







ORIGINAL ARTICLE

Factors associated with tuberculosis and human immunodeficiency virus co-infection in vulnerable populations

HIGHLIGHTS

1. Living on the streets is associated with TB/HIV co-infection.
2. People over 50 have a protective factor for TB/HIV.
3. Drug use was a risk factor for TB/HIV coinfection.

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ABSTRACT

Objective: To identify factors associated with tuberculosis and HIV co-coinfection in homeless people and those deprived of their liberty in Belo Horizonte, Minas Gerais, Brazil. **Method:** a cross-sectional, analytical study using data from the Notifiable Diseases/Tuberculosis Information System of Belo Horizonte, 2015 to 2022. The sociodemographic and clinical data of homeless people and people deprived of their liberty were described. Poisson regression was used to analyze the associated factors. **Results:** Drug use was a risk factor for coinfection in the street population. Being over 50 contributed 61% to this population's reduced coinfection. The study did not show factors associated with coinfection in people deprived of liberty. **Conclusion:** The study identified the factors that increase the vulnerability of homeless people, thus helping to guide care for this young, drug-using population.

DESCRIPTORS: Tuberculosis; Human Immunodeficiency Virus; Prisoners; Homeless; Vulnerability.

HOW TO REFERENCE THIS ARTICLE:

Silva VLC, de Souza TR, de Oliveira BCV, de Araújo KP, Arcêncio RA, de Freitas GL. Factors associated with tuberculosis and human immunodeficiency virus co-infection in vulnerable populations. Cogitare Enferm [Internet]. 2025 [cited "insert year, month and day"];30:e98815. Available from: <https://doi.org/10.1590/ce.v30i0.98815>

INTRODUCTION

Tuberculosis (TB) is an infectious and transmissible disease caused by the bacterium *Mycobacterium tuberculosis*, which is still considered a significant public health problem¹ and is the leading cause of death among infectious diseases². It is estimated that, in 2020, TB affected around 9.9 million people worldwide and was responsible for 1.3 million deaths³. TB is the ninth leading cause of death globally and mainly affects people infected with the Human Immunodeficiency Virus (HIV). It represents the leading cause of death among people living with HIV (PLHIV) since these individuals are 28 times more likely to develop the active form of TB than the general population^{2,4-5}.

In Brazil, 68,271 new cases of TB were reported in 2021, equivalent to 32 cases per 100,000 inhabitants³. In Minas Gerais, 3,365 new disease cases were reported in 2020⁶. The metropolitan region of Belo Horizonte (MG) concentrates approximately one-third of the state's cases⁶.

TB infection is influenced by social and biological factors⁷. Social factors are directly related to the Social Determinants of Health (SDH), which trigger or favor the conditions that increase the risk of becoming ill with TB⁷. On the other hand, biological factors are related to conditions that lead to a reduced immune response, as observed in HIV-infected patients, which characterizes TB/HIV coinfection.

TB is more frequent in vulnerable populations, such as homeless people (HP) and people deprived of their liberty (PDL). HP are 56 times more likely to fall ill with TB, while PDLs are 28 times more likely than the general population¹. Worsening social and economic conditions result in deteriorating living conditions, increasing the vulnerability of these individuals and, consequently, the risk of TB/HIV coinfection⁸.

Vulnerable populations with TB/HIV coinfection are exposed to living conditions that make access to healthcare difficult, which impacts diagnosis and adherence to treatment⁷. This data analysis is considered relevant for implementing public policies for these populations and guiding the actions of students and health professionals who will work directly with the target audience. Considering the relevance of TB/HIV coinfection and its social and economic repercussions, this study aims to identify factors associated with TB and HIV coinfection in HP and PDL in Belo Horizonte, Minas Gerais, Brazil.

METHOD

This is a cross-sectional, analytical study with a quantitative approach. The study is the municipality of Belo Horizonte, capital of the state of Minas Gerais, with an estimated population of 2,530,701 inhabitants⁹. According to the 2019 Health Surveillance Bulletin, 530 new cases of TB were reported in the municipality in 2017, corresponding to 15% of the total cases in the state of Minas Gerais. The incidence for all forms of the disease was 21.0/100,000 inhabitants and 16.9/100,000 inhabitants. In 2018, there was an increase of 0.4% for all forms, although this was approximately 40% lower than the incidence in Brazil. There was also a reduction of 0.6% for bacilliferous cases.

The study population consisted of 5,153 TB cases notified of the Notifiable Diseases Information System (SINAN) between 2015 and 2022. Only confirmed cases of pulmonary TB in the HP and PDL were considered. By exclusion criteria, cases in children under 18 and inconsistencies were removed, such as the fact that the Acquired Immunodeficiency

Syndrome (AIDS) field, which is an associated condition, must be marked as “yes” in the case of HIV positivity. We also excluded duplicate cases and people marked as PDL and HP. Questions without answers were considered *missing* in the analysis.

