



Factors associated with recovery and the abandonment of tuberculosis treatment in the incarcerated population

Fatores associados à cura e ao abandono do tratamento da tuberculose na população privada de liberdade

Kelle Karolina Ariane Ferreira Alves^I , Lívia Menezes Borralho^{II} ,
Aguinaldo José de Araújo^{III} , Ítalo de Macedo Bernardino^I ,
Tânia Maria Ribeiro Monteiro de Figueiredo^I 

ABSTRACT: *Objective:* This study aimed to investigate the factors associated with the outcomes of recovery and abandonment in the incarcerated population with tuberculosis. *Methods:* A quantitative and observational analytical study was performed with data from the Notification Disease Information System (Sinan), tuberculosis data from the incarcerated population in the state of Paraíba from 2007 to 2016; Notifications of individuals over the age of 18, reported as “new cases” and the outcome, “recovery” or “abandonment” status were included. Those people who until December 2016 had no outcome information were excluded. Analyses were performed using bivariate and multivariate statistics from the Poisson regression. *Results:* Of the 614 notifications, most were male (93.8%). In the bivariate analysis, there was a statistically relevant association of outcomes with Acquired Immunodeficiency Syndrome ($p = 0.044$), Human Immunodeficiency Virus (HIV) serology ($p = 0.048$) and lack of completion of follow-up bacilloscopy ($p = 0.001$). In the adjusted multivariate analysis, Acquired Immunodeficiency Syndrome (RR = 1.998; 95%CI 1.078 – 3.704; $p = 0.028$) and lack of completion of follow-up bacilloscopy (RR = 5.251; 95%CI 2.158 – 12.583; $p < 0.001^*$) remained significantly associated with the dropout outcome. *Conclusion:* Recovery and abandonment outcomes were mainly associated with whether the follow-up bacilloscopy was performed or not and Acquired Immunodeficiency Syndrome.

Keywords: Tuberculosis. Prisoners. Therapeutics. Treatment. Risk factors.

^IUniversidade Estadual da Paraíba – Campina Grande (PB), Brazil.

^{II}Secretary of Health of Paraíba – João Pessoa (PB), Brazil.

^{III}Universidade Federal do Rio Grande do Norte – Natal (RN), Brazil.

Corresponding author: Kelle Karolina Ariane Ferreira Alves. Rua Eliezer Dourado, 355, Coopirecê, CEP: 4990-000, Irecê, BA, Brazil. E-mail: kellekarolina@hotmail.com

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RESUMO: *Objetivo:* Este estudo objetivou investigar os fatores associados aos desfechos de cura e abandono na população privada de liberdade com tuberculose. *Métodos:* Estudo quantitativo, observacional e analítico. Realizado com dados oriundos do Sistema de Informação de Agravos de Notificação (Sinan), de tuberculose da população privada de liberdade nos anos de 2007 a 2016 no estado da Paraíba. Foram incluídas as notificações de indivíduos maiores de 18 anos notificados como “casos novos” e como encerramento por “cura” ou “abandono”. Excluíram-se aqueles que até dezembro de 2016 não tinham a situação de encerramento. Realizaram-se estatísticas bivariada e multivariada, por meio de regressão de Poisson. *Resultados:* Com 614 notificações, a maioria foi do sexo masculino (93,8%). Na análise bivariada, houve associação estaticamente relevante dos desfechos com síndrome da imunodeficiência adquirida ($p = 0,044$), sorologia para vírus da imunodeficiência humana ($p = 0,048$) e não realização de baciloscopia de acompanhamento ($p = 0,001$). Na análise multivariada ajustada, a síndrome da imunodeficiência adquirida (risco relativo – RR = 1,998; intervalo de confiança de 95% — IC95% 1,078 – 3,704; $p = 0,028$) e a não realização de baciloscopia de acompanhamento (RR = 5,211; IC95% 2,158 – 12,583; $p < 0,001^*$) permaneceram significativamente associadas ao desfecho de abandono. *Conclusão:* Os desfechos de cura e abandono estão associados principalmente com a realização ou não da baciloscopia de acompanhamento e com a síndrome da imunodeficiência adquirida.

Palavras-chave: Tuberculose. População privada de liberdade. Tratamento. Fatores de risco.

INTRODUCTION

Tuberculosis (TB) continues to be an important public health problem. The main goals discussed by the Ministry of Health (MoH) to affect its control are recovery and reducing patient treatment abandonment¹.

