

# Factors Associated With Drug-resistant Tuberculosis in the Deprived Population in the State of Paraná – Brazil

**Márcio Souza Santos** (✉ [marciosouza@usp.br](mailto:marciosouza@usp.br))

University of São Paulo at Ribeirão Preto School of Nursing

**Flávia Meneguetti Pieri**

State University of Londrina

**Thaís Zamboni Berra**

University of São Paulo at Ribeirão Preto School of Nursing

**Alessandro Rolim Scholze**

University of São Paulo at Ribeirão Preto School of Nursing

**Antônio Carlos Vieira Ramos**

University of São Paulo at Ribeirão Preto School of Nursing

**Juliane Almeida Crispim**

University of São Paulo at Ribeirão Preto School of Nursing

**Clovis Luciano Giacomet**

University of São Paulo at Ribeirão Preto School of Nursing

**Yan Mathias Alves**

University of São Paulo at Ribeirão Preto School of Nursing

**Fernanda Bruzadelli Paulino Costa**

University of São Paulo at Ribeirão Preto School of Nursing

**Heriederson Savio Dias Moura**

University of São Paulo at Ribeirão Preto School of Nursing

**Títillade Kehinde Ayandeyi Teibo**

University of São Paulo at Ribeirão Preto School of Nursing

**Giselle Lima Freitas**

Federal University of Minas Gerais

**Ricardo Alexandre Arcêncio**

University of São Paulo at Ribeirão Preto School of Nursing

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## Research Article

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# Abstract

## Background

Tuberculosis remains a serious public health issue worldwide, affecting people in vulnerable situations. The study aimed to analyze factors associated with drug resistant tuberculosis among patients who were in prison in the state of Paraná.

## Method

An ecological study was carried out on Drug-Resistant tuberculosis cases registered through the Information System of Paraná, Brazil (from 2008 to 2018). Descriptive statistics of quantitative parameters was applied, being calculated with absolute frequencies. Additionally, binary logistic regression was performed, where the Odds Ratio was calculated with its respective confidence interval. The Akaike Information Criterion and the likelihood ratio tests, Wald test, Anova and Mc Fadden tests were performed to choose and validate the model. The IBM SPSS and Statistics version 25 and RStudio software version 4.0.4 were used for data analysis.

## Result

653 cases were registered as tuberculosis cases in prison, and among these, 98 cases were Drug-Resistant TB. The schooling level among the study population was 8 to 11 years of education (OR: 0.41, 95%CI: 0.16 – 0.93), negative culture (OR: 0.29, 95%CI: 0.09– 0.74) and smoking (0.02, 95%CI: 0.01 – 0.74) all these were factors associated with drug-Resistant TB. With the study population having the clinical pulmonary form (OR: 9.87, 95%CI: 1.55 – 23.81) and having a positive microscopy in the fourth month of follow-up (OR: 6.46, 95%CI: 1.04 – 53.79), it was more likely to develop resistance.

## Conclusion

The study showed that the variables; education, culture exam, smoking, pulmonary clinical form, and follow-up microscopy were associated with drug resistance in the treatment of tuberculosis.

# Introduction

Tuberculosis (TB) remains a serious public health issue worldwide due to its magnitude, transcendence, and strong social relationship, affecting people in vulnerable situations. According to data from the World Health Organization (WHO) TB is among the 10 leading causes of death worldwide and is the leading cause of death from a single infectious agent, surpassing the human immunodeficiency virus (HIV)/Syndrome of Acquired Immunodeficiency (Aids)<sup>1</sup>.

In Brazil, in 2017, nearly 70,000 new cases of TB were reported, which represented an incidence rate of 33.5 cases per 100,000 inhabitants. In the period from 2008 to 2017, an average annual drop of 1.6 was observed, however it is noteworthy that in 2017, 19 (70.4%) Brazilian capitals had an incidence rate higher than that recorded in the country<sup>2</sup>.

Drug-resistant tuberculosis (TBDR) is characterized by resistance to any of the drugs considered for the treatment of TB, when confirmed through the sensitivity test or rapid molecular test for tuberculosis (TRM-TB), which constitutes a serious threat to public health, making it even more difficult to control the disease and eliminate the disease<sup>3</sup>.

The TBDR is more frequent among groups in situations of social vulnerability, including the confined population, which is 28 times more likely to develop the disease when compared to the general population<sup>4</sup>. In recent years the proportion of active TB cases in this population has increased significantly, even surpassing the cases of TB-HIV co-infection<sup>5</sup>.