The data analyzed is secondary and was provided by the Belo Horizonte Municipal Health Department through the SINAN notification forms. The data from the notification form considered variables in the study were sociodemographic and clinical data.

The sociodemographic data were: gender (male and female); age 18 to 29, 30 to 39, 40 to 49 and over 50; race/color (white and non-white — brown, black, yellow and indigenous); education — less than nine years of study and over nine years of study; and government beneficiary (yes or no), considered only for the PSR. Clinical variables were considered: alcoholism, smoking, mental illness, use of illicit drugs, and whether they had any other health problems. TB/HIV coinfection was considered the study's dependent variable.

A descriptive analysis was carried out of the sociodemographic and clinical profile of TB cases in people over 18, classified as HP or PDL. The data was exported electronically to *Microsoft Office Excel®* spreadsheets. The sociodemographic and clinical profile of the cases was calculated using these variables' absolute and relative (percentage) frequencies.

The data were analyzed using the *Statistical Package for Social Science (SPSS) software*, version 23.0. The chi-square test was used for dichotomous variables and the likelihood ratio test for polytomous variables. In addition, the adjusted standardized residuals were analyzed for the variables on which the likelihood ratio test was carried out. This analysis indicated which specific categories of variables are statistically significant because they have a value that deviates from the expected value. Significance is considered when the adjusted residual is >1.96 OR <-1.96 ¹⁰. After the bivariate analysis, Robust *Poisson* Regression was performed with the sociodemographic and clinical variables with a p-value of <0.2 . A statistically significant difference was considered when the variable had a p-value of <0.05 ¹¹. It is worth noting that only in the HP were there variables with $p<0.2$. Robust *Poisson* Regression was not carried out for PDL due to the low prevalence (13%).

The ethical aspects of the research are under Resolution 466/12 of the National Health Council (CNS, in Portuguese), which sets out the rules for research involving human beings. Certificate of Submission for Ethical Appraisal (CAAE, in Portuguese) 16114619.6.0000.5149 and opinion 3.508.404.

RESULTS

Between 2015 and 2022, 5,153 cases of pulmonary TB were registered in Belo Horizonte. Of these, 106 were PDL, and 14 were marked as positive for HIV. In HP, the total number of cases was 535, and 128 had TB/HIV coinfection. TB/HIV coinfection in PDL was prevalent in the 30-39 age group (26.7%), in males (11.8%), among self-declared blacks (13.4%), and those who used tobacco (17.4%), as shown in Table 1.

Table 1. Sociodemographic and clinical profile of TB cases with and without HIV in PLL in Belo Horizonte, 2015 to 2022. Belo Horizonte, MG, Brazil, 2023

	TB/HIV coinfection				p-value
	Yes		No		
	n	%	n	%	
Age					
18 to 29	4	8	46	92	0.113 ^b
30 to 39	8	26.7	22	73.3	
40 to 49	1	7.7	12	92.3	
Above 50	1	7.7	12	92.3	
Gender					
Female	3	23.1	10	76.9	0.262 ^a
Male	11	11.8	82	88.2	
Race					
White	3	16.7	15	83.3	0.576 ^a
Not White	11	13.4	71	86.6	
Education					
Over 9 years of education	3	21.4	11	78.6	0.421 ^a
Less than 9 years of education	3	18.75	13	81.25	
Alcoholism					
No	8	16.3	41	83.7	0.526 ^a
Yes	6	22.2	21	77.8	
Diabetes					
No	14	17.7	65	82.3	0.356 ^a
Yes	0	0	4	100	
Mental Illness					
No	14	19.2	59	80.8	0.237 ^a
Yes	0	0	6	100	
Drugs					
No	6	14	37	86	0.750 ^a
Yes	5	16.7	25	83.3	
Tobacco					
No	5	13.9	31	86.1	0.667 ^a
Yes	8	17.4	38	82.6	
Other ailments					
No	8	16.7	40	83.3	0.874 ^a
Yes	1	14.3	6	85.7	

Note: a Pearson's Chi-squared test; b Likelihood ratio test.

Source: The authors (2023).

In HP, TB/HIV coinfection was prevalent in the 30-39 age group (32.1%), in females (35.4%), in people with less than nine years of education (22.6%), without government assistance (23.4%) and self-reported use of tobacco (25.3%), drugs (30.6%) and alcohol (25.7%), as shown in Table 2.

