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Respiratory symptoms and active tuberculosis in a prison in Southern Brazil: Associated epidemiologic variables

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ABSTRACT

Backgound and Objectives: This study is justified by the high TB prevalence in prisons, which constitutes a public health problem and aims to estimate the prevalence of active tuberculosis (TB) and determine the variables associated with respiratory symptoms in a prison in Brazil. **Methods**: This is a descriptive study of 262 inmates divided into respiratory symptomatic and asymptomatic groups. Samples were evaluated by microscopy following the cultivation of the sputum from symptomatic individuals. Associated epidemiological variables were also evaluated. **Results:** Among the 262 inmates included, 178 (68%) were considered symptomatic, and of these, 25 (14%) were diagnosed with active TB. The contribution of culturing in the detection of TB cases was 48%. The prevalence of active TB was 9,542/100.000. Low educational level, use of drugs and alcohol, prison recidivism, and previous TB and HIV-positive status were associated with the presence of respiratory symptoms. Being male, single, black, a prison recidivist, an alcoholic and HIV-seropositive was associated with the development of TB. The rate of TB/HIV co-infection was 60%. The outcome was death in 12% of patients. Drug therapy interruption was reported by 96% of patients. **Conclusions:** The studied population showed a high prevalence of TB and TB/HIV co-infection. In addition, the rates of drug therapy interruption and mortality were alarmingly elevated.

KEYWORDS

Epidemiology
Tuberculosis
Coinfections
HIV infection
Prisons

INTRODUCTION

Tuberculosis (TB) in prisons is a serious health problem worldwide, particularly in developing countries such as Brazil, which has the fourth largest prison population in the world, with 498,487 inmates and an incarceration rate of 260/100,000 inhabitants.[1]

Prisons are mostly overcrowded with low standards of hygiene and reduced ventilation and lighting. In addition, factors such as malnutrition, alcoholism and drug addiction also promote infection by Koch's bacillus and the potential onset of TB.[2] Furthermore, most inmates come from socially marginalized communities, where TB is highly prevalent and access to health care is uncertain.[3]

HIV infection is another factor associated with the high rates of TB in prisons. It is estimated that 5-10% of individuals infected with Mycobacterium tuberculosis will develop the disease in their lifetime, whereas among HIV-infected individuals, that risk increases to 50%.[4] Worldwide, HIV infection is estimated to be 75 times more prevalent among inmates than the general population.[5]

Under such conditions, TB finds a favorable environment for its development, and disease prevalence ininmate populations tends to be much higher than that observed in the non-incarcerated population.[6]

Prisons are considered critical social vectors for transmission of the bacillus and disease development, which can reach the community through correctional officers, health care professionals and visitors. Moreover, prisons are foci for selection of drug-resistant strains.[7]

Therefore, the objective of this study was to confirm the prevalence of active TB and associated variables in a prison in southern Brazil.

METHODS

This was a descriptive inquiry study of the inmate population of a medium-sized prison in southern Brazil that houses approximately 900 inmates (100 women and 800 men). The samples collected from May 2010 to May 2011 were processed in the Mycobacteria and Molecular Biology Laboratory of Universidade Federal do Rio Grande (FURG), state of Rio Grande do Sul, Brazil.

Initially, the inmate population was educated about TB through posters and explanatory and illustrative pamphlets, which were

present in all pavilions and galleries, as to the mode of transmission, main symptoms and treatment of the disease. From there, inmates who were identified through signs or symptoms compatible with TB were included in the study. The study sample consisted of 262 inmates (95% males) in the closed regime. Being part of the semi-open regime was used as an exclusion criterion.

Inmates were classified as respiratory symptomatic or asymptomatic, using the clinical scoring system proposed by the World Health Organisation,[8] in which patients with scores greater than or equal to 5 are considered symptomatic. An epidemiological questionnaire was also administered. Sputum samples were collected from inmates considered to be symptomatic for direct microscopy using the Ziehl-Neelsen method[9] and culture in Ogawa-Kudoh medium.[10] All cultures were monitored for up to 8 weeks.

Individuals were considered smokers when they reported smoking cigarettes in the last six months. Individuals classified as addicted to drugs and alcohol acknowledged periodic use of these substances, with consequent repercussions in their social and professional lives.

Calculations of co-positivity, co-negativity and culture contribution were performed using the formula proposed by the Ministry of Health.[11] Statistical analysis of data was performed using SigmaStat software, version 3.1, and the Chi-squared test was used for the analysis of associations between variables.