The emergence of TBDR cases is mainly related to the irregular use of medications and treatment defaults. According to the national guidelines, TB treatment for those who have not been treated previously consists of rifampicin, ethambutol and isoniazid for at least six months, and resistance to one of the first-line drugs requires replacement by second-line drugs and increased treatment time, which may predispose to abandonment<sup>3</sup>.

The treatment duration for TBDR has ranged between 18 to 24 months, which is three or four times longer compared to the treatment for sensitive cases, which often results in a worse outcome, such as failures or treatment interruption<sup>6-8</sup>. The TBDR is more present in socially vulnerable groups, including the Homeless Population and the People Deprived of Liberty (PDL), a study shows that developing TB in these populations is 28 times more likely compared to the general population<sup>4</sup>.

In Brazil, the problem of TB is not only in the detection of cases, but also in ensuring that these detected cases complete their treatment, with treatment success being around 71%, when the recommended rate is at least 85%<sup>9</sup>, which suggests that many people with TB are dropping out of treatment before completing it and therefore becoming vulnerable to developing TBDR.

In this context, it is worth highlighting the National Policy for Comprehensive Health Care for Persons Deprived of Liberty in the Prison System (PNAISP), established by inter-ministerial ordinance No. 1, of January 2, 2014, with the objective of expanding the health actions of the Unified System for PDL. Among the multiple guidelines of the PNAISP, a specific line of action for the control of TB was incorporated.

However, most studies in which TBDR is the study objective are carried out in the general population, with little emphasis on PDL, which reveals an important knowledge gap. The TBDR epidemic in PDL is considered hidden in many scenarios, which points to an important and necessary topic to be investigated for the advancement of knowledge in this area<sup>10</sup>.

Thus, the systematic monitoring of TBDR within prisons is essential to eliminate the possibilities of community transmission, in addition, knowing which factors are associated with this clinical condition is strategic in the sense of designing larger intervention policies and projects. Thus, the study aims to show which factors are related to TBDR among populations deprived of liberty in southern Brazil.

## Method

### Study setting

This is an ecological study carried out in the state of Paraná, which is one of the 27 federative units in Brazil, located in the southern region of Brazil. The state has a population of approximately 10 million inhabitants distributed in 399 municipalities, representing 4.5% of the Brazilian population<sup>11</sup>.

Regarding social indicators, the state of Paraná has the fifth highest Human Development Index (0.74) in the country, the fourth lowest illiteracy rate (0.52%) and the fourth lowest infant mortality rate (13.8 deaths/1,000 live births) among Brazilian federative units<sup>12</sup>.

The Paraná prison system is composed of 55 prison units distributed in nine regions of the State<sup>13</sup>. In the state of Paraná, the PDL comprises a total of 29,831 people while, according to the last survey available by the National Penitentiary Department carried out in 2019, the total number of PDL in Brazil is 748,009<sup>13</sup>.

In the State of Paraná, the PDL, in the year 2019, comprised a total of 29,831, which represents 3.98% of the national PDL, mostly male (94.66%), in a closed regime (62.20%) and with at least 1 child (65.0%). Regarding the available places, 20,740 (95.03%) for men and 1,084 for women (4.97%)<sup>13</sup>.

### Reference population

The study population consisted of sensitive TB cases and those bacteriologically confirmed for TBDR notified in the Notification Diseases Information System (SINAN) between 2008 and 2018, these data were available by the coordination of the Department's State Tuberculosis Control Program of Epidemiological Surveillance of the State Health Department of Paraná.

It is noteworthy that to compose the study population TB patients / cases were filtered "institutionalized" for reporting forms by the year 2015 and from 2015 as "prisoners". The inclusion criteria were TB cases in PDL, whose drug resistance confirmation was performed by means of sputum culture with positive sensitivity test and identification of resistant bacillus in Rapid Molecular Test, following the criteria established by the National Tuberculosis Control Program. The exclusion criteria were cases in which the notification had blank data<sup>14</sup>.

### Statistical analysis

Initially, consistency analysis of the database records was performed and descriptive analysis of the cases was applied to characterize the profile of the population studied, for which descriptive statistics and quantitative parameters were used, and absolute and relative frequencies were calculated using the IBM software SPSS Statistics version 25.