Studies carried out in Uganda and the Republic of Congo have emphasized that TB is a health problem in the prison system around the world and that many countries are facing a real outbreak of the disease in these places^{2,3}. In 2017, in Brazil, 10.5% of the new TB cases reported were in the incarcerated population (IP). The state of Paraíba had 1,031 new cases, with an incidence coefficient of 25.6 cases / 100 thousand inhabitants⁴.

Studies indicate that the higher incidence of TB in prisons is directly related to overcrowding conditions, poor ventilation, lighting and a high prevalence of other comorbidities at the site, factors that favor transmission^{5,6}.

In addition to incarceration being a risk factor for TB infection, infection within prisons may be linked to that of the general population, since there is a large flow of people circulating between the two environments. Thus, programs and public policies for the control of TB must consider the importance of reducing the transmission of the disease in prisons, which, consequently, may reflect in the general population^{7,8}.

As such, it is necessary to identify positive interventions in the early diagnosis and treatment of the patient until recovery is achieved⁹. Additionally, it is necessary to discover strategies to improve treatment outcomes and avoid drug resistance caused by recurrent abandonment of treatment³.

For management, the proportion indicators that show an end to TB cases such as recovery, abandonment, and death reflect on the effectiveness of programs and treatment. It must be reinforced that, in order to achieve the established goals, it is necessary to get to know the IP, in order to guarantee visibility for the planning of effective measures so that, finally, a positive impact can be obtained with the general indicators^{10,11}.

As such, it is essential to carry out an investigation of the factors that can contribute to recovery and abandonment outcomes in order to contribute to the planning of actions that reduce unfavorable outcomes. Given the above, the present study aims to investigate the factors associated with the outcomes of recovery and abandonment in the IP affected by TB.

METHODS

This is a quantitative, observational and analytical study, carried out based on secondary data from the Notifiable Diseases Information System (*Sistema de Informação de Agravos de Notificação* - Sinan), provided by the Paraíba State Department of Health, regarding the cases of TB reported in the IP in Brazil in the years from 2007 to 2016.

For the composition of the sample, notifications were included from subjects over 18 years old who entered the system as a “new case” and whose case appears as closed from “recovery” or “abandonment”. Those whose cases had not been closed by December 2016 were excluded. “New cases” were considered to be any patient who had never undergone TB treatment or who had undergone it for up to 30 days. The “recovery” closure happened when the patient had completed TB treatment, and “abandonment” occurred in cases of active TB in patients, who had stopped taking the medication for 30 consecutive days or more.

For analysis purposes, the variable “follow-up bacilloscopy” was coded to cover the performance of a follow-up bacilloscopy that should have been performed during the treatment of the patient. Based on the recommendations of the Ministry of Health, it is recommended that the patient have at least two negative bacilloscopies, if initially bacilloscopy-free, so that can be considered recovered¹¹. Therefore, it was established, in the present study, to consider notifications that consisted of at least two bacilloscopies as “performed” and those that did not, as “not performed”.

Initially, a descriptive statistical analysis was performed, aiming to characterize the sample. Absolute and percentage frequencies were calculated for categorical variables, as well as measures of central tendency and variability for quantitative variables. Then, Pearson’s χ^2 test (or Fisher’s exact test, when appropriate) was used to determine the association between outcomes (recovery or abandonment) and independent variables (sex, age, education, tuberculin skin test, form, associated conditions, such as acquired immunodeficiency syndrome - AIDS - and diabetes, sputum culture, human immunodeficiency virus - HIV -, diagnostic bacilloscopy, follow-up bacilloscopy and supervised treatment). The level of significance was set at $p < 0.05$. Subsequently, Poisson regression analysis was performed to determine the magnitude of the associations observed in the bivariate analysis. The multivariate model was built based on the statistical significance of the variables in the bivariate

analysis, as well as on the clinical and epidemiological relevance (confounding factors, such as sex, age and HIV). All analyzes were conducted with the aid of IBM SPSS Statistics software version 20.0, considering a 95% confidence interval.

The study was evaluated and approved by the Ethics and Research Committee of the Universidade Estadual da Paraíba, thus obtaining the approval report, under nº 52879215.4.0000.5187. In addition, the recommendations made in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for observational studies were followed.

RESULTS

In the period corresponding to the study, from January 2007 to December 2016, 614 notifications of new cases from IP were made, with 93.8% (n = 576) referring to males. Sociodemographic data are shown in Table 1.

Table 1. Sociodemographic profile of incarcerated individuals diagnosed with tuberculosis. Brazil, 2007–2016.*

Variables	n	%
Sex [614]		
Male	576	93.8
Female	38	6.2
Age [614]		
Average (SD): 31,18 (10,26)		
Median (IIQ) 29,00 (24,00-36,00)		
Race [601]		
White	98	16.3
Black	57	9.5
Yellow	6	1.0
Brown	437	72.7
Indigenous	3	0.5
Education [443]		
≤ 8 years of study	400	90.3
> 8 years of study	43	9.7

*The values between [] indicate the total of valid cases for each variable; SD: standard deviation; IIQ: interquartile range (25th percentile - 75th percentile).

Table 2 shows the clinical profile of the subjects notified with TB during the study period, as well as the performance of tests for diagnosis and monitoring of the pathology.

According to Table 3, there was a statistically significant association between the outcomes (recovery or abandonment) and AIDS ($p=0.044$), HIV serology ($p = 0.048$) and the failure to perform follow-up bacilloscopy microscopy ($p = 0.001$). The abandonment rate was significantly higher among individuals with AIDS (33.3%) and those who did not undergo follow-up sputum bacilloscopy microscopy (21.2%).

According to Table 4, AIDS (relative risk - RR = 1.998; 95% confidence interval — 95%CI 1.078 – 3.704; $p = 0.028$) and no follow-up bacilloscopy microscopy (RR = 5.211; 95%CI) 2.158 – 12.583; $p < 0.001^*$) remained significantly associated with the abandonment outcome.

Table 2. Clinical characterization of incarcerated individuals diagnosed with tuberculosis. Brazil, 2007–2016.*

Variables	n	%	Variables	n	%
Chest X-ray [394]			(HIV) [448]		
Suspect	385	97.7	Positive	28	6.3
Normal	8	2	Negative	384	85.7
Another pathology	1	0.3	In Progress	36	8
Tuberculin test [88]			Bacilloscopy (diagnosis) [548]		
Non-reactor	19	21.6	Positive	474	86.5
Weak reactor	9	10.2	Negative	74	13.5
Strong reactor	60	68.2	Bacilloscopy (monitoring) [614]		
Form [614]			Performed as recommended	184	30
Pulmonary	580	94.5	Not performed	430	70
Extrapulmonary	31	5	DOT [546]		
Pulmonary + Extrapulmonary	3	0.5	Yes	250	45.8
(AIDS) [451]			No	296	54.2
Yes	24	5.3	Closed [614]		
No	427	94.7	Recovered	510	83.1
			Abandoned	104	16.9

*The values between [] indicate the total of valid cases for each variable; AIDS: acquired immunodeficiency syndrome; HIV: human immunodeficiency virus; DOT: directly observed treatment.

Table 3. Bivariate analysis of the outcome (recovery or abandonment) and independent variables. Brazil, 2007–2016.

Variables	Outcome						p
	Recovered		Abandoned		Total		
	N	%	n	%	n	%	
Sex							
Male	477	82.8	99	17.2	576	100.0	0.521 ^a
Female	33	86.8	5	13.2	38	100.0	
Age							
≤ 29 years	283	83.0	58	17.0	341	100.0	0.958 ^a
> 29 years	227	83.2	46	16.8	273	100.0	
Education level							
≤ 8 years of study	330	82.5	70	17.5	400	100.0	0.329 ^a
> 8 years of study	38	88.4	5	11.6	43	100.0	
Tuberculin test							
Non-reactor	14	73.7	5	26.3	19	100.0	0.339 ^b
Weak reactor	7	77.8	2	22.2	9	100.0	
Strong reactor	52	86.7	8	13.3	60	100.0	
Form							
Pulmonary	481	82.9	99	17.1	580	100.0	0.999 ^b
Extrapulmonary	26	83.9	5	16.1	31	100.0	
Pulmonary + Extrapulmonary	3	100.0	0	0.0	3	100.0	
AP (AIDS)							
Yes	16	66.7	8	33.3	24	100.0	0.044^{**}
No	354	82.9	73	17.1	427	100.0	
AP (Diabetes)							
Yes	12	80.0	3	20.0	15	100.0	0.727 ^b
No	421	83.2	85	16.8	506	100.0	
Sputum culture							
Positive	58	92.1	5	7.9	63	100.0	0.080 ^b
Negative	6	66.7	3	33.3	9	100.0	
In Progress	25	86.2	4	13.8	29	100.0	
HIV							
Positive	20	71.4	8	28.6	28	100.0	0.048^{**}
Negative	318	82.8	66	17.2	384	100.0	
In Progress	34	94.4	2	5.6	36	100.0	

Continue...

