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 jails3-4. 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 system4. 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-RT23), 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) questionnaire5. 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 disease6. 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 variance7. 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.
TABLE 1 - Clinical and epidemiologic characteristics of inmates at the Harry Amorim da Costa Jail, Dourados, Brazil.

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

*elementary school; **middle school; ***high school. BCG: Bacille Calmette-Guérin; 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 worldwide2-3. The active disease prevalence in our study cohort, 400 per
Tuberculosis has been reported as the leading cause of death in jails in underdeveloped countries. 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). Because these environmental and behavioral factors, including genetic characteristics, differences in MTB virulence, reinfection, the existence of different BCG strains, and nutritional differences, 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. 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%. 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. 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. 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. 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.
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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES