Revista da Sociedade Brasileira de Medicina Tropical 46(4):515-518, Jul-Aug, 2013
http://dx.doi.org/10.1590/0037-8682-1441-2013

Short Communication

Active and latent tuberculosis in prisoners in the Central-West Region of Brazil

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ABSTRACT

Introduction: Jailed populations exhibit high rates of tuberculosis (TB) infection and active disease. **Methods:** A cross-sectional study was performed to estimate the prevalence of latent and active TB and to identify factors associated with latent infection in inmates. **Results:** The prevalence of latent TB was 49%, and the prevalence of active TB was 0.4%. The presence of a Bacille Calmette-Guérin (BCG) scar (prevalence ratio (PR)=1.65; 95% confidence interval (CI): 1.09-2.50; p=0.0162) and the World Health Organization (WHO) score for active TB in prisons (PR=1.07; 95% CI: 1.01-1.14; p=0.0181) were correlated with infection. **Conclusions:** The identification of associated factors and the prevalence of latent and active TB allows the development of plans to control this disease in jails.

Keywords: Prisoners. Bacille Calmette-Guérin. Latent tuberculosis.

Tuberculosis (TB) is the second leading cause of death due to infectious disease worldwide. In Brazil, the incidence of active TB is at least 20 times higher in the jailed population than in the general population (669.7-3,173 per 100,000 individuals versus 37.0 per 100,000 individuals)[1]. The prevalence of latent TB in the jailed Brazilian population varies between 40% and 72%[2]. The high rates of infection by *Mycobacterium tuberculosis* (MTB) are related to long terms of imprisonment and the poor sanitary conditions in jails[3,4]. Latent tuberculosis infection (LTBI) predisposes inmates to a greater risk of progression to active disease and increases the transmission rates inside and outside of the jail system[4]. The aim of this study was to estimate the prevalence of latent and active TB infection and to describe the risk factors associated with latent TB among inmates in a jail in the central-western region of Brazil.

A cross-sectional study was performed in a population of inmates at the Harry Amorim da Costa Jail (HACJ) in Dourados City between July and August 2010. The inclusion criteria specified only that the participants be HACJ inmates and sign an informed consent form. A trained team administered 0.1ml of the purified protein derivative, ready-to-use antigen ($PPD\text{-}RT_{23}$) produced by the Statens Serum Institute (Copenhagen, Denmark) intradermally on the anterior side of the lower left arm of each participant. The transverse diameter of the induration was measured 48h after application. Latent infection was diagnosed in cases of an induration greater than 10mm produced by the tuberculin skin test (TST). A standardized questionnaire was given to the participants, addressing the following parameters: habits (smoking, alcohol, and drug use), imprisonment length, and respiratory symptoms. The alcohol intake section of the questionnaire consisted of four questions. Alcoholism was established using the Cut down, Annoyed, Guilty, and Eye-opener (CAGE) questionnaire[5]. Respiratory symptoms were assessed according to the World Health Organization (WHO) clinical scoring system for identifying active TB in jails: a cough lasting for more than two weeks (2 points), expectoration (2 points), chest pain (1 point), weight loss in the last three months (1 point), and a recent loss of appetite (1 point). The maximum score is 7. The WHO suggests that scores equal to or greater than 5 indicate a high probability of active disease[6]. Inmates exhibiting at least one respiratory complaint were referred for clinical examination. When expectoration was observed, chest X-ray, bacilloscopy, and cultures were performed.

The data were recorded using the double entry method with EpiData software (version 3.1) and were analyzed with statistical analysis system (SAS) software (version 9.1). Categorical variables are expressed as proportions, and quantitative variables are described using means (and standard deviations) or medians (and interquartile ranges). The possible factors associated with latent infection were evaluated based on the prevalence ratio obtained from a Poisson regression with robust variance[7]. This study was approved by the Institutional Review Board of the Federal University of Grande Dourados (Nº 020/2009).

