pre-and-post the training were hold to evaluate the effect of the program. All of the rural doctors registered in Zhongmu County were included in the study with the following inclusion criteria: licensed doctor work in the local rural clinic or community health center; voluntarily sign the informed consent form and willing to participate in the training and tests during the study duration. Those without mobile phone or WeChat account were excluded.

2.2. Demographics survey

For each study participant, socio-demographic information was collected by a standardized questionnaire administered by trained interviewers. The collected information including age, gender, educational level, working year, ever managed TB patients and self-reported history of close contact with TB patients.

2.3. Pre-and-post training tests

Two tests were hold before and after the training with a self-administered questionnaire consisting of 30 choice questions (9 single choice questions and 21 multiple choice questions). These questions could be divided into four sections according to the contents: 7 questions on the general knowledge of TB (mainly focused on symptoms and mode of transmission); 8 questions on TB detection and treatment (mainly focused on qualified smear sample for microscopy, common first line anti-TB drugs, regimens and possible adverse events); 10 questions on TB patients care and management (mainly focused on detailed obligation of rural doctors on management of TB patients, free policy for TB treatment and detection and location and services provided by local dispensaries) and 5 questions on the general knowledge of LTBI (mainly focused on the definition of LTBI, Bacillus Calmette - Guerin vaccination and tuberculin skin test) (please see the Additional File 1 for the questionnaire). The rural doctors were asked to complete the tests independently pre-and post-training.

2.4. WeChat-based training

WeChat subscription account (WeChat SA) is a lightweight app in WeChat, which can transmit real-time information to subscribers. In the present study, a WeChat SA named "TB control commune of rural doctors" was used to post training materials. The WeChat-based training lasted for one year from Dec 2018 to Dec 2019. In order to ensure all rural doctors could access to WeChat SA, all rural doctors were taught to subscribe it hand to hand. WeChat SA posted original content, displayed mainly in form of text, once a week with the topics of TB detection, treatment, prevention and patient management. Then a poster summarized the main point of the article would be released later within week. Apart from text and poster, other article types such as video, cartoon and interview were used as well for the need of content expression. During the intervention, a total of 70 original articles were released in WeChat SA during the training. Apart form 10 extension articles focusing on HIV/TB, diabetes/TB or non-mycobacteria tuberculosis, the contents of the rest 60 articles were closely connected to the main points on the test paper. There were 19, 26 and 15 were displayed in the form of text, poster and other types (such as video or cartoon), respectively (Additional Table 2).

2.5. Statistical analysis

The data were double entered in EpiData 3.1 (The EpiData Association, Odense, Denmark). After cleaning, the data were analyzed with SAS 9.4 (SAS Institute Inc., NC, USA) and GraphPad Prism 8 (GraphPad Prism Software Inc., San Diego, California). For each article posted, the total amount of reading from the date of publication to the date of holding offline test was acquired from backyard of WeChat SA. With respect to the pre-and-post-training tests, each question was assigned with corresponding score based on the number of questions of each subgroup and then normalized to 100 points. For multiple-choice questions, only choosing all of the correct answers could get the point. Scores were presented as medians (25% quantile [Q25]-75% quantile [Q75]) and compared using Wilcoxon matched-pairs signed rank test for same person pre-and-post the training. Kruskal-Wallis tests were used to compare the distribution of scores and readings among different groups. Multivariable linear regression was used to explore the possible factors related with score difference pre-and-post the training. Selected factors included in the analysis were gender; age in years ($\leq$40 years, 40–50 years; 50–60 years; $\geq$60 years); years of education ($\leq$9 years, 10–12 years, >12 years); number of TB patients ever managed (none, 1–5 TB patients, >6 patients); working years ($\leq$25 years, >25 years); The frequency of reading the WeChat SA (occasionally, often, always). $P < 0.05$ was considered reaching statistical significance.