Table 3. Continuation.

Variables	Outcome						p
	Recovered		Abandoned		Total		
	N	%	n	%	n	%	
Bacilloscopy diagnosis							
Positive	391	82.5	83	17.5	474	100.0	0.574 ^a
Negative	63	85.1	11	14.9	74	100.0	
Bacilloscopy monitoring							
Carried out	171	92.9	13	7.1	184	100.0	<0.001 ^{a*}
Not carried out	339	78.8	91	21.2	430	100.0	
DOT							
Yes	210	84.0	40	16.0	250	100.0	0.861 ^a
No	247	83.4	49	16.6	296	100.0	

^a χ^2 test by Pearson; ^bFisher's exact test; *p <0.05; AP: associated problem; AIDS: acquired immunodeficiency syndrome; HIV: human immunodeficiency virus; DOT: directly observed treatment.

Table 4. Multivariate analysis of the outcome (recovery or abandonment) and independent variables. Brazil, 2007–2016.

Variables	Multivariate model	
	RR _{Adjusted} (95%CI)	p
Sex		
Male	2.283 (0.686 – 7.603)	0.179
Female	1	
Age		
≤ 29 years	0.774 (0.514 – 1.164)	0.219
> 29 years	1	
AP (AIDS)		
Yes	1.998 (1.078 – 3.704)	0.028*
No	1	
Bacilloscopy diagnosis		
Positive	1.665 (0.898 – 3.086)	0.105
Negative	1	
Bacilloscopy monitoring		
Carried out	1	< 0.001*
Not carried out	5.211 (2.158 – 12.583)	

RR: relative risk; 95%CI: 95% confidence interval; * p <0.05; AP: associated problem; AIDS: acquired immunodeficiency syndrome.

DISCUSSION

In the characterization of the study subjects, the IP proved to be formed predominantly of brown men, young adults, and individuals with eight years or less of schooling, which is in line with the national scenario of the prison system^{12,13} and with recent studies about TB in the IP^{1,14,15}. The profile found draws attention to the social aggravation of the problem. The population considered is young, and affected by a disease historically laden with stigma and they are in seclusion in a phase of life where they are considered to be “economically active”.

The predominant form of TB was pulmonary, followed by extrapulmonary, which was similar to a study conducted in 2017 that evaluated the incidence of TB in IP in the country¹⁰. The predominance of pulmonary TB in IP is concerning, since the bacillus is transmitted through the air, and overcrowding conditions, poor ventilation and lighting in prison units favor the spread of the disease.

In relation to clinical data and the management of patients during treatment, some findings stand out, such as the case of performing the directly observed treatment (DOT). In addition to the low DOT performance in prison units, flaws were found in the notifications, as many of them did not contain this information. When compared to the national literature, this data alerts to the fact that the literature refers to DOT as an important tool for reducing treatment abandonment, directly contributing to the control of the disease^{11,16-18}.

When considering the existence of the prison health team (PHT) to assist the IP, a greater accomplishment of DOT was expected. However, it did not occur, raising questions about the assistance provided by the teams to enable adherence to the treatment and obtain recovery. The MoH emphasizes in its 2019 manual that DOT is an important tool for therapeutic adherence, especially in vulnerable populations¹¹.

The data also point to a low coverage of tests for the diagnosis and monitoring of TB, which are recommended by the Ministry of Health, especially the tuberculin skin test. It is recommended for the detection of latent TB infection, especially in the population with HIV. Furthermore, it is considered to be a relevant tool to help in decision making for the treatment of latent TB¹¹.

In view of the high prevalence of HIV in the IP¹⁹, it was expected that greater HIV testing would be carried out, in order to assist in the early diagnosis of co-infection. Understanding the airborne transmission of the bacillus and the high occupancy rates of Brazilian prisons, which could favor a false positive in the tuberculin skin test, a study carried out in 2016 showed that the health team that works in the prison units use the chest x-rays, sputum cultures and rapid molecular tests instead⁶.

HIV testing was a variable included in the notification form only starting in 2014. For this reason, there is no way to know precisely, over the study period, how the exam coverage was provided. However, since this information started, low performance was observed, since testing is recommended for all patients. In a Brazilian multicenter study and in an international study, the need for greater emphasis on early diagnosis and monitoring of TB/HIV co-infection¹⁹⁻²¹ is highlighted.