The HACJ population was comprised of 1,261 inmates, and 19% (249) of the inmates participated in the study. All inmates were male, and their clinical and epidemiologic characteristics are described in **Table 1**. The prevalence of active disease was 400 per 100,000 individuals. A tuberculin skin test reading was performed in 86% (215/249) of the participants. Readings could not be performed in 34 participants who were not available

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Received 9 November 2011
Accepted 25 January 2012

TABLE 1 - Clinical and epidemiologic characteristics of inmates at the Harry Amorim da Costa Jail, Dourados, Brazil.

Variable	Number of responses	Number	Percentage
Age (years)	244		
18-26		58	24.0
26-34		86	36.0
34-42		50	20.0
older than 42		50	20.0
Schooling	248		
no schooling		8	3.0
Fundamental (first phase)*		109	44.0
Fundamental (second phase)**		106	43.0
Intermediate***		23	9.0
Undergraduate		2	1.0
BCG scar	248	189	76.0
Number of cigarettes per day	249		
0 (no smoker)		111	45.0
1-9		56	22.0
10-19		45	18.0
more than 20		37	15.0
CAGE score greater than 2	249	33	13.0
HIV positive	249	6	2.0
Years in jail	202		
fewer than 2		84	41.0
2-3		52	26.0
more than 3		66	33.0

*elementary school; **middle school; ***high school. BCG: Bacille Calmette-Guerin; CAGE: cut down, annoyed, guilty and eye opener; HIV: human immunodeficiency virus.

due to routine inmate activities, such as attending school or participating in cleaning and cooking tasks. The prevalence of latent MTB infection in the remaining HACJ inmates was 49% (106/215). Among 215 TST readings, 49% (106) were reactive, exhibiting indurations greater than 10mm; 25% (58) were non-reactive; and 24% (51) were scored as zero. Positive values are described in **Figure 1**.

A Poisson regression with robust variance was performed for variables that were potentially related to latent infection. Variables that were not statistically significant in the univariate analysis included age (p=0.7620), tobacco use (p=0.7443), more than eight years of schooling (p=0.8238), imprisonment for more than two years (p=0.8254), a CAGE questionnaire score of more than 2 (p=0.5269), human immunodeficiency virus (HIV) positivity (p=0.3618), and indigenous origin (p=0.6623) **(Table 2)**. The multivariate analysis (significance at p<0.2) included the presence of a Bacille Calmette-Guérin (BCG) vaccine scar on the right arm (p=0.0623) and the WHO clinical score for each additional symptom (p=0.1512). The presence of a BCG scar (prevalence ratio (PR)=1.65; 95% confidence interval (CI): 1.09-2.50; p=0.0162) and any increase in the WHO clinical score (PR=1.07; 95% CI: 1.01-1.14; p=0.0181) were statistically significant in the multivariate model.

In total, 24 inmates exhibited WHO clinical scores greater than 5, which is considered the cut-off point for a high probability of active disease. Of these 24 individuals, two (8.4%) had been diagnosed with TB during the previous year, and one inmate (4.2%) was diagnosed with TB after the study was concluded. This inmate was included in the prospective cohort of a subsequent study (unpublished). These data indicate that WHO clinical scores can be used to identify new TB cases. Moreover, in our study, the clinical scores were correlated with LTBI, suggesting that the WHO symptoms are associated with latent infection.

The jail environment is favorable for MTB transmission and contributes to the high rates of latent infection and active disease. In this study, the latent infection rate was 49% (106/215), which is consistent with the values found in Brazil and worldwide[2,3]. The active disease prevalence in our study cohort, 400 per

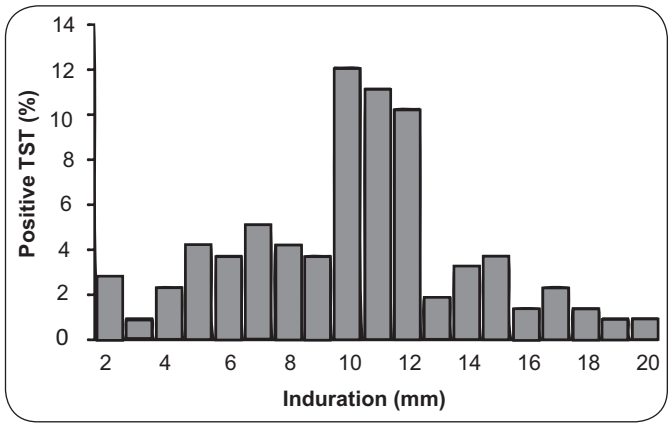

FIGURE 1 - Distribution of positive tuberculin skin test (TST) values in inmates at the Harry Amorim da Costa Jail, Brazil.

TABLE 2 - Prevalence ratio calculated in a modified Poisson regression of variables associated with latent tuberculosis among 215 prisoners at Harry Amorim da Costa Jail, Dourados, Brazil.

Variable	Number of observations	Prevalence ratio (95% CI)
Age (per one-year increase)	211	1.00 (0.9856-1.0200)
More than 8 years of schooling	215	1.08 (0.5459-2.1394)
Time in jail greater than 2 years	179	0.95 (0.6221-1.4603)
Smoking	215	0.93 (0.6406-1.3748)
Race - indigenous	212	0.87 (0.4797-1.5951)
HIV positive	215	0.40 (0.0558-2.8662)
BCG scar	214	1.63 (0.9750-2.7519)*
CAGE score greater than 2	215	1.18 (0.6976-2.0207)
Score (per one-symptom increase)	215	1.07 (0.9740-1.1863)*

95% CI: 95% confidence interval; HIV: human immunodeficiency virus; BCG: Bacille Calmette-Guérin; CAGE: cut down, annoyed, guilty and eye opener. * $p<0.2$.

100,000, was higher than the rates reported in American jails, which range from 19-24 per 100,000[8], but similar to the rates reported in other Brazilian studies.

Tuberculosis has been reported as the leading cause of death in jails in underdeveloped countries[4]. TB is a serious health problem in jail populations for several reasons. First, jail overcrowding, inadequate ventilation, and poor hygienic conditions in cells facilitate bacillus transmission. Second, most inmates have a history of poor nutrition and alcohol and tobacco use. Once in jail, these individuals continue to engage in high-risk behaviors, such as drug use and unprotected sex (both factors contributing to human immunodeficiency virus (HIV) infection)[9,10]. Because these environmental and behavioral patterns are ubiquitous in the inmate population, the individual variation in age, smoking, schooling, imprisonment length, and CAGE scores was not sufficient to establish these variables as indisputable potential LTBI risk factors. The constant circulation of inmates among multiple jails contributes to discontinuity in treatment and the consequent dissemination of disease to other jails. Moreover, jail populations are in constant communication with the broader community through contact with employees and visitors, which makes these populations important disease reservoirs and dissemination foci.

Although certain vaccinated individuals do not develop scars, the presence of a BCG scar has been established as a reliable vaccination marker, with 90% sensitivity and 70% specificity[11]. A BCG scar was observed in 76% (189) of the participants and was correlated with a positive TST reaction in the multivariate analysis.

BCG vaccination remains controversial. Reports indicate that the efficacy of this vaccine varies between 14% and 80%[12]. Several studies have reported an overt inability of BCG to protect against infection and active disease, and the ineffectiveness of the vaccine has been attributed to several factors, including genetic characteristics, differences in MTB virulence, reinfection, the existence of different BCG strains, and nutritional differences[13,14]. From this perspective, the correlation between a vaccine scar and latent infection found in this study might be explained by the inability of BCG to protect against TB infection. Alternatively, the detection of BCG in reactive patients might be caused by a cross-reaction between the vaccine and tuberculin antigens. Studies have established that an allergy to tuberculin can be artificially induced by BCG, which can result in false-positive results. However, in Brazil, BCG vaccination is typically performed immediately after birth, and evidence indicates that BCG interferes minimally with TST values after 10 years[15]. Because the average age in this study was 33 (±10.7; range: 18-77), it seems unlikely that BCG vaccination interfered with the TST results. Instead, BCG may act only as a marker of the immune response against MTB, without necessarily inducing protection. In this regard, patients with a vaccination scar might be more likely to respond to a TST because these individuals are not protected against MTB infection.