3. Results

3.1. Demographic information

As shown in Additional Fig. 1, there were 653 registered rural doctors in study the site. Among them, 594 met the inclusion and exclusion criteria and participated in the pre-training test. While for the post-training test, 127 rural doctors quitted. The demographic distribution between those who took both tests and those who only took first test was showed in Additional Table 3. Female and those without a history of close contact with TB patients were more likely to refuse the second test. Finally, 467 rural doctors were included in the final analyses. As shown in Table 1, most of the subjects were males (342/467, 73.23%) and more than half of them (275/467, 58.86%) aged 40–60 years old. Most of the study participants (340/467, 72.81%) were only with a high school education. As approximately two thirds of rural doctors had ever managed TB patients, thus most of them had close contact history. Nearly all of the subjects had subscribed the WeChat SA and 57.01% (248/467) of subscribers would read the WeChat SA once new article
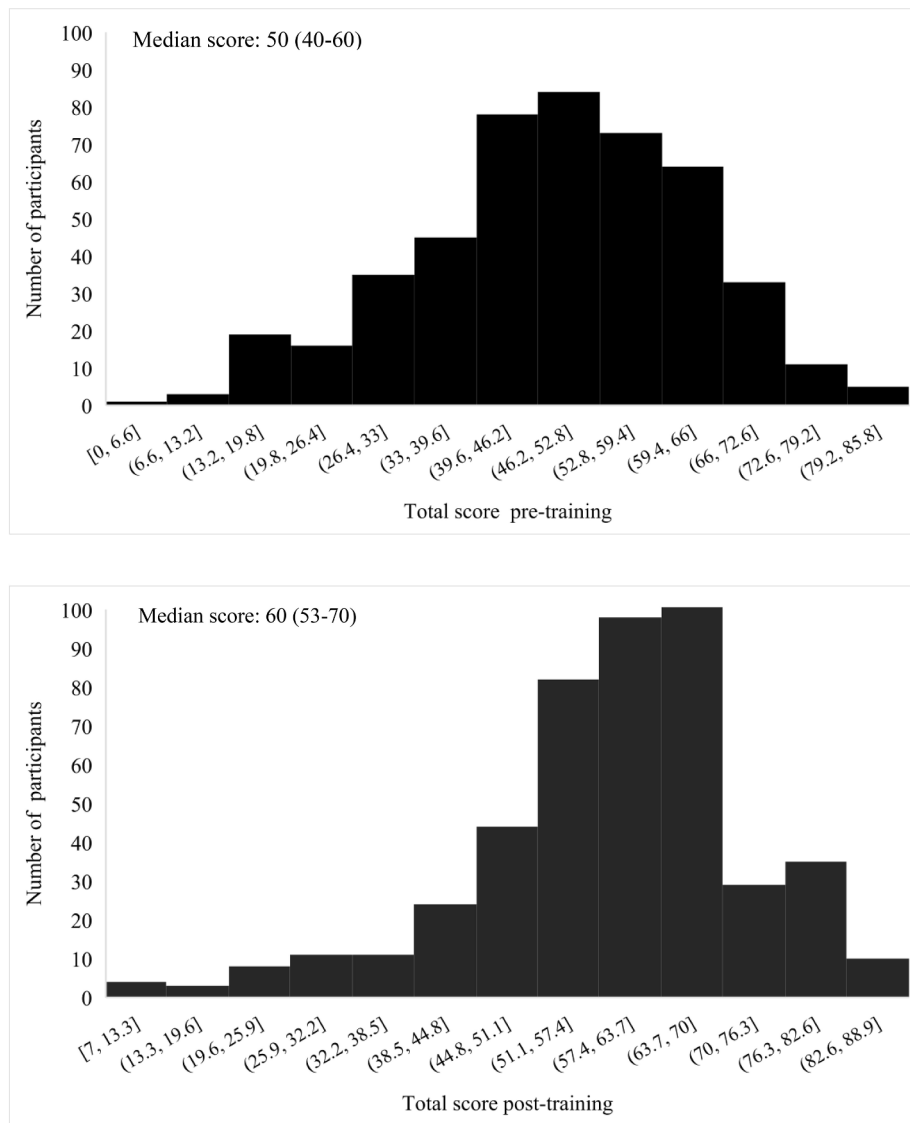
Fig. 1. The distribution of score pre-and-post training. Histograms were used to describe the distribution of score pre-and-post training. The median score was 50 (40–60) and 60 (53–70) pre-and-post trainings, a right shift was observed after training.

was updated.