To identify the factors associated with TBDR in PDL, binary logistic regression was used based on the variables present in the SINAN notification form, where variables that could explain the variable of interest were chosen, the dependent variable being the occurrence of TBDR. and the selected independent variables were: sex, age, race/color, education, type of entry (new case, recurrence, re-entry after abandonment, don't know, post-death), clinical form, associated diseases (HIV, AIDS, alcoholism, diabetes, mental illness, use of illicit drugs, tobacco), clinical examinations performed (chest x-ray, culture, histopathology, bacilloscopy, sensitivity test or TRM-TB) and performance of directly observed treatment.

All selected independent variables were dichotomized (0 and 1) as well as the dependent variable (drug resistance) which was also dichotomized (0: sensitive TB; 1: TBDR). Then, the selected variables were tested for multicollinearity from the variance inflation factor, excluding those with an index greater than 10<sup>15</sup>. After the initial selection process of the independent variables, the Logistic Regression was conducted using the RStudio software version 4.0.4. The best model was chosen from the lowest values of the Akaike Information Criterion (AIC)<sup>16</sup>.

After exhausting all the possibilities of the analysis and arriving at the final model (smaller AIC), the likelihood ratio tests, Wald test, Anova and Mc Fadden were performed to validate the model. It is also noteworthy that for the final model with the best parameter of comparison, the calculation of the Odds Ratio (OR) and their respective 95%CI was performed for the statistically significant variables (p<0.05).

### Ethical aspects

The study was authorized by the Paraná State Health Department – SESA and approved by the Ribeirão Preto College of Nursing with the Certificate of Presentation for Ethical Appreciation (CAAE) n° 31631520.2.0000.5393. As it involved the use of secondary data, the study did not require the Informed Consent Term.

## Results

A total of 653 cases of TB were reported in adults deprived of their liberty during the study period, with a minimum age of 18 years and a maximum of 82 years of age, with a mean of 27 years and a median of 29 years of age. Of these reported cases, a total of 98 TBDR cases were observed, with a minimum age of 18 years and a maximum of 61 years of age.

The Table 1 shows the sociodemographic and clinical profile of TB cases in people deprived of liberty reported between 2008 and 2018 in the state of Paraná, Brazil. The highest percentage affected males (n=639; 97.9%), in people of white race/color (n=438; 67.1%), with incomplete 5th to 8th grade (n=256; 39.2 %) and of the total of 14 women, none was pregnant at the time of diagnosis.

Table 1  
– Sociodemographic and clinical profile of tuberculosis cases in adults deprived of liberty reported between 2008 and 2018 in the State of Paraná, Brazil.

Variables	TBDR (n=98)		TB-SENSITIVE (n=555)		TOTAL (n=653)	
	n	%	n	%	N	%
<b>Age (Years old)</b>						
18 - 29	64	65.31	329	59.28	393	60.18
30 - 59	33	33.67	220	39.64	253	38.74
60 or more	1	1.02	6	1.08	7	1.07
<b>Sex</b>						
Masculine	97	98.98	542	97.66	639	97.86
Feminine	1	1.02	13	2.34	14	2.14
<b>Breed</b>						
White	58	59.18	380	68.47	438	67.08
Black	14	14.29	39	7.03	53	8.12
Yellow	0	0.00	3	0.54	3	0.46
Brown	25	25.51	130	23.42	155	23.74
Indigenous	0	0.00	1	0.18	1	0.15
Ignored	1	1.02	2	0.36	3	0.46
<b>Education</b>						
No education	1	1.02	9	1.62	10	1.53
1st to 4th grade incomplete	9	9.18	48	8.65	57	8.73
4th grade complete	7	7.14	53	9.55	60	9.19
5 th to 8th grade incomplete	37	37.76	219	39.46	256	39.20
Complete primary education	11	11.22	64	11.53	75	11.49
Incomplete high school	6	6.12	51	9.19	57	8.73
Complete high school	4	4.08	33	5.95	37	5.67
Incomplete higher education	0	0.00	2	0.36	2	0.31
Complete higher education	0	0.00	1	0.18	1	0.15
Ignored	23	23.47	75	13.51	98	15.01
<b>Input Type</b>						
New case	80	81.63	483	87.03	563	86.22
Relapse	10	10.20	41	7.39	51	7.81
Re-entry after abandonment	7	7.14	28	5.05	35	5.36
Do not know	1	1.02	1	0.18	2	0.31
Post-death	0	0.00	2	0.36	2	0.31
<b>Clinical Form</b>						
Pulmonary	97	98.98	514	92.61	611	93.57
Extrapulmonary	0	0.00	24	4.32	24	3.68
Pulmonary + Extrapulmonary	1	1.02	17	3.06	18	2.76
Source: Author himself.						

