Assessment of tuberculosis among male prisoners in Shiraz central prison, south of Iran.

Hossein Faramarzi[1] [ID], Razieh Sadat Mousavi-Roknabadi[2,3*] [ID], Zahra Shayan[4] [ID], Ali Faramarzi[5] [ID], Sima Javanmardi[6] [ID], Sadegh Kamgar[5].

[1] Department of Community Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.
[2] Department of Emergency Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.
[3] Emergency Medicine Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.
[4] Trauma Research Center, Department of Biostatistics, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.
[5] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran.
[6] Health Affairs, Non-Communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

Corresponding author and reprints: Razieh Sadat Mousavi-Roknabadi, Emergency Medicine Department, School of Medicine, Shiraz University of Medical Sciences, Namazi Hospital, Postal Code: 71937-11351, Shiraz, Iran. **Email:** mousavi_razieh@sums.ac.ir

Abstract

Background: Prisons play an important role in the prevalence of Tuberculosis (TB) in a region. This study aimed to determine the situation of TB in high-risk male prisoners in Shiraz central prison of Fars province in southern Iran.

Methods: This cross-sectional study (June-October 2018) was conducted on male prisoners in Shiraz central prison, southern Iran. According to 4 criteria, the prisoners were determined as high-risk prisoners for TB, and para clinical tests included three sputum samples and chest radiograph were performed for them. Then, the high risk and low risk participants were compared in terms of demographic characteristics and past medical history.

Results: Among 2,995 prisoners, only 108 (3.6%) had at least one of the high-risk criteria. But after performing further TB tests for these prisoners, no prisoners with TB disease were found. The high-risk prisoners were statistically older than low-risk prisoners (38.30±9.74 vs. 35.17±9.62, P=0.001). Also, the length of incarceration was statistically different in both groups (P=0.002), and drug abuse was more in high-risk group (P<0.001). Moreover, high risk prisoners used cigarettes/day more (14.87±11.55 vs. 9.71±9.09, P<0.001), but both groups were not different in term of the marital status (P=0.519), educational level (P=0.662), job (P=0.39), and nationality (P=0.342).

Conclusion: Our results showed that none of the high-risk prisoners for TB had positive test. The length of incarceration, drug abuse, smoking, as well as age were more in high-risk prisoners in comparing low risk group.

Introduction

Tuberculosis (TB) is a chronic infectious disease which is caused by *Mycobacterium tuberculosis* (1). It is one of the most important public health issues worldwide, and it has been recognized as one of the most important causes of mortality (2). Prisons play an important role in the prevalence of TB in a region. TB incidence rate in prisons is higher than in the general population because of several reasons which are

related to prisons conditions such as; inadequate ventilation, poor general health of prisoners and the high number of imprisoned persons (3, 4).

Although studies showed the increase of TB in prisons through recent years in both industrialized and developing countries, most of TB infection and its related deaths occur in developing countries, including Iran (5, 6). In Iran, limited statistics has been published publicly and there are some barriers to health care access in prisons including; insufficient human resources, limited resources for TB early diagnosis, and difficulty in continue of treatment after release from prison. In a study carried out in Khuzestan province, Iran, the ratio of TB cases was 7.9% among 4562 prisoners (5). This rate was reported as 4.5% among 59 prisoners in a study in Tajikistan (7) and 48% in 425 prisoners in another study in Pakistan (6). Moreover, the surveys that has carried out in African countries such as Ethiopia showed that the prevalence of TB in prisons is 10-36 times higher than in general population (8-10).

The purpose of this study was to determine the situation of TB disease among the high-risk male prisoners in Shiraz central prison, one of the largest prisons in southern Iran.

Methods

This cross-sectional study (June-October 2018) was conducted on male prisoners in Shiraz central prison, southern Iran in 2018. According to the similar study which has done in Tehran prison (prevalence =0.13% and d =0.03%) (11), at least 2,845 participants were needed. Therefore, all 2,995 men, who were prisoners in the study period were considered as the study sample size. The interviewers informed the prisoners that they could refuse to participate and it would have no impact neither their relationship with prison authorities nor their medical observations. Each participant had an anonymous number that linked into his identification data and

only the coordinator had access to this. To consider ethical issue, the collected data were not revealed to anyone, except for the researchers; hence, patients' names were kept confidential.