3.2. Summary of released original content in WeChat SA

As shown in Table 2, the median reading for each article was 105. When stratified by the types of the article, the median readings for each article were 202, 33 and 177 for the articles in the form of text, poster and other types. As compared to posters, a significant higher reading was found for articles released in the form of text and other types (video or cartoon) (p < 0.001). When stratified by the contents, the average readings for the four sections were 165, 101, 129 and 54 (p for difference = 0.956), respectively.

3.3. Subgroup analyses on testing pre-and-post the training

The distribution of scores for each rural doctor pre-and post-the training were described using histograms shown in Fig. 1. The median score pre-training was 50.0 (40.0–60.0). A remark right shift was observed and the median score post-training was 60.0 (53.0–70.0) (p < 0.001).

The 30 questions were divided into four sections according to the

contents. Significantly increased scores were observed after training for each section as described in Fig. 2A (p < 0.001). For "General knowledge of TB" section, the median score increased from 71.4 (57.1–85.7) to 85.7 (71.4–99.9). For "TB detection and treatment" section, the median score increased from 50.0 (25.0–62.5) to 62.5 (37.5–75.0). For "TB patients care and management" section, the median score increased from 50.0 (40.0–60.0) to 60.0 (50.0–70.0). For "General knowledge of LTBI" section, the median score increased from 20.0 (0–60.0) to 40.0 (20.0–60.0).

When classified the questions according to the article types being displayed (in the form of text or with combined types [text + other]), significantly increased scores were observed after training for both types. (Fig. 2B) (p < 0.001). For core point for training in form of text on WeChat SA, the median score increased from 50.0 (40.0–60.0) to 60.0 (40.0–70.0). For core point for training in combined types on WeChat SA, the median score increased from 52.6 (36.8–63.1) to 63.1 (52.6–73.6).

3.4. Potential demographics factors related with score

Further analyses were conducted to describe the distribution of score pre-and-post training among different subgroups (Fig. 3). No difference

Table 1

Characteristics of the study population.

Variables	N*	%
Total	**467**	**100**
Gender		
Male	342	73.23
Female	125	26.77
Age		
≤40 years	109	23.34
41–50 years	191	40.90
51–60 years	84	17.99
>60 years	83	17.77
Marriage status		
Ever married	463	99.14
Never married	4	0.86
Years of education		
≤9 years	27	5.78
10–12 years	340	72.81
>12 years	100	21.41
Income per month		
≤2500 RMB	248	53.10
>2500 RMB	219	46.90
Working years as village doctor		
≤25 years	237	50.75
>25 years	230	49.25
With a history of close contact with TB patients		
Yes	352	75.37
No	115	24.63
Number of TB patients ever managed		
0	140	29.98
1–5	146	31.26
>6	181	38.76
Have subscribed the WeChat SA		
Yes	435	95.39
No	21	4.61
The frequency of reading the WeChat SA		
Always	248	57.01
Often	147	33.79
Occasionally	40	9.20