Regarding the clinical profile of TB, most cases were characterized by being new (n=563; 86.22%); mostly in the pulmonary form (n=611; 93.57%) and had the outcome of cure (n=434; 66.46%).

Regarding the characteristics of the cases enrolled in the study, few participants had Aids (n=35; 5.36%), TB-Diabetes co-infection (n=10; 1.53%), and self-reported to have alcoholism (n=85; 13.02%) or mental illness (n=6; 0.92%). It is noteworthy that most adults deprived of liberty had smoking as a problem (n=328; 50.23%) (Table 2).

Table 2  
– Risk factors for tuberculosis in adults deprived of liberty reported between 2008 and 2018 in the State of Paraná, Brazil.

Variables	TBDR (n=98)		TB-SENSITIVE (n=555)		N TOTAL (n=653)	
	N	%	n	%	N	%
<b>Aids</b>						
Yes	3	3.06	32	5.77	35	5.36
No	86	87.76	499	89.91	585	89.59
Ignored	9	9.18	24	4.32	33	5.05
<b>Alcoholism</b>						
Yes	14	14.29	71	12.79	85	13.02
No	74	75.51	457	82.34	531	81.32
Ignored	10	10.20	27	4.86	37	5.67
<b>Diabetes</b>						
Yes	1	1.02	9	1.62	10	1.53
No	88	89.80	518	93.33	606	92.80
Ignored	9	9.18	28	5.05	37	5.67
<b>Mental disease</b>						
Yes	1	1.02	5	0.90	6	0.92
No	88	89.80	524	94.41	612	93.72
Ignored	9	9.18	26	4.68	35	5.36
<b>Illicit drugs</b>						
Yes	40	40.82	279	50.27	319	48.85
No	38	38.78	266	47.93	304	46.55
Ignored	20	20.41	10	1.80	30	4.59
<b>Smoking</b>						
Yes	43	43.88	285	51.35	328	50.23
No	37	37.76	263	47.39	300	45.94
Ignored	18	18.37	7	1.26	25	3.83
Source: Own authorship						

Table 3 evidences that most cases had suspected TB x-ray (n=504; 77.18%), sputum smear microscopy (n=423; 64.78%) and positive sputum culture (n=456; 69.83%), underwent directly observed treatment (n=615; 94.18%) and showed resistance to the Isoniazid medication (n=85; 13.02%), identified from the sensitivity test.

Table 3  
 – Characteristics regarding the diagnosis of tuberculosis in adults deprived of liberty notified for tuberculosis between 2008 and 2018 in the State of Paraná, Brazil.

Variables	TBDR (n=98)		TB-SENSITIVE (n=555)		TOTAL (n=653)	
	n	%	n	%	n	%
<b>X-ray</b>						
Suspect	70	71.43	434	78.20	504	77.18
Normal	3	3.06	11	1.98	14	2.15
Unrealized	25	25.51	109	19.64	134	20.52
Ignored	0	0.00	1	0.18	1	0.15
<b>Sputum Culture</b>						
Positive	84	85.71	372	67.03	456	69.83
Negative	5	5.10	85	15.31	90	13.78
In progress	3	3.06	12	2.16	15	2.30
Not performed	6	6.11	86	15.50	92	14.09
<b>HIV</b>						
Positive	3	3.06	32	5.77	35	5.36
Negative	93	94.90	485	87.38	578	88.52
In progress	1	1.02	3	0.54	4	0.61
Not performed	1	1.02	35	6.30	36	5.52
<b>Histopathology</b>						
BAAR Positive	3	3.06	23	4.14	26	3.98
Suggestive of TB	2	2.04	14	2.52	16	2.45
Not suggestive of TB	0	0.00	1	0.18	1	0.15
In progress	0	0.00	4	0.72	4	0.61
Unrealized	89	90.82	505	90.99	594	90.96
Ignored	4	4.08	8	1.44	12	1.84
<b>Immigrant</b>						
Yes	0	0.00	3	0.54	3	0.46
No	81	82.65	550	99.10	631	96.63
Ignored	17	17.35	2	0.36	19	2.91
<b>Receive government benefit</b>						
Yes	1	1.02	10	1.80	11	1.68
No	75	76.53	525	94.59	598	91.58
Ignored	22	22.45	20	3.60	44	6.74
<b>Teste molecular rápido</b>						
Sensitive to Rifampicin	43	43.88	428	77.12	471	72.13
Resistant to Rifampicin	18	18.37	6	1.08	24	3.68
Undetectable	1	1.02	47	8.47	48	7.35
Ignored	22	20.41	20	3.60	44	6.74
Unrealized	16	16.33	1	0.18	17	2.60
<b>Sensitivity test</b>						
Resistant to Isoniazid only	53	54.08	32	5.77	85	13.02
Source: Author himself.						