Data were collected using a data gathering form, which included three parts; a. socio-demographic characteristics (such as; age, marital status, education, occupation before incarceration, length of incarceration, habitat, nationality and number of family members); b. past medical history (such as; history of pulmonary and extra pulmonary TB and its duration, as well as the treatment length, relatives TB disease, HIV infection, smoking and drug abuse, other infections or surgery or history of long-term use of medications); c. symptoms suggestive for TB disease.

To compare the high-risk and low risk participants, according to 4 criteria, the prisoners were determined as suspected and high-risk prisoners: 1. having at least two clinical suggestive symptom of TB (over two week cough, night sweats, weight loss, expectoration, fever, anorexia and shortness of breath); or 2. cough >2 weeks, plus history of TB individual or in their family member; or 3. cough >2 weeks, plus at least one risk factor (such as; uncontrolled diabetes, renal disease, silicosis, GI surgery, drug abuser, long time corticosteroid therapy, chemotherapy); or 4. HIV positive (12, 13).

Three sputum samples and chest radiograph were performed for high-risk prisoners. The sputum samples were stored at 2-8°C, and at the end of every week they were sent to Shiraz University of Medical Sciences' Tuberculosis Center for preparing smear and Ziehl-Neelsen staining. When the results were prepared, each individual was followed up as below (12, 13). If the prisoner's sputum smear was positive, we defined him as smear-positive TB, and if the prisoner's sputum smear was negative and he had only clinical symptoms and radiographic evidence of TB, he was

defined as smear-negative TB (14). All chest radiographies were evaluated for only having active tuberculosis by a radiologist.

Smear-positive pulmonary TB is defined as: one positive sputum smear for acid-fast bacilli (AFB). Smear-negative pulmonary TB is defined as: at least two sputum specimens negative for AFB and radiographic abnormalities consistent with active tuberculosis, or a patient with negative smear which is culture-positive for Mycobacterium tuberculosis. Extra pulmonary TB is defined as: one specimen from an extra pulmonary site culture-positive for Mycobacterium tuberculosis or positive smear for AFB or histological or strong clinical evidence consistent with active extra pulmonary tuberculosis (14).

All analyses were performed by SPSS software version 16.0 for Windows, using Chi-square and Fisher's exact tests for proportions, and independent *t* test for the means. Results were presented as mean ± standard deviation (SD) for continuous variables and were summarized in number (percentage) for categorical ones. Two-sided P <0.05 and confidence interval (CI) of 95% were considered to be statistically significant. It is worthy to say that uncompleted data were considered in the statistical analysis and were recorded as not determined.

The current study was conducted in accordance with the Declaration of Helsinki, and it was approved by the vice-chancellor of research and technology, as well as the local ethics committee of Shiraz University of Medical Sciences (IR.sums.med.rec.1397.558). Also, the related permissions were granted by the authorities of Shiraz central prison. The interviewers informed the prisoners that they could refuse to participate and it would have no impact neither their relationship with prison authorities nor their medical observations. Each participant had an anonymous number that linked into his identification data and only the coordinator

had access to this. To consider ethical issue, the collected data were not revealed to anyone, except for the researchers; hence, patients' names were kept confidential.

Results

Overall, 2,995 prisoners were studied, that the mean ± SD of age was 35.28±9.64 (range, 18-76) years, and 1,550 (51.8%) were married. Most of the participants had elementary and middle school education (57.2%). Moreover, two most prevalent jobs among them were self-employment job (59.1%) and manual worker (22.4%). As shown in Table 1, 1326 (44.8%) had been lived with their family and 19 (0.6%) were homeless. Total of 2,872 (95.89%) had Iranian nationality, 1361 (45.44%) had no history of drug abuse, and most of them had length of incarceration more than 12 months (54.99%).

Ten (0.3%) prisoners were previously affected with pulmonary, and 5 (0.2%) with extra pulmonary TB. Also, 5 (0.2%) of the participants passed at least 6 months after their treatment duration. Furthermore, 42 (1.4%) participants had positive history of TB among their relatives, and in 11 (26.2%) of them, this disease belonged to their parents. Nineteen (0.6%) had known HIV and 759 (25.4%) were unknown in this regard.