Abbreviation: TB, tuberculosis; WeChat SA: WeChat subscription account

* Sum might not always equal to total due to missing data

for the scores before the training were found for gender, but after training, female got a higher improvement. Individuals with less working year (≤25 years) had higher scores for both tests compared to those with working year > 25 years (p < 0.001). Higher educational levels was found to be associated with higher scores regardless of training (p < 0.001). In addition, the trends didn't change when the analysis was stratified by gender (Additional Fig. 2). Individuals never management of TB patients got higher scores compared with those ever management of TB patients before training (p = 0.01). While after training, the difference was no longer significant (p = 0.179). Multivariable 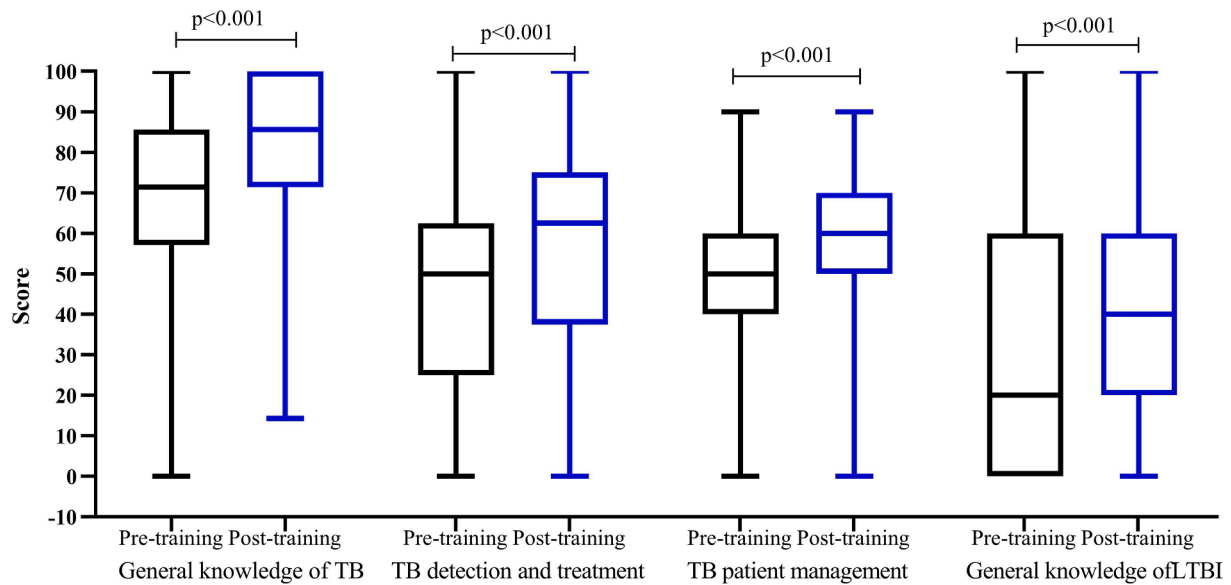linear regression was used to explore the possible factors related with testing score difference pre- and post- the training. Gender was the only factors related with improved TB knowledge level post training after adjusted for age, education, number of TB patients ever managed, working years and reading frequency (p = 0.041).
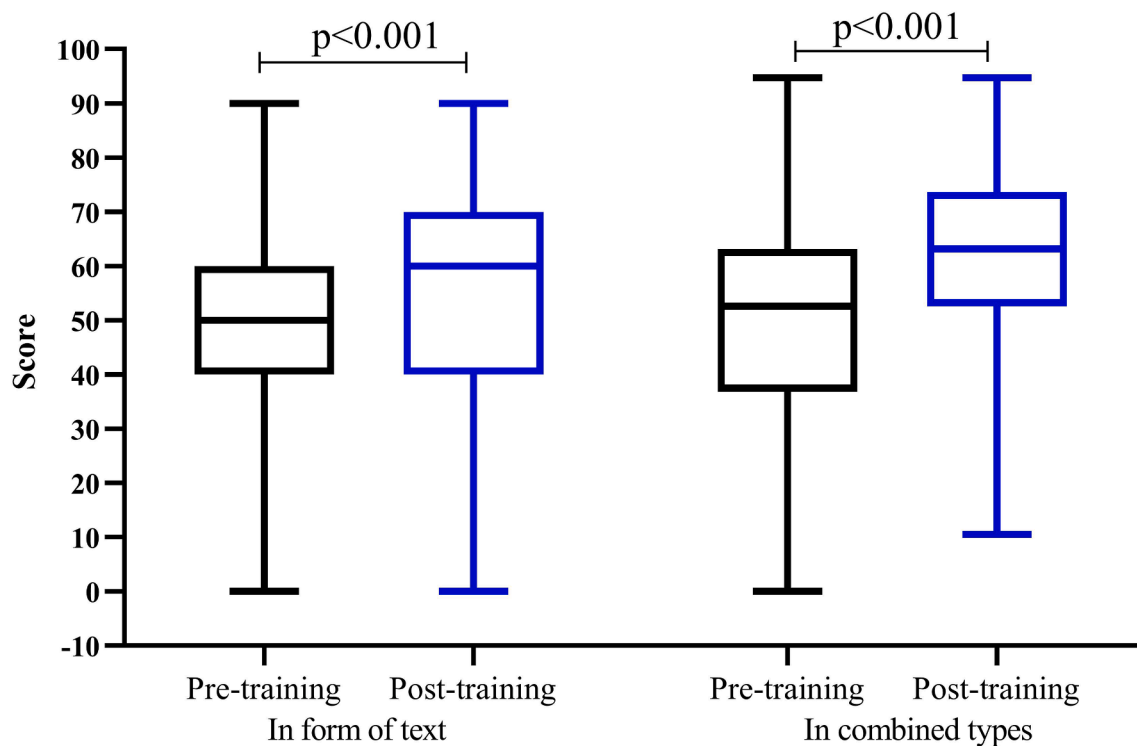
4. Discussion

As far as we know, this is the first study to explore the effect of WeChat-based training on improving the knowledge of TB management for rural doctors in China. Offline tests before and after the training were hold to evaluate the effect of the training. To a certain extent, one-year WeChat-based training improved the capability of the rural doctors and the median score increased from 50 in pre-training test to 60 in post-training test (p for difference < 0.001). The effectiveness of information transmission by means of the new media was found to be influenced by gender.

As one of the TB high burden countries, China has launched a series of projects to tackle the epidemic. However, there was a huge gap between the official requirements and actual practices [4]. A meta-analysis including 12 studies evaluated the performance of TB control services in China. The summarized results showed that around halves of TB patients were treated by self-administration (52%) and that only 20% actually had their treatment observed by healthcare workers [16]. Another meta-analysis showed that when compared with directly observed treatment short-course (DOTS), self-administered therapy was associated with lower rates of treatment success, adherence, and sputum smear conversion as well as higher rates of development of drug resistance. TB treatment outcomes improved when patient education, healthcare provider education, reminders and tracers, or mobile digital technologies were employed [17]. Rural doctors are responsible for implementing health education, referring symptomatic TB patients, managing TB patients during treatment, reporting inappropriate discontinuation and side effects occurring under the DOTS strategy [18]. It was reported that rural doctors need to manage 0.7 million current TB cases in China. Despite their crucial responsibility in TB management, their knowledge and awareness on TB need to be improved. Thus, it was essential to strengthen their capability on TB control through enhancing systematic practice training.

Although several studies had investigated the awareness of different populations on TB knowledge previously in China, few were conducted in rural doctors. A study published in Chinese reported that the awareness rate of TB knowledge improved obviously from 46.8% to 87.1% for 205 rural doctors after training [19]. However, only eight questions were used for testing and evaluation in this study, the core points covered are limited. A cross-sectional study was performed among 1088 medical students using self-administered questionnaire to evaluate their TB knowledge level. Similar to our research, 32 multiple-choice questions were used and each question had five possible answers. The total mean percentage of correct answers for TB knowledge was 44.4% [20]. Another study conducted among medical students as well found 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

Table 2

Summary of average reading posted in WeChat SA classified by contents and types.

Types	Median reading	Classified by contents				P value [b]
		General knowledge of TB	TB detection and treatment	TB patients care and management	General knowledge of LTBI	
Total	**105**	**165**	**101**	**129**	**54**	0.956
Text	**202**	NA	202	142	440	
Poster	**33**	37	42	29	29	
Video + cartoon	**177**	189	109	217	NA	
P value [a]	**<0.001**					

Abbreviation: LTBI: latent tuberculosis infection; TB, tuberculosis; WeChat SA: WeChat subscription account

a: p value for Kruskal-Wallis tests, significant statistical difference was found for the comparison of the average reading between three groups classified by types.

b: p value for Kruskal-Wallis tests, no significant statistical difference was found for the comparison of the average reading between three groups classified by contents.