Another important examination is the sputum culture, which is part of the national plan to end TB. Its broad achievement was established as one of the strategies for disease

control²². The studied IP did not have wide access to this test, which is worrying, since it provides bacteriological confirmation and has become a relevant tool in decision making in the treatment of the disease and in the detection of bacterial resistance²³.

The low performance of chest X-rays is also questioned, as they have been shown to be relevant in the diagnosis of pulmonary TB in the penitentiary environment^{6,24}. Therefore, access should be widely offered²⁵ as a screening for incoming prisoners and for the diagnosis of those who are already inmates²⁴.

Bi and multivariate analyzes indicate an association of AIDS with the outcomes, with greater proportions of abandonment in individuals with the disease. This relationship may be even more serious, according to a study published in 2017, which showed that a TB/AIDS co-infection can lead to death due to the health conditions of AIDS patients²⁶.

Another association found was HIV, corroborating other studies that affirm that a TB/HIV co-infection makes adherence to treatment difficult, which can cause abandonment^{18,27}.

Sputum bacilloscopy microscopy for diagnosis did not show a statistically significant association for the outcomes, but the exam is extremely important, as it allows for the diagnosis of bacilliferous patients, the main sources of disease transmission¹¹.

Follow-up sputum bacilloscopy showed a significant association in the bi and multivariate analyzes, especially when it was observed that the proportion of abandonment was higher in patients who did not undergo the exam. The MoH recommends a monthly examination to monitor the patient's bacillus load during treatment and points out that, in the incarceration environment, the exam is even more relevant, as it assesses the presence of bacilli and, consequently, the risk to patient contacts¹¹.

In addition to the disagreement with what is recommended by the Ministry of Health, this data may raise another important issue, that periodic examination is only possible when there is monitoring and a consequent bond with the patient, which should be performed by the PHT. The bond with patients provides the professional with signs presented by patients in relation to the possibility of abandoning treatment²⁸.

It is also necessary to reflect on whether there are enough health and safety professionals to offer a service that provides for the creation of bonds and monthly monitoring of the patient in the prison system. It is understood that the dynamics in prisons value the security of the incarcerated and health professionals, and therefore, they rely on the support of the penitentiary agents to move in the prison environment and to guide the incarcerated individuals to the prison units. In the case of IP, care and bonding become even more important, due to the patient's condition of vulnerability²⁹.

Monitoring during treatment needs to be carried out holistically by PHT, which, according to the National Policy for Comprehensive Health Care for Persons Deprived of Liberty in the Prison System (*Política Nacional de Atenção Integral à Saúde das Pessoas Privadas de Liberdade no Sistema Prisional* - PNAISP), must include multiple professionals that are trained to offer prevention and treatment actions for health problems²⁸. PNAISP also clarifies that the subject is in a situation of deprivation of liberty and not deprivation of the right to comprehensive health care^{30,31}.

Thus, it is necessary to build effective strategies that are capable of offering an integrated, humanized and quality form of care, prioritizing actions recommended in the fight against TB, and ensuring patients' rights and care for their health.

It is important to envision the condition of imprisonment for incarcerated individuals as a unique opportunity to intervene in the diagnosis and treatment of TB, mainly because TB is an infectious disease, so the idea is to reduce the burden of the disease inside and outside the prison units⁹.

The main limitation of this study was the use of secondary data. However, this type of data source becomes important, especially when working on a topic as complex as TB in the IP. Secondary data, if well analyzed, has advantages, mainly due to its high coverage and low cost¹⁰.

In addition, the definition of "follow-up bacilloscopy" adopted in the study may have influenced the results found, since there is the possibility that the subject may have abandoned treatment at any time, and it was not possible to perform at least two bacilloscopies.

The findings show that TB patients who are deprived of their liberty do not receive recommended interventions for early diagnosis, and, during the treatment of the disease, the bond between the team and the patient is superficial. The actions recommended by the Ministry of Health must be carried out by the PHT, which has professionals that are qualified for the management of the disease, such as doctors, nurses and nursing technicians.

The study contributes to the field by raising the discussion on the importance of follow-up bacilloscopy microscopy in prison units, in addition to demonstrating that monitoring and bonding during treatment are essential for achieving recovery. In this way, it contributes to the improvement of public health, with the reduction of the dissemination of the bacillus, and the control and fight against the disease in the prison system.

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