One hundred-eight (3.6%) prisoners had at least one of four criteria, and they were categorized as high-risk prisoners (Table 2). But after performing further TB tests for the prisoners, all of them were smear-negative, and no prisoners with TB were found. It is worthy to mention that it was not find any positive active TB in radiography, too.

The high-risk prisoners were statistically older than low-risk prisoners (38.30±9.74 vs. 35.17±9.62, P=0.001). Also, the length of incarceration was statistically different in both groups (P=0.002), and drug abuse was more in high-risk group (P<0.001).

Table 1: The participants' characteristic, and comparison between high and low risk male prisoners for tuberculosis in Shiraz central prison, southern Iran (2018)

Variables	Total (n=2,995)	High-risk (n=108)	Low risk (n=2,887)	P-value
Age (year) (mean±SD)	35.28±9.64	38.30±9.74	35.17±9.62	0.001*
Marital status (%)				
Single	1,311 (43.77)	53 (49.07)	1,258 (43.57)	0.519
Married	1,550 (51.75)	49 (45.37)	1,501 (51.99)	
Others	134 (4.47)	6 (5.56)	128 (4.43)	
Educational level (%)				
Illiterate	262 (8.75)	13 (12.04)	249 (8.62)	
Elementary and middle school	1,710 (57.10)	64 (59.26)	1,646 (57.01)	
Diploma	706 (23.57)	21 (19.44)	685 (23.73)	0.662
Advanced diploma	156 (5.21)	5 (4.63)	151 (5.23)	
Bachelor's degree and higher	153 (5.11)	5 (4.63)	148 (5.13)	
Not determinant	8 (0.27)	0 (0)	8 (0.28)	
Job (%)				
Shopkeeper or Self-employed	1,768 (59.03)	53 (49.07)	1,715 (59.40)	
Manual worker	669 (22.34)	31 (28.70)	638 (22.10)	
Driver	168 (5.61)	5 (4.63)	163 (5.65)	0.39
Farmer	160 (5.34)	8 (7.41)	152 (5.27)	
Governmental employee	116 (3.87)	5 (4.63)	111 (3.84)	
Others	114 (3.81)	6 (5.56)	108 (3.74)	
Nationality (%)				
Iranian	2,872 (95.89)	103 (95.37)	2,769 (95.91)	0.342
Non-Iranian	123 (4.11)	5 (4.63)	118 (4.09)	
Length of incarceration (%)				
Less than 3 months	577 (19.27)	10 (9.26)	567 (19.64)	
3-6 months	316 (10.55)	11 (10.19)	305 (10.57)	0.002*
6-9 months	257 (8.58)	5 (4.63)	252 (8.73)	
9-12 months	180 (6.01)	3 (2.78)	177 (6.13)	
More than 12 months	1,647 (54.99)	79 (73.15)	1,568 (54.31)	
Residence status (%)				
With family	1,326 (44.27)	47 (43.52)	1,279 (44.30)	
Tenant	1,002 (33.46)	41 (37.96)	961 (33.29)	
Personal home	614 (20.50)	18 (16.67)	596 (20.64)	0.255
Homeless	19 (0.63)	2 (1.85)	17 (0.59)	
Not determinant	34 (1.14)	0 (0)	34 (1.18)	
Smoking (Cigarette/day) (mean±SD)	9.90±9.24	14.87±11.55	9.71±9.09	<0.001*
Drug abuse (%)				
Yes	653 (21.80)	29 (26.85)	624 (21.61)	
No	1,361 (45.44)	23 (21.30)	1,338 (46.35)	<0.001*
Withdrawal	977 (32.62)	56 (51.85)	921 (31.90)	
Not determinant	4 (0.13)	0 (0)	4 (0.14)	

* Statistically significant

Moreover, high-risk prisoners used cigarettes/day more (14.87±11.55 vs. 9.71±9.09, P<0.001), but both groups were not different in term of marital status (P=0.519), educational level (P=0.662), job (P=0.39), and nationality (P=0.342).