A

B

Fig. 2. Subgroup analyses of the score pre-and-post training classified by content and type. The 30 questions were clustered into four sections according to the content each item belong to, significantly increased scores were observed after training for each section as described in Fig. 2A. During the training, different types were used to display each theme, apart from text, video, caricature, picture were also used to attract the readers. The 30 questions were divided into two subgroups according to types (only text and combined types), significantly increased scores were observed after training for both types (Fig. 2B). The black box represents the distribution of score pre- training and the blue box represents the distribution of score post-training. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
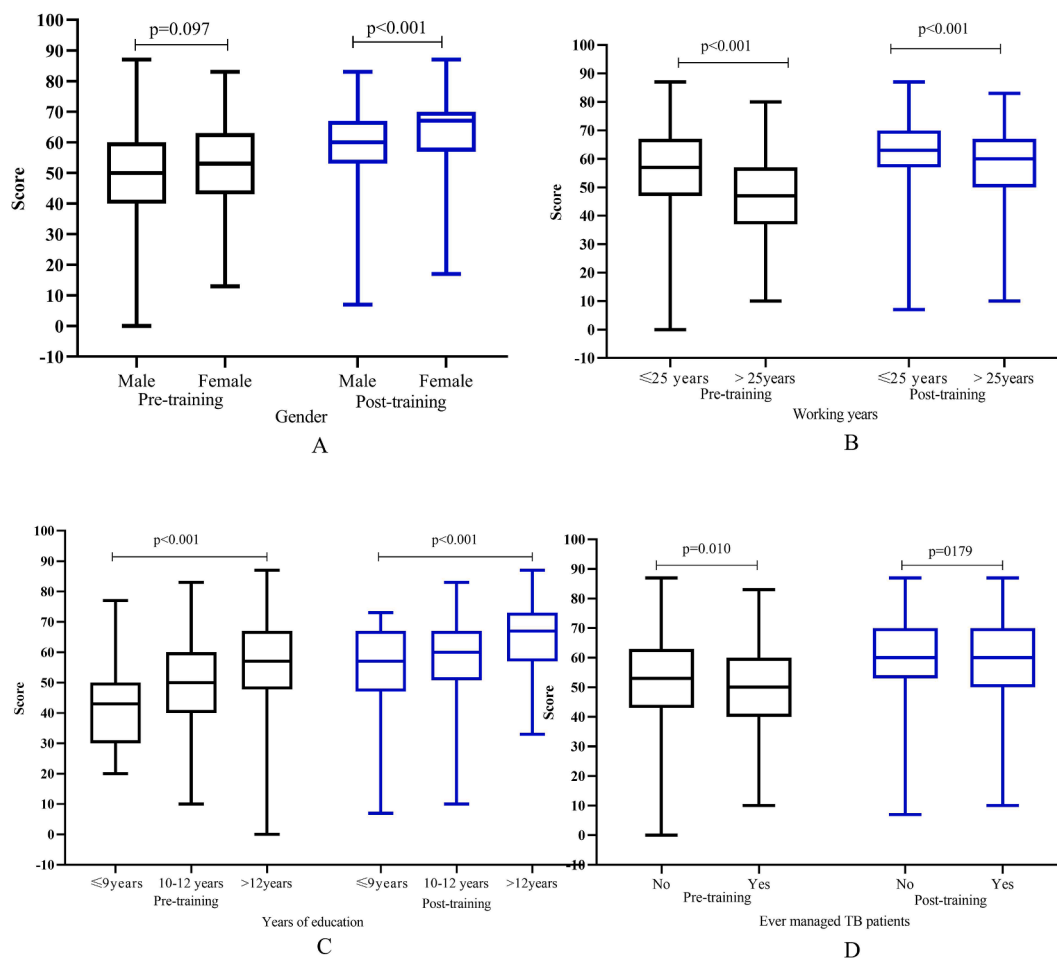
Fig. 3. The distribution of score pre-and-post training among different subgroups. Village doctors were classified into subgroups by gender (A), working years (B), years of education (C) and ever managed TB patients (D). The distribution of scores pre-and-post training among subgroups were showed in Fig. 3. The median scores were always higher after training compared with pre-training for each subgroup. The black box represents the distribution of score pre-training and the blue box represents the distribution of score post-training. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

TB treatment policy, respectively [21]. Although the questions designed in above study were not exactly the same and the rate of awareness could not be compared directly, it still indicated that no matter for rural doctors or medical students with higher level of education, their TB knowledge were inadequate, and necessary education are needed to promote TB knowledge and practices in healthcare workers.

It was well known that exposure to health education was significantly associated with increased knowledge. A study from India showed community training including community radio, wall painting and street plays might contribute to increase in knowledge of TB [22]. As has been observed in our study, the median score increased by 20% after one-year WeChat SA-based training. Female doctors got a better improvement after adjusting other covariate such as education level, working year and reading frequency (increased by 20.0% vs 26.4%). Biological, learning ability or memory performance between female and male might partly result in the difference. To our surprise, individuals never managed TB patients got higher scores as compared with those ever-managed TB patients before training. Differences in the distribution of education levels might be a confounder as nearly a half of individuals who had never managed TB patients had a higher education level. In addition, a positive relation was indeed found between education level and the performance of learning regardless of training. Recruiting medical students with undergraduate or graduate degree to rural areas to be rural doctors might be an important step to fill in the gap. While the fact is, it is difficult to attract new blood to work in rural