Following the ethical principles established by resolution 196/96 of the National Health Council,[12] this research was approved by the Research Ethics Committee of FURG, protocol number 16/2010 and permission was obtained from the Superintendent of Correctional Services (SUSEPE), and the participating inmates signed the Free and Informed Consent Form (FICF).

RESULTS

Microscopy and Cultivation

Of the 309 inmates included in the study, 178 (68%) were considered respiratory symptomatic and 131 asymptomatic. Among the symptomatic patients, 47 did not answer the epidemiological questionnaire and 33 did not have sputum samples collected due to transference, completed sentence or change to semi-open regime, according to Figure 1. A total of 290 samples were collected from 145 symptomatic inmates and sent for microscopy and culture procedures, with 25 (14%) cases of TB being detected.

The co-positivity and co-negativity at microscopy regarding culture samples were 40% and 96.8%, respectively. The contribution of culturing with respect to microscopy for the diagnosis of TB was 48%.

Twelve patients were negative at microscopy and positive at the culture, and of these, 91.6% (11) were TB/HIV-co-infected. Three patients who were positive at microscopy had a contaminated culture, and two who were positive at microscopy had a negative culture (Table 1).

Table 1. Results of microscopy and culture of samples from respiratory symptomatic individuals

	CASES positive culture	CASES negative culture/count	Total
CASES positive microscopy	8	5	13
CASES negative microscopy	12	153	165
Total	20	158	178

Epidemiological Profile of Respiratory Symptomatic and Asymptomatic Individuals

The epidemiological profiles (Table 2) of the 131 inmates from the symptomatic group and the 131 participants from the asymptomatic group were evaluated. We determined that 95% of the participants were males and 67.5% were white, with a median age for both groups of 30 years.

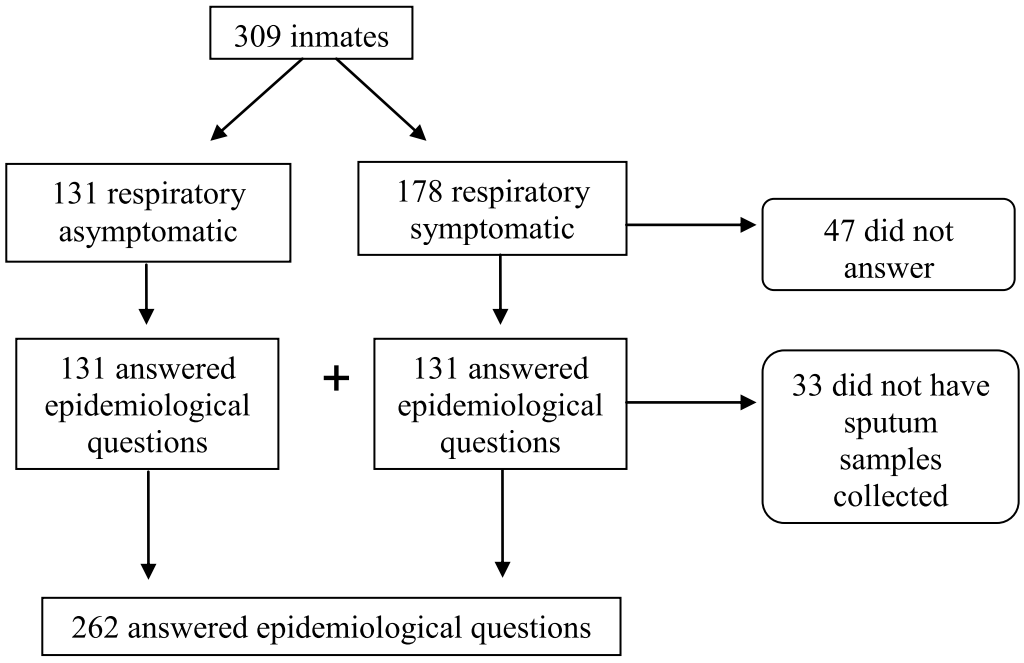

Figure 1. Diagram of included inmates.

With respect to marital status, on average, 57% of participants were single, with no significant difference observed between the groups. Regarding education, 81% of symptomatic inmates had less than 8 years of education, whereas in the asymptomatic group, the rate was 59.6% (p=0.007).

The use of alcohol, tobacco and other drugs among asymptomatic participants was 29%, 58% and 72%, respectively, whereas among symptomatic individuals, the rates were 44%, 85% and 79%, respectively. Alcohol abuse was associated with respiratory symptoms (p=0.01) and smoking (p<0.001).