Table 2. Sociodemographic and clinical profile of TB cases with and without HIV in HP in Belo Horizonte, 2015 to 2022. Belo Horizonte, MG, Brazil, 2023

	TB/HIV coinfection				p-value	RP	CI 95%
	Yes		No				
	n	%	n	%			
Age							
18 to 29	20	33.3	40	66.7	0.001^b	1.598	1.025-2.492
30 to 39	50 ¹	32.1		67.9			
40 to 49	44	20.9		79.1			
Above 50	14 ²	13	94	87			
Gender							
Female		35.4	51	64.6	0.009^a		0.216 - 0.309
Male		21.9		78.1			
Race							
White	10	17.9	46	82.1	0.197 ^a		
Not White		25.8		74.2			
Education							
Over 9 years of education	9	31	20	69	0.351 ^a		
Less than 9 years of education	24	22.6	82	77.4			
Government beneficiary							
No	33	23.4		76.6	0.569 ^a		
Yes	6	18.8	26	81.3			
Alcoholism							
No	19	18.8	82	81.2	0.153 ^a		
Yes	93	25.7		74.3			
Diabetes							
No		26.1		73.9	0.123 ^a		
Yes	5	14.3	30	85.7			
Mental illness							
No	91	25.6		74.4	0.493 ^a		
Yes	11	21.2	41	78.8			
Drugs							
No	19	12.8		87.2	0.000^a	2.38	1.511 - 3.749
Yes		30.6		69.4			
Tobacco							
No	29	19.2		80.8	0.154 ^a		
Yes	71	25.3		74.7			
Other ailments							
No	56	22.5		77.5	0.256 ^a		
Yes	3	12.5	21	87.5			

Note: ^a Pearson's Chi-square test; ^b Likelihood ratio test; ¹ Adjusted residual >1.96; ² Adjusted residual <-1.96.

Source: Elaborated by the authors (2023).

The analysis of factors associated with TB/HIV coinfection in PDL in this study showed no significant associations with the sociodemographic and clinical variables considered. Poisson regression with robust variance was used to identify the characteristics associated with the prevalence of TB/HIV coinfection in PDL. This regression was used since the outcome was frequent in the sample studied (23.9%; n=128). Through multivariate analysis of sociodemographic variables, being over 50 proved to be a protective factor in 61% (95% CI: 0.1659–0.919) of the reduction in TB/HIV coinfection. Education level and gender were not statistically associated with coinfection ($p>0.05$) in this model (Table 3).

Table 3. Sociodemographic characteristics associated with the prevalence of TB/HIV co-infection in Belo Horizonte's HP, 2015 to 2022. Belo Horizonte, MG, Brazil, 2023

	RP	IC 95%	p-valor
Age			
18 to 29	1	1	1
30 to 39	1.056	0.598 - 1.865	0.850
40 to 49	0.657	0.357 - 1.210	0.178
Above 50	0.390	0.1659 - 0.919	0.031
Gender			
Female	1	1	1
Male	0.673	0.433 - 1.047	0.079
Race/Color			
White	1	1	1
Not White	1.756	0.768 - 4.017	0.182

Elaborated by the authors (2023).

The multivariate analysis of the clinical variables indicated that the use of illicit drugs increased the prevalence of coinfection by 2.55 times (95% CI: 1.537–4.235). Tobacco use, alcoholism, and diabetes were not statistically associated with coinfection ($p>0.05$) in this model, as shown in Table 4.

Table 4. Clinical characteristics associated with the prevalence of TB/HIV co-infection in the PSRs of Belo Horizonte, 2015 to 2022. Belo Horizonte, MG, Brazil, 2023

	PR	CI 95%	p-value
Alcoholism			
No	1	1	1
Yes	1.241	0.719 - 2.144	0.438
Drugs			
No	1	1	1
Yes	2.296	1.347 - 3.913	0.002
Diabetes			
No	1	1	1
Yes	0.216	0.177 - 1.480	0.512
Tobacco			
No	1	1	1
Yes	0.905	0.572 - 1.432	0.670

Source: Elaborated by the authors (2023).

DISCUSSION

During the analysis period, 106 cases of TB were recorded among the PDL, of which only 14 were recorded as TB/HIV coinfection. Drug use, in turn, was a factor associated with TB/HIV coinfection in the HP, with a prevalence ratio 2.55 times higher among drug users compared to non-users. The age factor, referring to people over 50, was a protective factor for coinfection, contributing 61% to the reduction in cases compared to younger people.

Considering the difficulties faced by vulnerable groups in accessing health and social care services, as well as the presence, relevance, and impact of TB on these groups, which has repercussions on diagnosis and, especially, on adherence to treatment. This study highlights the need for guidance on care for young drug users who are homeless.

The study was conducted with 20 individuals, including homeless people and those leaving the prison system, in Porto Alegre (RS). The results indicated that people coinfecting with TB/HIV had characteristics that were considered determining factors in the process of becoming ill with TB associated with HIV, especially coming from disadvantaged population groups. They were marked by poverty and the violation of fundamental rights to achieve a dignified human condition¹². This data corroborates the historical fight against TB, which is included among the list of neglected diseases, with 95% of cases occurring in low- and middle-income countries².