Discussion

In this study, we did not find any TB-infected prisoner, only high and low risk

male prisoners were compared. In other studies, which were published about the prevalence of TB and its risk factors, various effective factors for TB were mentioned, that the most important of them are discussed below:

Age: Age was an effective factor, which was higher in high-risk prisoners. We found that the mean±SD of age was 35.28±9.64 in our participants, and it was significantly

Table 2: Criteria for selection of high-risk prisoners for tuberculosis in Shiraz central prison, southern Iran (2018)

	Criteria		Frequency (%) (n=108)		
1	Having at least two clinical suggestive symptom of TB (over-two-week cough, night sweats, weight loss, expectoration, fever, anorexia and shortness of breath)	Yes	47 (44.4)	Cough	5.6%
				Expectoration	6.4%
				Shortness of breath	4.5%
				Weight loss	3.1%
				Anorexia	2.8%
				Night sweats	1.7%
				Fever	1.5%
		No	61 (56.6)		
2	Cough more than 2 weeks, plus history of TB individual or in their family member	Yes	54 (50)		
		No	54 (50)		
3	Cough more than 2 weeks, plus at least one risk factor (such as; uncontrolled diabetes, renal disease, silicosis, GI surgery, drug abuser, long time corticosteroid therapy, chemotherapy)	Yes	54 (50)		
		No	54 (50)		
4	HIV positive	Yes	5 (4.6)		
		No	52 (48.1)		
		Unknown	51 (47.2)		

higher in high-risk prisoners. In an Ethiopian survey, the mean of age of 96.8% of TB prisoners was 32.5 years (9), and it was 24±7 years in the Brazilian one (15).

Education level: The result of our study showed that the most of high-risk prisoners had elementary and middle school education, but it was not different in high-risk and low risk prisoners. Likewise, other surveys in Ethiopia and Brazil showed that the majority of TB-infected prisoners were not high-educated (9, 10, 15, 16).

The length of incarceration: In several studies, the length of incarceration is considered as a significant factor. According to a survey in Pakistan, 52% of the cases had been kept <1 year in the prison, and this factor was statistically significant for TB (9). Furthermore, in another survey in Pakistan, this factor was considered as an important factor for TB (6). In contrast, a Brazilian study declared that the length of incarceration was not statistically relevant (16). In the current study, the length of incarceration was statistically different in high and low risk prisoners, and most of the prisoners had been kept >12 months in the prison.

Nationality: Most of our participants were Iranian in both groups, and the percent of not Iranian prisoners were more in the high-risk group, but there were no statistical different were found. Two other previous studies found a significant correlation between being a foreign-born and being a high-risk for TB (17, 18).

Drug abuse: In the present study, drug abuse was more in the high-risk prisoners. In line of our study, Alavi et al. (2014) showed that drug abuse was an important factor in making a prisoner susceptible for TB (5).

Smoking: Several studies evaluated the effect of smoking on TB (19). Also, in the current study, it was found that smoking was more in high-risk group, statistically. In contrast, in a study which was done in the United States (2012) did not indicate any association between smoking and TB (20).

HIV co-infection: Globally, HIV infection is the greatest risk factor for the development of tuberculosis (21). We considered this factor as a part of a criteria for categorization high-risk participants. Two studies which performed in Iran and

Tajikistan in stated that there is an important statistical association between HIV and TB in prisoners (5, 7) Also, López de Goicoechea-Saiz et al. (2014) found a higher frequency of TB among individuals with HIV infection prisoners in Spain (22).

Previous history of TB*:* Winetsky et al. (2014) found a history of previous TB as a factor that independently associated with increased prevalence of TB in the prisoners (7). Although 0.3% of all of our prisoners had positive history of TB according to their self-report, they were categorized as high-risk group, so this factor could not be evaluated in our study.

TB in relatives*:* Previous studies mentioned that *TB in relatives* was an effective factor for TB. The results of a study which were performed in the largest prison of Bangladesh (2010) and in Brazil (2015) showed that contact with person with TB is the most important factor for TB in the prisoners (4, 23). In the current study, this factor was considered as a part of a criteria for categorization high-risk participants.