Approximately 85% of inmates in both groups came from neighborhoods and communities located in the outskirts of the city, and less than 5% lived downtown. Recidivism in prison was a factor associated with the presence of symptoms, having been reported by 59% of symptomatic and 40% of asymptomatic inmates (p=0.002).

A previous history of TB was reported by 18.3% and 10% of symptomatic and asymptomatic participants, respectively. We determined that 19.8% of symptomatic and 10.7% of asymptomatic individuals were known to be HIV-positive, whereas 56.5% of symptomatic and 75.6% of asymptomatic participants were unaware of their HIV status.

Table 2. Epidemiological profiles of respiratory symptomatic and asymptomatic participants

CHARACTERISTIC	SYMPTOMATIC (n= 131)	ASYMPTOMATIC (n=131)	Total	p-value
SEX				
Female	10/7.6%	3/2.3%	13	0.046
Male	121/92.4%	128/97/7%	249	
MARITAL STATUS				
Single	76/58%	74/56.5%	150	0.803
Married	55/42%	57/43.5%	112	
EDUCATION				
Illiterate	10/8%	7/5.3%	17	0.007
Incomplete Elementary school	96/73%	71/54.3%	167	
Complete Elementary school	17/13%	29/22.1%	46	
Incomplete High school	3/2%	11/8.3%	14	
Complete High school	5/4%	13/10%	18	
AGE				
Up to 20 years	6/4.6%	7/5.3%	13	0.641
From 21 to 30	62/47.3%	63/48%	125	
From 31 to 40	46/35.1%	43/33%	89	
From 41 to 50	15/11.4%	12/9.1%	27	
51 years or older	2/1.5%	6/4.6%	8	
ETHNICITY				
Caucasian	85/65%	92/70%	177	0.356
Non-Caucasian	46/35%	39/30%	85	
DRUG USE				
Yes	103/79%	94/72%	197	0.198
No	28/21%	37/28%	65	
ALCOHOL USE				
Yes	58/44%	38/29%	96	0.01
No	73/56%	93/71%	166	
PREVIOUS TB				
Yes	24/18.3%	13/10%	37	0.050
No	107/81.7%	118/90%	225	
RECIDIVIST INMATE				
Yes	77/59%	52/40%	129	0.002
No	54/41%	79/60%	133	
PLACE OF RESIDENCE				
Downtown Rio Grande	6/4.5%	3/2.3%	9	0.240
Periphery of Rio Grande	106/81%	116/88.5%	222	
Other cities	19/14.5%	12/9.2%	31	
SMOKER				
Yes	112/85%	76/58%	188	< 0.001
N o	19/15%	55/42%	74	
COUGHING				
Yes	105/80%	11/8%	116	<0.001
No	26/20%	120/92%	146	
SPUTUM				
Yes	122/93%	16/12%	138	<0.001
No	9/7%	115/88%	124	
HIV				
Yes	26/19.8%	14/10.7%	40	0.002
No	31/23.7%	18/13.7%	49	
Does not know	74/56.5%	99/75.6%	173	
Total patients	131	131	262	

Epidemiological profile of TB cases

A total of 25 new cases of active TB were found, with a prevalence of 9,542/100.000 cases. The development of TB was associated with male gender (p = 0.008), comprising 84% of all cases, and a median age of 32 years, whereas among females, the median age was 39 years (Table 3).

The single (76% p = 0.046) and non-white (56% p = 0.008) individuals had a higher prevalence of TB. Although there was no significant difference between the groups, 96% of patients had some elementary school education, and of these, 56% had attended up to 4th grade of elementary school. In most cases, a low level of education typified the profile of the inmate.

The use of alcohol and drugs was reported by 60% and 80% of the patients, respectively. Furthermore, the use of tobacco was reported by 84% of the prisoners with active disease. A previous case of TB was reported by 44% of the TB patients, and prison recidivism was associated with a greater tendency to present with TB (72% of cases; p = 0.017). With respect to place of residence, the distribution of cases indicated that 84% of active disease cases were from the poor and peripheral communities of Rio Grande.

TB/HIV co-infection was verified in 60% of cases, and 73.3% of these patients were diagnosed exclusively by culture. Seropositivity was associated with a greater tendency to develop TB (p <0.001).

Although all patients were referred for treatment during the study, a 96% failure rate in the continuity of therapy was observed due to the continuous unavailability of medication in prison. In three cases (12%), the outcome was inmate's death , all of whom were co-infected with TB and HIV.