The literature indicates that the potential for TB transmission is increased in collectivities such as prison systems¹³. Due to factors such as the high prevalence of HIV infection among incarcerated individuals, overcrowding, poor nutrition, unsanitary conditions, prolonged detention without adequate ventilation, and limited access to health care⁷. PDL experience situations of social vulnerability when subjected to risks related to lack of social and educational coverage and lack of access to health services and actions¹⁴. Therefore, these social determinants impact the quality of life and health of these individuals and lead to the occurrence of infectious diseases such as TB and HIV, causing illness or death¹⁴.

In this study, the sociodemographic characteristics of the PDL were age between 18 and 29 years, male gender, non-white race, and low education level. And, as a clinical characteristic, tobacco use stood out for the majority. Although the variables analyzed were not considered to be associated with TB/HIV coinfection in PDL, it is acknowledged that the small sample may have contributed to this finding. Attention to the public is suggested since the greater vulnerability of PDL to TB and TB/HIV coinfection itself is recognized in the literature as a public health problem¹⁴.

The sociodemographic characteristics prevalent in the HP in this study were ages between 40 and 49, male gender, non-white race/color, low schooling, and not receiving government aid. The clinical ones were alcoholism, illicit drug use, and tobacco use. Of these, age (under 50) and drug use were statistically associated with the prevalence of coinfection in this population.

The literature reports that the profile of those affected by TB and HIV is younger. This is a critical determinant that leads to a greater risk of staying in crowds and greater sexual exposure without the proper use of preventive measures². In this study, HP aged over 50 had a protective factor for TB/HIV coinfection.

The use of drugs by HP may be related to the need to stay in the different public spaces and to cope with the situation¹². A systematic review that aimed to compile the vulnerability factors associated with TB and TB/HIV coinfection in HP identified the use of illicit drugs, alcohol, and tobacco as factors that lead to vulnerability. They are related to the stigma of addiction, the desire to escape from reality, and the desire to improve general well-being. This also contributes to the interruption of TB treatment.^{2,15}

In this context, the use of psychoactive substances can have unique meanings in the lives of these individuals. They can relieve the streets' tensions, soothe the cold, reduce hunger, minimize anguish and sadness, and help with physical regulation, such as sleeping and having sex¹⁶. Other studies have also shown that the use of alcohol and other drugs by HP becomes an escape valve or shield against the challenging conditions of the street¹⁷.

The need to use drugs must be analyzed in the biological, psychosocial, and sociocultural context in which the individual is living. This is especially true for vulnerable groups, such as HP, because the effects of drugs are also associated with these contexts. Understanding the social mechanisms and lived experiences surrounding the use of drugs by this population helps to know how the vital role of drugs has been constructed in the lives of these people. It also helps to find ways of solving or preventing the risk factors for consumption, or reducing the damage caused by this invisibility and exclusion¹⁷.

Substance use has the potential to further aggravate the condition of HP due to the precariousness and social exclusion to which they are subjected, making them, in some cases, a marginalized and invisible population.

Notably, PDL and HP have low income, low schooling, and black or brown race/color characteristics. In addition, they experience social exclusion and difficulties in accessing the rights that determine their illness, life, and death processes. These conditions, considered to be social determinants of health, condition this public to be at greater risk of becoming ill since social, economic, political, environmental, and cultural factors influence the transmission and prevalence of TB-HIV coinfection¹⁸.

The study was carried out using secondary data, which was significantly incomplete and limited. In addition, this is a cross-sectional study that portrays and analyzes a specific period. It is also recognized that the small sample of PDL may have influenced the absence of statistically significant findings associated with coinfection in this study.

CONCLUSION

This study made it possible to identify the factors associated with TB/HIV coinfection in HP and PDL notified in Belo Horizonte (MG) between 2015 and 2022. In the analysis of PDL, no association was identified between the variables studied and coinfection, possibly due to the small sample size. Even though no associations were identified, the vulnerability of this population and the need for attention in care are highlighted. It is recommended that further studies be conducted on this population with a different analysis that considers the limitations presented in this study.

The study contributes to promoting visibility for vulnerable groups, identifying factors that increase the chances of becoming ill with TB and HIV. This allows professionals to redirect their care towards young people, drug users, and the homeless.

At the same time, it suggests training professionals to provide sensitive care to vulnerable groups and comprehensive and inclusive public policies on this issue.

ACKNOWLEDGMENTS

This work was carried out with the support of grant code 001, PROBIC/FAPEMIG.

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Received: 20/10/2023

Approved: 05/02/2025

Associate editor: Dra. Luciana de Alcantara Nogueira

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ISSN 2176-9133



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