areas due to identity recognition, career development and low income [8]. Therefore, for most rural doctors with lower education level, apart from routine in-service trainings, instant training that had good feasibility and accessibility and was not subject to venue and time constraint needs to be enhanced. A number of studies had explored the effect of WeChat-based training on others health disorders, such as mental health or chronic cardiovascular and cerebrovascular diseases [13,23]. Our study took TB as an entry point, which might be a good attempt to provide new insight for further improving rural doctors' knowledge on the other infectious diseases.

Several limitations of this study should be kept in mind. First, only a 20% increase in median score was observed in self-controlled testing. Low median readings might at least partly explain such a limited improvement. The efficacy of such designed training was essentially depended on self-learning willingness. Therefore, how to improve rural doctors' engagement through enriching the article content or controlling article length should be considered in further practice. Second, parts of the rural doctors in our study were mainly responsible for general medical care but not disease prevention, thus they might lack interests in the content of this WeChat SA specifically on TB. Expanding WeChat SA among more rural doctors especially responsible for disease control might achieve more sound effect. Third, currently, there is no standard testing questionnaires for evaluating the level of TB knowledge for healthcare workers. Most studies using self-designed questionnaire only set two options (Yes/No) for choice question. In our study, the set of

multiple choices increased the difficulty of the test. In the future, establishing evaluation method that can be widely used will be important for improving the consistency and generalizability of such studies. Fourth, follow-up bias was inescapable as one fifth of rural doctors did not participate in the post-training test, but it might not significantly influence the current results as no difference (p = 0.244) was found between them and those included in final analyses.

5. Conclusion

Our study indicated that the knowledge on TB management needs to be greatly improved in rural doctors in China. New media-based training provided new insight and might be an effective tool. Along with the popularity of mobile telecommunication, further studies are needed to explore effective and innovative ways to optimize the training of rural doctors.

6. Take home message

WeChat-based training could partly improve the knowledge of rural doctors on TB management. How to improve rural doctors' engagement should be considered in the future.

Ethical statement

The study protocol was approved by the ethics committees of the Institute of Pathogen Biology, Chinese Academy of Medical Sciences (IPB-2016-6). All subjects provided written informed consent.

CRediT authorship contribution statement

Henan Xin: Data curation, Writing - original draft. **Haoran Zhang:** Visualization, Investigation, Supervision. **Dakuan Wang:** Project administration, Validation. **Bin Zhang:** Investigation. **Xuefang Cao:** Visualization, Investigation, Supervision. **Boxuan Feng:** Visualization, Investigation, Supervision. **Zhusheng Quan:** Visualization, Investigation, Supervision. **Ying Du:** Visualization, Investigation, Supervision. **Yijun He:** Visualization, Investigation, Supervision. **Ling Guan:** Project administration, Validation. **Fei Shen:** Project administration, Validation. **Jianmin Liu:** Project administration, Validation. **Zisen Liu:** Investigation. **Shouguo Pan:** Investigation. **Qi Jin:** Conceptualization. **Lei Gao:** Conceptualization, Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jctube.2021.100266.