Table 3. Epidemiological profile of active TB cases and negative TB cases

CHARACTERISTIC	NEGATIVE TB (n=237)	ACTIVE TB (n=25)	Total	p-value
SEX				
Female	9/4%	4/16%	13	0.008
Male	228/96%	21/84%	249	
MARITAL STATUS				
Single	131/55%	19/76%	150	0.046
Married	106/45%	6/24%	112	
EDUCATIONAL LEVEL				
Illiterate	15/6%	2/8%	17	0.179
From 1st to 4th grade	59/25%	12/48%	71	
From 5th to 7th grade	90/38%	6/24%	96	
Complete Elementary school	42/18%	4/16%	46	
Incomplete High school	14/6%	0/0%	14	
Complete High school	17/7%	1/4%	18	
AGE				
Up to 20 years	13/5%	0/0%	13	0.039
From 21 to 30	117/49%	8/32%	125	
From 31 to 40	80/34%	9/36%	89	
From 41 to 50	21/9%	6/24%	27	
51 years or older	6/3%	2/8%	8	
ETHNICITY				
Caucasian	166/70%	11/44%	177	0.008
Non-Caucasian	71/30%	14/56%	85	
DRUG USE				
Yes	177/75%	20/80%	197	0.558
No	60/25%	5/20%	65	
ALCOHOL USE				
Yes	81/34%	15/60%	96	0.011
No	156/66%	10/40%	166	
TOBACCO USE				
Yes	170/72%	21/84%	191	
No	67/28%	4/16%	71	
PREVIOUS TB				
Yes	26/11%	11/44%	37	0.360
No	211/89%	14/56%	225	
RECIDIVIST INMATE				
Yes	111/47%	18/72%	129	0.017
No	126/53%	7/28%	133	
PLACE OF RESIDENCE				
Downtown Rio Grande	8/3%	1/4%	9	0.986
Periphery of Rio Grande	201/85%	21/84%	222	
Other cities	28/12%	3/12%	31	
HIV				
Yes	26/11%	15/60%	41	< 0.001
No	41/17%	9/36%	50	
Do not know	170/72%	1/4%	171	
Total patients	237	25	262	

DISCUSSION

The epidemiological profile of the prison population was similar to what has been reported by other studies: the majority of inmates are single, white young adult males with a median age of 30 years, with no significant differences between the symptomatic and asymptomatic groups. The low educational level was a striking feature, as more than 70% of the inmates had not finished elementary school, and of these, 50% were considered functionally illiterate.[13]

The proportion of respiratory symptomatic individuals in the prison population was 68%, whereas the expected prevalence for the general population is 1%.[14] High rates have been reported in other prison populations, such as 81.8% in a study carried out in Zambia.[15] This high rate of symptomatic individuals complicates the active monitoring and control of TB and is most likely related to the large number of smokers, drug users and alcoholics in prisons and radiological screening is a good alternative to identify TB cases.[3]

Although considered asymptomatic by OMS screening, 8% of inmates of this group had cough and 12% sputum, what justifies the finding of high prevalence of smokers, alcoholics and drug addicted in the prison environment. Alcohol abuse has shown to be related to the presence of respiratory symptoms, which can be explained by the decreased immune function, malnutrition and social fragility caused by alcohol.[16] Furthermore, we determined that smoking was also strongly associated with the presence of symptoms, being present in 85% of symptomatic inmates.[17] Drug abuse was extensively reported by detainees of both groups, reaching approximately 80%, which reflects the reality of prisons. These substances also produce immune system weakness in individuals, thereby facilitating infection by Koch's bacillus.[18]

The results of this study show a high prevalence of alcoholics, smokers and drug users among symptomatic and asymptomatic prisoners, exposing the insufficiency of health care in prison, primarily the absence of prevention programs and health education and the lack of an active prison health care team.[19]

The use of cultivation in the laboratory diagnosis of TB contributed to a 48% increase in the detection of cases. Similar findings were reported in a study performed in a prison in the city of Campinas, where the TB prevalence based on culture was 2,065/100,000, whereas it was 787/100,000 based on microscopy.[20] The higher sensitivity of the culture is demonstrated by the capacity to detect approximately 100 bacilli/mL, whereas microscopy detects 5,000-10,000 bacilli/mL.[21] In locations where samples are systematically cultivated for all respiratory symptomatic individuals, the contribution of cultivation to the expected diagnosis can vary from 30% to 40%. The rate in the present study was slightly higher than the estimated rate. This observation may be associated with the high prevalence of TB/HIV co-infection (60%) in the studied group. For patients co-infected with HIV, culture is essential due to immunosuppression, lung lesions are not usually cavitary, but paucibacillary, with few or no visible bacilli in the sputum, thereby reducing even further the sensitivity of microscopy.[22]

HIV infection is closely related to the development of TB. High rates of HIV infection are reported in prisons, reaching 77% of the prison population in some studies.[23] However, although HIV infection is an important health problem inside prisons, in this study, on average, unawareness of HIV status was 66% in both groups. This unawareness produces consequences, such as the spread of disease by injectable drug use and unprotected sexual activity, and it deprives these individuals of medical care, exposing them to opportunistic infections and increasing their chances of developing TB.