Other diseases background*:* Due to lack of existence of any TB patients in our participants, evaluation of this factor on TB is not possible. However, the Brazilian survey in 2016 showed that 2% of prisoners used injected drugs and 1% of prisoners with TB had the experience of usage the inhaled drugs (15).

The lack of cooperation of some of the prisoners in participating in this study was our main limitation that with explaining the importance of this study, made them interesting. Also, we did not find any prisoners with positive TB test for evaluating the risk factors in our population.

In conclusion, our results showed that none of the high-risk male prisoners for TB had positive test. The length of incarceration, drug abuse, smoking, as well as age were more in high-risk prisoners in comparing low risk group. More studies with cohort design are recommended for understating the relative factors for TB in prisoners. The results of such studies can be useful for healthcare policy making and related advocacies. Annual TB screening is suggested, also, prisons authorities should pay more attention to establish a surveillance system for prevention, early diagnosis, and proper treatment of TB.

Conflict of interest

None declared.

Ethical statements

The current study was conducted in accordance with the Declaration of Helsinki, and it was approved by the vice-chancellor of research and technology, as well as the local ethics committee of Shiraz University of Medical Sciences (IR.sums.med.rec.1397.558). Also, the related permissions were granted by the authorities of Shiraz central prison. The interviewers informed the prisoners that they could refuse to participate and it would have no impact neither their relationship

with prison authorities nor their medical observations. Each participant had an anonymous number that linked into his identification data and only the coordinator had access to this. To consider ethical issue, the collected data were not revealed to anyone, except for the researchers; hence, patients' names were kept confidential.

Informed Consent

In this study, the researchers used collected data from the prisoners' screening program, which was performed by Vice-Chancellor of Health of Shiraz University of Medical Sciences, and the patients signed the written informed consent.