References

[1] World Health Organization. Global tuberculosis report 2020. https://www.who.int/publications/i/item/9789240013131. Accessed 26 Oct 2020.
[2] Houben RM, Dodd PJ. The global burden of latent tuberculosis infection: a re-estimation using mathematical modelling. PLoS Med 2016;13(10):e1002152.
[3] Wang L, Liu J, Chin DP. Progress in tuberculosis control and the evolving public-health system in China. Lancet 2007;369(9562):691–6.
[4] Wang L, Zhang H, Ruan Y, Chin DP, Xia Y, Cheng S, Chen M, Zhao Y, Jiang S, Du X, He G, Li J, Wang S, Chen W, Xu C, Huang F, Liu X, Wang Yu. Tuberculosis prevalence in China, 1990–2010; a longitudinal analysis of national survey data. The Lancet 2014;383(9934):2057–64.
[5] Ni Q, Xie F, Wu M. The plight of China's village doctors. Lancet 2016;388(10062):2869–70.
[6] National Technical Steering Group of the Epidemiological Sampling Survey for Tuberculosis. Report on fourth national epidemiological sampling survey of tuberculosis. Chinese Journal Tuberculosis and Respiratory Disease 2002; 25: 3-7. (in Chinese).
[7] Hu D, Zhu W, Fu Y, Zhang M, Zhao Y, Hanson K, Martinez-Alvarez M, Liu X. Development of village doctors in China: financial compensation and health system support. Int J Equity Health 2017;16(1):9.
[8] Zhang W, Tian BC, Wang QY. The KAP of TB control and prevention among village doctors in China: a cross-sectional study. Chin J Health Educ 2008;24:572–4 (in Chinese).
[9] Fang T, Liu YL. Investigation and analysis of rural doctors on tuberculosis prevention and control knowledge in Chongqing. Chongqing Med 2011;40:2351–3 (in Chinese).
[10] Yuen CM, Amanullah F, Dharmadhikari A, Nardell EA, Seddon JA, Vasilyeva I, Zhao Y, Keshavjee S, Becerra MC. Turning off the tap: stopping tuberculosis transmission through active case-finding and prompt effective treatment. Lancet 2015;386(10010):2334–43.
[11] Li Xi, Lu J, Hu S, Cheng KK, De Maeseneer J, Meng Q, Mossialos E, Xu DR, Yip W, Zhang H, Krumholz HM, Jiang L, Hu S. The primary health-care system in China. Lancet 2017;390(10112):2584–94.
[12] Huang W, Long H, Li J, Tao S, Zheng P, Tang S, Abdullah AS. Delivery of public health services by community health workers (CHWs) in primary health care settings in China: a systematic review (1996–2016). Glob Health Res Policy 2018; 3:18.
[13] WeChat user number statistics. Tech Business analysis. http://seonew.cn/yxzj/2016/0407/707.html.
[14] Li X, Li T, Chen J, Xie Y, An X, Lv Y, et al. A WeChat-based self-management intervention for community middle-aged and elderly adults with hypertension in Guangzhou, China: a cluster-randomized controlled trial. Int J Environ Res Public Health 2019;16(21):4058.
[15] Li Y, Guo Y, Hong YA, Zhu M, Zeng C, Qiao J, Xu Z, Zhang H, Zeng Y, Cai W, Li L, Liu C. Mechanisms and Effects of a WeChat-Based Intervention on Suicide Among People Living With HIV and Depression: Path Model Analysis of a Randomized Controlled Trial. J Med Internet Res 2019; 21(11): e14729.
[16] Hou WL, Song FJ, Zhang NX, Dong XX, Cao SY, Yin XX, et al. Implementation and community involvement in DOTS strategy: a systematic review of studies in China. Int J Tuberc Lung Dis 2012;16(11):1433–40.
[17] Alipanah N, Jarlsberg L, Miller C, Linh NN, Falzon D, Jaramillo E, et al. Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. PLoS Med 2018; 15(7): e1002595.
[18] Gai R, Xu L, Wang X, et al. The role of village doctors on tuberculosis control and the DOTS strategy in Shandong Province, China. Biosci Trends 2008;2(5):181–6.
[19] Chen MC. Investigation on the awareness rate of tuberculosis knowledge among the village doctors and cadres. Chin J Dis Control P 2008; 12 (3): 262-264. (in Chinese).

[20] Ou Y, Luo Z, Mou J, Ming H, Wang X, Yan S, Tan A. Knowledge and determinants regarding tuberculosis among medical students in Hunan, China: a cross-sectional study. BMC Public Health 2018;18(1):730.

[21] Zhao Y, Ehiri J, Li D, Luo X, Li Y. A survey of TB knowledge among medical students in Southwest China: is the information reaching the target? BMJ Open 2013;3(9):e003454.

[22] Thapa B, Prasad BM, Chadha SS, Tonsing J. Serial survey shows community intervention may contribute to increase in knowledge of Tuberculosis in 30 districts of India. BMC Public Health 2016;16(1):1155.

[23] Guo Y, Hong YA, Cai W, et al. Effect of a WeChat-based intervention (Run4Love) on depressive symptoms among people living with HIV in China: a randomized controlled trial. J Med Internet Res 2020;22(2):e16715.