A total of 25 patients were diagnosed with TB, reaching a prevalence of 9,542/100,000, which is 265 times higher than that observed in the Brazilian population and 9 times higher than that observed in the Brazilian prison population.[12] The implementation of control measures adopted by different countries may explain the large fluctuations in the prevalence of TB in prisons. Whereas Israel reports 25/100,000 cases of TB in prison,[24] with a structured and stringently controlled program, rates up to 4,600/100,000 are seen in Rio de Janeiro with poor TB control.[25] In sub-Saharan Africa where the conditions are poor and there is no disease control program, studies show a prevalence of TB in prison of 3,797-5,800/100.000.[26]

A pattern in the epidemiological profiles of patients who developed the active disease was identified, with important differences when compared with those that did not have active TB. Although most study participants were white (67.5%), non-white inmates predominated among TB patients (60%). Another study carried out in the state of Rio Grande do Sul showed that although the population is predominantly composed of white (63.4%), those who developed TB were primarily Non-white (77.5%).[27] These data are most likely associated with the social fragility that African descendant individuals experience due to a history of slavery in the past. However, this finding could also confirm previous studies that demonstrated that Afro-American individuals are more susceptible to infection with M. tuberculosis than Caucasians.[28]

In this study, a low educational level was observed in both groups; however, the proportion of inmates that had not finished elementary school was higher among those with active TB, reaching 90%. A low educational level is a problem when fighting TB, as studies have shown that lack of education is also related to poor treatment adherence.[29]

Prison recidivism was also more pronounced among infected patients (72%), whereas among those ones who did not develop disease, the rate of recidivism was 47%. Time in prison has been associated with an increased chance of developing active disease. In a study performed in São Paulo, where the recidivism rate was greater than 80%, 100% of inmates with prison time longer than one year were positive for latent infection.[30]

Previous TB development was dramatically higher among those who became ill (44%) compared with the non-ill group (11%), indicating the possibility of either endogenous reactivation or exogenous reinfection. Both cases demonstrate that these individuals are more likely to develop TB via either intrinsic or extrinsic factors and are therefore a special group to be considered inside the prison system.

The rate of mortality among those that became ill (12%) was 5 times higher than that observed in the Brazilian population.[12] The irregular use of the medication, despite the absence of records, was reported by the patients in 96% of the cases, occasioned by the intermittent medication supply. The default of a health team who is responsible for the follow-up and adherence by the patients to the treatment, guaranteeing their access to medication justifies this failure in the process. Medications were supplied by the local TB Service; however, adequate patient follow-up was quite poor. The high rate of drug therapy interruption observed here is alarming, given that it contributes to the selection of resistant strains in addition to not interrupting the cycle of bacillus transmission.

A reduction in the incidence of TB in prison and better adherence to medical treatment depend on different measures, such as screening policies, the introduction of more accurate diagnostic

methods, the implementation of a continuous education program, the identification of high-risk groups, the determination of HIV status and the implementation of Directly Observed Treatment Short Course (DOTS).

This study has several limitations, depending on the characteristics of the studied population and the prison institution structure. The screening of symptomatic individuals could not rely on radiological diagnosis due to the lack of infrastructure to transfer the inmates to a hospital. Moreover, restricted access to the prison galleries made the use of a symptom score viable alternative methodologies for screening for symptomatic infection. The absence of a prison health care team was also an important limitation, as it precluded a dialogue between the researchers and those responsible for taking care of the patients, interactions that may have generated valuable information and better monitoring of the patients during treatment.

The high prevalence of TB in the prison environment show that TB and HIV prevention measures and control are urgently needed in this penitentiary and the formation of a health care team that defends the rights of the citizens deprived of freedom and ensures access to health care are essential to respect these citizens' rights and is the duty of the State. The variables associated to a higher predisposition of TB development, such as alcohol and drug abuse also need an intervention in order to reduce the prevalence of TB and the morbimortality caused by the use of these substances. In addition to characterizing the local reality of TB, which was unknown until now, this study produced the additional benefit of helping to formulate strategies for disease control inside prisons.

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