The prevalence of TB in the jail system is an important public health problem. Several strategies could be used to combat TB in jails. Jail overcrowding must be managed, and inmates must be provided with better hygienic and ventilation conditions. Moreover, strategies to actively search for new cases must be developed, and inmates should be screened to identify latent TB infection and to test for human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). Inmates must also be given access to radiologic and bacteriologic diagnosis and subjected to a medical examination at admission to avoid transmission between jails.

In Brazil, the prevalence of active and latent TB at the time of admission is 2.7% and 60%, respectively. The use of screening tests for TB before admission is already being performed in several states in the country[15]. The universal implementation of chest X-ray and sputum analysis for symptomatic patients is essential to control the disease and to reduce the incidence in Brazilian prisons. Together, these screening tools could facilitate the treatment of new inmates with TB before they are exposed to uninfected inmates (e.g., through shared cells). Combating TB in jail populations is a crucial step on the path to the eradication of this disease, which affects millions of individuals in Brazil and worldwide.

ACKNOWLEDGMENTS

We are grateful to the interviewers: Débora Rigo Guimarães de Macedo Bento, Giovana Castro de Oliveira, Gisele Douradinho Texeira, and Vanessa da Costa Maldonado. We also thank Harry Amorim da Costa Jail Director Joel Rodrigues Ferreira for his logistical support.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

1. Raviglione MC, Dye C, Schmidt S, Kochi A. Assessment of worldwide tuberculosis control. WHO Global Surveillance and Monitoring Project. Lancet 1997; 350:624-629.
2. Nogueira PA, Abrahão RM. Tuberculosis infection and imprisonment length in the jail population of police districts in west São Paulo. Rev Bras Epidemiol 2009; 12:30-38.
3. Aerts A, Habouzit M, Mschiladze L, Malakmadze N, Sadradze N, Menteshashvili O, et al. Pulmonary tuberculosis in prisons of the ex-USSR state Georgia: results of a nation-wide prevalence survey among sentenced inmates. Int J Tuberc Lung Dis 2000; 4:1104-1110.
4. Baussano I, Williams BG, Nunn P, Beggiato M, Fedeli U, Scano F. Tuberculosis incidence in prisons: a systematic review. PLoS Med 2010; 7:e1000381.
5. Mayfield D, McLeod G, Hall P. The CAGE questionnaire: validation of a new alcoholism screening instrument. Am J Psychiatry 1974; 131: 1121-1123.
6. World Health Organization (WHO). Tuberculosis control in prisons: a manual for programme managers. Geneva: WHO; 2000.
7. Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol 2004; 159:702-706.
8. MacNeil J, Lobat M, Moore M. An unanswered health disparity: tuberculosis among correctional inmates, 1993 through 2003. Am J Public Health 2005; 95:1800-1805.
9. Reyes H, Coninx R. Pitfalls of tuberculosis programmes in prisons. BMJ 1997; 315:1447-1450.
10. Abrahão RM, Nogueira PA, Malucelli MI. Tuberculosis in county jail prisoners in the western sector of the city of Sao Paulo, Brazil. Int J Tuberc Lung Dis 2006; 10:203-208.
11. Pereira SM, Bierrenbach AL, Dourado I, Barreto ML, Ichihara MY, Hijjar MA, et al. Sensitivity and specificity of the BCG scar reading. Rev Saude Publica 2003; 37:254-259.
12. 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; 32:794-799.
13. Fine PEM, Vynnycky E. The effect of heterologous immunity upon the apparent efficacy of (e.g., BCG) vaccines. Vaccine 1998; 16: 1923-1928.
14. Springett VH, Sutherland I. A re-examination of the variations in the efficacy of BCG vaccination against tuberculosis in clinical trials. Tuber Lung Dis 1994; 75:227-233.
15. Ministério da Saúde. Manual de recomendações para o controle da Tuberculose no Brasil; Brasília: Ministério da Saúde; 2010.