	TBDR (n=98)		TB-SENSITIVE (n=555)		TOTAL (n=653)	
Resistant only to Rifampicin	3	3.06	0	0.00	3	0.46
Resistant to Isoniazid and Rifampicin	4	4.08	1	0.18	5	0.77
Resistant to other first-line drugs	5	5.10	2	0.36	7	1.07
Sensitive	8	8.16	304	54.77	312	47.78
In progress	0	0.00	10	1.80	10	1.53
Unrealized	5	5.10	55	9.91	60	9.19
Ignored	20	20.41	151	27.21	171	26.19
<b>Antiretroviral therapy</b>						
Positive	1	1.02	28	5.05	29	4.44
Negative	93	94.90	493	88.83	586	89.74
Ignored	4	4.08	34	6.13	38	5.82
<b>Transfer</b>						
Diferent state	2	2.04	10	1.80	12	1.84
Source: Author himself.						

Using logistic regression, as shown in Table 4, it was possible to identify that having an education between 8 and 11 years (OR: 0.41; IC95%: 0.16 – 0.93), not using tobacco (OR: 0.02; IC95%: 0.01 – 0.06) and negative sputum culture (OR: 0.29; IC95%: 0.09 – 0.74) were negatively correlated with the outcome of interest, that is, these are factors that can be considered as protection against TBDR.

The independent pulmonary clinical form variables (OR: 9.87, 95%CI: 1.55 – 23.81) and positive bacilloscopy in the fourth month of follow-up (OR: 6.45, 95%CI: 1.04 – 53.79) showed a positive correlation with the event of interest, that is, people with these characteristics and deprived of liberty are 9.87 and 6.45 more likely to get sick from TBDR.

Table 4  
– Explanatory model for drug-resistant tuberculosis in the population deprived of liberty in the state of Paraná, Brazil.

	Coefficient	Pr(> z )	Odds Ratio (95%CI)
Education: 8 to 11 years of study	-0.87	0.04	0.41 (0.16 – 0.93)
Clinical form: Pulmonary	2.28	0.05	9.87 (1.55 – 23.81)
Not to use tobacco	-3.84	<0.01	0.02 (0.01 – 0.06)
Negative sputum culture	-1.20	0.01	0.29 (0.09 – 0.74)
Positive bacilloscopy in the 4th month of treatment	1.86	0.05	6.45 (1.04 – 53.79)
Source: own authorship			

AIC: 476,43; pseudo R<sup>2</sup> (McFadden): 0,21.

## Discussion

The present study aimed to highlight the factors associated with TBDR in PDL in the state of Paraná, and it was identified, after conducting logistic regression, that schooling between 8 and 11 years of study (OR: 0.41, 95%CI: 0.16 - 0.93), having a negative sputum culture (OR: 0.29, 95%CI: 0.09–0.74) and not smoking (OR: 0.02, 95%CI: 0.01–0.74) are factors associated with a lower chance of developing TBDR, whereas pulmonary clinical form (OR: 9.87, 95%CI: 1.55 – 23.81) and positive bacilloscopy in the fourth month of follow-up (OR: 6.46, 95%CI: 1.04 – 53.79) were considered as factors associated with a higher chance of development of TBDR.

When the educational level has been evaluated, it was evidenced that the higher the level of education, the lower the chance for the development of TBDR. Since, the educational level directly implies self-care with health, and low education can make the individual more prone to risky behaviors and reduce their perception and self-care in relation to their clinical status, in addition to being associated with possible treatment failure, thus allowing the possibility of drug resistance, abandonment and death from TB<sup>17</sup>.

The educational level directly implies self-care with health, since low education can make the individual more prone to risky behaviors and thus reduce their perception of their clinical status, in addition to being associated with possible treatment failures, increasing possibility of drug resistance<sup>17</sup>.