References

1. Dye C. Global epidemiology of tuberculosis. Lancet. 2006;367(9514):938-40. doi: 10.1016/S0140-6736(06)68384-0.
2. World Health Organization. Global tuberculosis report 2019. Available from: https://www.who.int/tb/publications/global_report/en/
3. Baussano I, Williams BG, Nunn P, Beggiato M, Fedeli U, Scano F. Tuberculosis Incidence in Prisons: A Systematic Review. PLoS Med. 2010; 7(12): e1000381. doi: 10.1371/journal.pmed.1000381.
4. Banu S, Hossain A, Uddin MK, Uddin MR, Ahmed T, Khatun R, et al. Pulmonary Tuberculosis and Drug Resistance in Dhaka Central Jail, the Largest Prison in Bangladesh. PLoS ONE. 2010;5(5). PLoS One. 2010; 5(5): e10759. doi: 10.1371/journal.pone.0010759.
5. Alavi SM, Bakhtiarinia P, Eghtesad M, Albaji A, Salmanzadeh S. A comparative study on the prevalence and risk factors of tuberculosis among the prisoners in khuzestan, South-west iran. Jundishapur J Microbiol. 2014;7(12):e18872. doi: 10.5812/jjm.18872.
6. Hussain H, Akhtar S, Nanan D. Prevalence of and risk factors associated with Mycobacterium tuberculosis infection in prisoners, North West Frontier Province, Pakistan. Int J Epidemiol. 2003;32(5):794-9. doi: 10.1093/ije/dyg247.
7. Winetsky DE, Almukhamedov O, Pulatov D, Vezhnina N, Dooronbekova A, Zhussupov B. Prevalence, risk factors and social context of active pulmonary tuberculosis among prison prisoners in Tajikistan. PLoS One. 2014;9(1):e86046. doi: 10.1371/journal.pone.0086046.
8. Gizachew Beza M, Hunegnaw E, Tiruneh M. Prevalence and Associated Factors of Tuberculosis in Prisons Settings of East Gojjam Zone, Northwest Ethiopia. Int J Bacteriol. 2017;2017:3826980. doi: 10.1155/2017/3826980.
9. Ali S, Haileamlak A, Wieser A, Pritsch M, Heinrich N, Loscher T, et al. Prevalence of Pulmonary Tuberculosis among Prison prisoners in Ethiopia, a Cross-Sectional Study. PLoS One. 2015;10(12):e0144040. doi: 10.1371/journal.pone.0144040.
10. Abebe DS, Bjune G, Ameni G, Biffa D, Abebe F. Prevalence of pulmonary tuberculosis and associated risk factors in Eastern Ethiopian prisons. Int J Tuberc Lung Dis. 2011;15(5):668-73. doi: 10.5588/ijtld.10.0363.
11. Farhoudi B, SeyedAlinaghi S, Hosseini M, Pahlaviani FG, Firouzeh MM, Shahbazi M, et al. Prevalence of Tuberculosis in a Prison in Tehran by Active Case Finding. Infect Disord Drug Targets. 2019;19(2):167-170. doi: 10.2174/1871526518666180507122425.
12. Maher D, Grzemska M, Coninx R, Reyes H. Guidelines for the control of tuberculosis in prisons. Geneva: World Health Organization 1998. Accessed on August 13, 2020. http://whqlibdoc.who.int/hq/1998/WHO_TB_98.250.pdf.
13. Ali S, Haileamlak A, Wieser A, Pritsch M, Heinrich N, Loscher T, et al. Prevalence of Pulmonary Tuberculosis among Prison Inmates in Ethiopia, a Cross-Sectional Study. PLoS One. 2015;10(12):e0144040. Published 2015 Dec 7. doi:10.1371/journal.pone.0144040.
14. Treatment of tuberculosis: guidelines for national programs, 3rd ed. Geneva, World Health Organization, 2003. http://www.who.int/tb/publications/cds_tb_2003_313/en/index.html (accessed August 13, 2020).
15. Navarro PD, Almeida IN, Kritski AL, Ceccato MD, Maciel MM, Carvalho WD, Miranda SS. Prevalence of latent Mycobacterium tuberculosis infection in prisoners. J Bras Pneumol. 2016;42(5):348-355. doi: 10.1590/S1806-37562016000000001.
16. Reis AJ, David SM, Nunes LS, Valim AR, Possuelo LG. Recent transmission of drug-resistant Mycobacterium tuberculosis in a prison population in southern Brazil. J Bras Pneumol. 2016;42(4):286-289. doi: 10.1590/S1806-37562016000000023.
17. Carbonara S, Babudieri S, Longo B, Starnini G, Monarca R, Brunetti B, et al. Correlates of Mycobacterium tuberculosis infection in a prison population. Eur Respir J. 2005;25(6):1070-6. doi: 10.1183/09031936.05.00098104.
18. Ruvinsky S, Fiorilli G, Pérez MG, Motto E, Cambaceres C, Mannino L, et al. Microbiological features and risk factors for

acquiring multidrug-resistant Acinetobacter baumannii bacteremia in pediatric patients. Case-control study. [in Spanish]. Rev Chilena Infectol. 2015 Feb;32(1):19-24. doi: 10.4067/S0716-10182015000200005.

19. Hsien-Ho Lin, Majid Ezzati, and Megan Murray. Tobacco Smoke, Indoor Air Pollution and Tuberculosis: A Systematic Review and Meta-Analysis. PLoS Med. 2007 Jan; 4(1): e20. doi: 10.1371/journal.pmed.0040020.

20. Weant TE, Turner AN, Murphy-Weiss M, Murray DM, Wang SH. Can social history variables predict prison prisoners' risk for latent tuberculosis infection? Tuberc Res Treat. 2012;2012:132406. doi: 10.1155/2012/132406.

21. Sharma SK, Mohan A, Kadhiravan T. HIV-TB co-infection: epidemiology, diagnosis & management. Indian J Med Res. 2005;121(4):550-67.

22. López de Goicoechea-Saiz ME, Sternberg F, Portilla-Sogorb J. Prevalence and associated risk factors of latent tuberculosis infection in a Spanish prison. Rev Esp Sanid Penit. 2018;20(1):4-10.

23. Sacchi FP, Praça RM, Tatara MB, Simonsen V, Ferrazoli L, Croda MG, et al. Prisons as reservoir for community transmission of tuberculosis, Brazil. Emerg Infect Dis. 2015 Mar;21(3):452-5. doi: 10.3201/eid2103.140896.