In this perspective, a low level of education (less than eight years of schooling) has been associated with a higher risk of dropping out during TBDR treatment, and in turn this is associated with a set of precarious socioeconomic conditions<sup>18</sup>.

The population of the Brazilian prison system is considered, for the most part, young and with low access to education, since just over 10% of the PDL attend educational activities, whether for schooling, professional training, income generation, culture or sport<sup>19</sup>.

The literature highlights how factors that increase the risk of contracting TB are the unhealthy habits and lifestyle of this population, such as using illegal drugs, alcohol, tobacco, malnutrition and even other pathologies, which corroborates the findings of this study, since not using tobacco was characterized as a lower chance of developing TBDR<sup>20</sup>.

From this perspective, according to epidemiological data, the relationship between using illicit drugs and having TB is increasing, evidencing a public health problem. A research carried out in a university hospital in São Paulo showed that patients who drink alcohol, smokers and those who use illicit drugs fail to undergo TB treatment more often than those who did not have any of these risk factors<sup>21</sup>, increasing the likelihood of progressing to drug resistance for TB. The clinical pulmonary form was the most prevalent, which may hypothesize that it is the form that mostly causes drug resistance. However, if considered that in the cases included in this study, it was observed that 98.98% among the reported cases had this clinical form, it is expected that most cases of drug resistance present this form of TB.

As for the sputum culture, when a person is positive, it allows to state that this person supports the TB transmission chain, that is, he can infect about 10 to 15 people during a period of one year, which increases the concern when we are talking about those deprived of liberty living in overcrowded places, besides this person can directly transmit the resistant form of TB<sup>3</sup>.

It is known that sputum smear microscopy is a simple, safe method, used all over the world and has a low cost<sup>22</sup>. Given the above, it is expected that those who have a negative sputum culture have less chance of developing TBDR, whereas having a positive bacilloscopy in the 4th month of treatment represents a threat, as it indicates that the drugs used did not have the expected effect and thus, did not interrupt the chain of transmission and increases the chance of developing TBDR.

Furthermore, with regard to the PDL, it is worth noting that the Brazilian prison system was regulated in 1984 and since then it has brought debates about fundamental rights. In this perspective, the increase in the number of people deprived of liberty is a reality in Brazil, since in December 2017, the country had the third largest prison population in the world, with a predominance of black people with low education, with 88% not having completed high school<sup>19</sup>.

It is noteworthy that the structural conditions in prisons are crucial for the health-disease process of PDL. The environment is hostile and unhealthy, which enables the occurrence and spread of different diseases, including TB, as well as enhancing the possibility of the development of TBDR<sup>23</sup>.

This reality is also present in other countries, since TB in PDL is a global problem, especially in developing countries. Unhealthy conditions, inadequate treatment for TB, poor ventilation, overcrowding, lack of sun with consequent vitamin D deficiency, among other aspects, negatively contribute to the spread and permanence of the disease in this population<sup>10, 24</sup>.

The inadequate treatment of TB, carried out inside the prisons, exposes the other people who live with the PDL, be they the workers as well as the visitors themselves, increasing the transmission chain. Thus, in addition to enhancing the transmission of the disease, it increases the possibility of transmitting TB already in its resistant form, which ends up hindering the treatment and consequently the control of the disease, making it impossible to reach the third objective for sustainable development in its sub-item 3.3 of the 2030 agenda proposed by the United Nations, which is to end epidemics, including TB<sup>10, 25</sup>.

Since 2000, Brazil has had on average, an annual growth rate of its prison population of 7.14%, Paraná concentrates 6.88% of the country's prison population (Brasil, 2017). The occupancy rate, which is calculated by the ratio between the total numbers of people deprived of liberty and the number of spaces in the prison system. In June 2017 in Brazil, a rate of 171.62% was recorded and the crime of theft and drug trafficking represent the majority of reasons for deprivation of liberty<sup>19</sup>.

With the growth of this population, the implementation of the National Tuberculosis Program in prisons becomes increasingly important, since the actions proposed by the Ministry of Health are partially applied<sup>26</sup>.

TB is a disease that has treatment and cure, however, the patient must commit to the treatment until the end, as well as, that the State guarantees the effective treatment through directly observed treatment<sup>3,7-8,10,20</sup>. Thus, one of the reasons for the high mortality rate from TB would be the lack of patient adherence to treatment, which also increases the incidence and appearance of multidrug-resistant bacilli<sup>24, 27</sup>.

The delay in the diagnosis of the disease is generally related to the naturalization of the lack of assistance to PDL, the interpretation of the prison as a place of "death" and "suffering" and the deprivation of the right to health for the PDL due to its position before society, which highlights the inequity of access to

health care for this population group<sup>28-29</sup>. Thus, this context points to another major challenge in disease control, which is the need for changes in the conceptions of the right to health within prison units<sup>20</sup>.

The invisibility of this population by the state, the low concern with re socializing, as they are a neglected population, mostly with low income and education, living in poverty, living in precarious conditions in overcrowded prisons, suffering prejudice and being absent of effective public policies is the reason that this and other diseases prevail within prison systems, being a national public health problem that ends up infringing the Federal Constitution itself<sup>23,30</sup>.

Considering that the study showed positive microscopy in the fourth month of treatment as a factor associated with TBDR and the habit of not smoking and the presence of negative culture as protective factors, it is essential to develop public policies aimed at this population. It is suggested to invest in improving health conditions in the prison system, promoting healthy lifestyle/behavior and monitoring symptomatic respiratory diseases. For strategic monitoring in the admission of the deprived of liberty, active case finding for diseases, in addition to TB, should be intensified, treating this disease as a priority, bringing the State's responsibility and the importance of using strategies so that the PDL can be a priority. Building life projects, providing the reduction of social inequality is also important.

It is noteworthy that the study has limitations related to data collected from the SINAN of the State of Paraná, since the data may suffer from underreporting, mainly due to the diagnostic difficulty involved in TBDR, caused, for example,, due to the lack of indication of patients for sensitivity tests, as well as the difficulty in collecting blank information in the database and the impossibility of knowing and evaluating the history of previous treatment for TB.

## Conclusion

From the results, factors associated with TBDR were evidenced, which are public health problems and that contribute to the permanence of this disease. There is a need for advances to improve the public health care network, from the perspective of tuberculosis surveillance, so that there is continuous improvement of health surveillance in the country, such as the systematic use of bacilloscopy throughout treatment, an important predictor to predict the occurrences of TBDR.

For this, the importance of building feasible policies with the reality of penitentiaries is highlighted, considering all aspects that permeate it, without forgetting the inequity of access to health due to the naturalization of the lack of care, as well as the indifference and the position generated facing society.

## Abbreviations

AIC  
Akaike Information Criterion  
Aids  
Syndrome of Acquired Immunodeficiency  
BAAR  
Alcohol-Acid Resistant Bacillus  
CAAE  
Certificate of Presentation for Ethical Appreciation  
HIV  
human immunodeficiency virus  
OR  
Odds Ratio  
PNAISP  
National Policy for Comprehensive Health Care for Persons Deprived of Liberty in the Prison System  
PPL  
People Deprived of Liberty  
SINAN  
Notification Diseases Information System  
TB  
tuberculosis  
TBDR  
Drug-resistant tuberculosis  
TRM-TB  
test or rapid molecular test for tuberculosis  
WHO  
World Health Organization  
95%CI  
95% Confidence interval.

## Declarations

**Ethics approval and consent to participate:**

All methods were carried out in accordance with the relevant guidelines and regulations and that compliance with Resolution 499/2012 of the National Health Council, the study was approved by the Research Ethics Committee of the Nursing College of Ribeirão Preto, University of São Paulo under the Certificate of Ethical Appraisal number 359 31631520.2.0000.5393 issued on July 14, 2020.

**Consent for publication:**

Not applicable.

**Availability of data and materials:**

The data were obtained from the Epidemiological Surveillance Sector of the State Health Department Paraná, Brazil. Data were provided for the survey but are not publicly available; data can be made available upon request to the Epidemiological Surveillance Sector of the State Health Department Paraná. The data is anonymized, that is, it was not possible to identify who were the people who were notified.

**Competing interests:**

The authors declare that they have no competing interests.

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**Authors' contributions:**

MSS, FMP and RAA participated in the conception of the project, as well as the analysis and interpretation of the data and the wording of the article; TZB, ARS, ACVR and JAC participated in the analysis and interpretation of the data and also a relevant critical review of the intellectual content. CLG, YMA, FBPC, HSDM, TKAT and GLF participated in drafting the manuscript and the relevant critical review of the intellectual content. All the authors have read and approved the final manuscript.

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