PUBLICAÇÃO OFICIAL DO NÚCLEO HOSPITALAR DE EPIDEMIOLOGIA DO HOSPITAL SANTA CRUZ E PROGRAMA DE PÓS GRADUAÇÃO EM PROMOÇÃO DA SAÚDE - DEPARTAMENTO DE BIOLOGIA E FARMÁCIA DA UNISC

ISSN 2238-3360

Revista de Epidemiologia e Controle de Infecção

Original Article

Factors associated with HIV infection in people with tuberculosis in Belo Horizonte, (2001-2020)

Fatores associados à infecção por HIV em pessoas com tuberculose em Belo Horizonte (2001-2020)
Factores asociados a la infección por VIH en personas con tuberculosis en Belo Horizonte (2001-2020)

Site doi: https://doi.org/10.17058/reci.v15i2.20010

Submitted: 11/09/2024
Accepted: 05/14/2025
Available online: 06/25/2025

Corresponding author:
E-mail: thaissrsouza@gmail.com
Address: Professor Alfredo Balena Avenue, 190 - Santa Efigenia, Belo Horizonte, Minas Gerais, Brazil.

Thaís Rodrigues de Souza[1]
Vitória Lopes de Castro Silva[1]
Alexandra Dias Moreira[1]
Fernanda Penido Matozinhos[1]
Giselle Lima de Freitas[1]

[1]Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil.

ABSTRACT

Background and Objectives: Tuberculosis (TB) remains a concern for health services. The bacillus that causes the disease can act synergistically with the Human Immunodeficiency Virus (HIV). Brazil has a high prevalence of TB and HIV, therefore, the objective of the study was to analyze the factors associated with the occurrence of TB/HIV in adults in the city of Belo Horizonte, from 2001 to 2020. **Methods:** Quantitative, cross-sectional study, whose population was composed of reported cases of TB in Belo Horizonte/MG, from 2001 to 2020. The frequencies of the variables of interest were evaluated and analysis with the chi-square test and likelihood ratio. The Poisson Regression model was developed and the prevalence ratio calculated. **Results:** A total of 23,414 cases of tuberculosis were registered and of these, 4,067 were cases of TB/HIV coinfection. Coinfection was more frequent in the homeless population (2.97%). The most prevalent associated condition was alcohol use (7.27%). The significant variables for the outcome of coinfection were male gender, age 31 to 49 years, brown race, diabetes, and drug use. **Conclusion:** The profile found confirms the relationship between coinfection and social determinants of health and reaffirms the need for intersectoral care for vulnerable groups.

Keywords: *Tuberculosis. HIV. Lung Diseases. Coinfection.*

RESUMO

Justificativa e Objetivos: A tuberculose (TB) continua sendo uma preocupação relevante para os serviços de saúde. O bacilo causador da TB pode atuar de forma sinérgica com o Vírus da Imunodeficiência Humana (HIV). O Brasil apresenta alta prevalência de TB e HIV. Assim, o objetivo do estudo foi analisar os fatores associados à ocorrência de TB/HIV em adultos no município de Belo Horizonte, de 2001 a 2020. **Métodos:** Estudo quantitativo, transversal, cuja população foi composta por casos notificados de TB em Belo Horizonte/MG, de 2001 a 2020. Foram avaliadas as frequências das variáveis de interesse e realizada análise com teste de qui-quadrado e da razão de verossimilhança. Foram desenvolvidos o modelo de Regressão de Poisson e o cálculo da razão de prevalência. **Resultados:** Foram registrados 23.414 casos de tuberculose. Destes, 4.067 são casos de coinfecção TB/HIV. A coinfecção foi mais frequente na população em situação de rua (2,97%) e o uso de álcool foi o agravo associado mais prevalente (7,27%). As variáveis significativas para o desfecho da coinfecção foram: sexo masculino, idade entre 31 e 49 anos, raça parda, diabetes mellitus e uso de drogas ilícitas. **Conclusão:** O perfil encontrado confirma a associação entre a coinfecção e os determinantes sociais da saúde, ressaltando a necessidade de atenção integrada, com foco intersetorial, às populações vulneráveis.

Descritores: *Tuberculose. HIV. Pneumopatias. Coinfecção.*

RESUMEN

Justificación y Objetivos: La tuberculosis (TB) sigue siendo una preocupación relevante para los servicios de salud. El bacilo que causa la tuberculosis puede actuar de forma sinérgica con el virus de la inmunodeficiencia humana (VIH). Brasil tiene una alta prevalencia de tuberculosis y VIH. Así, el objetivo del estudio fue analizar los factores asociados a la ocurrencia de TB/VIH en adultos en el municipio de Belo Horizonte, en el período de 2001 a 2020. **Métodos:** Se trata de un estudio cuantitativo, transversal, cuya población estuvo compuesta por casos notificados de TB en Belo Horizonte/MG, de 2001 a 2020. Se evaluaron las frecuencias de las variables de interés y se realizó el análisis con la prueba de chi-cuadrado y la razón de verosimilitud. Se desarrolló el modelo de regresión de Poisson y el cálculo de la razón de prevalencia. **Resultados:** Se registraron 23.414 casos de tuberculosis. De estos, 4.067 son casos de coinfección por tuberculosis y VIH. La coinfección fue más frecuente en la población sin hogar (2,97%) y el consumo de alcohol fue el problema asociado más prevalente (7,27%). Las variables significativas para el resultado de la coinfección fueron: sexo masculino, edad entre 31 y 49 años, raza mestiza, diabetes mellitus y consumo de drogas ilícitas. **Conclusión:** El perfil encontrado confirma la asociación entre la coinfección y los determinantes sociales de la salud, destacando la necesidad de atención integrada, con enfoque intersectorial, a las poblaciones vulnerables.

Palabras Clave: *Tuberculosis. VIH. Enfermedades pulmonares. Coinfección.*

INTRODUCTION

Tuberculosis (TB) is one of the oldest public health problems and remains a concern for health organizations and services. The World Health Organization (WHO) declared the disease a global epidemic in 1993, and reducing its burden is among the Sustainable Development Goals for 2030. However, it still causes high morbidity and mortality in many countries, including Brazil.[1,2]

TB holds significant epidemiological relevance on its own, and the causative bacillus (*Mycobacterium tuberculosis*) can act synergistically with other microorganisms, leading to coinfections, such as the association between TB and the human immunodeficiency virus (HIV). In Brazil, TB is the leading defined cause of death among people living with HIV (PLWH).[3,4]

TB/HIV coinfection creates a series of challenges for the prevention and treatment of both conditions, including therapeutic failure and immunosuppression with low CD4+ lymphocyte counts. These factors contribute to low adherence or treatment abandonment due to the high frequency of adverse or paradoxical reactions. Illness, the chain of transmission, and complications arising from both TB and HIV infections are directly related to social determinants of health, such as sex, skin color, and economic and housing conditions.[5–7]

The Brazilian Ministry of Health recommends an articulation between TB and HIV control programs to boost the detection of infections. Any individual who tests positive for one condition must be immediately tested for the other. A study has found a high number of TB notifications only post-mortem, i.e., the information was not included in official statistics. In these cases, TB and HIV were the most common causes of death. This finding indicates a weakness in the care provided and a delay in the diagnosis of patients and their contacts.[7–8]

The Brazilian Unified Health System (SUS), particularly Primary Health Care (PHC), has the reach and tools for early diagnosis, treatment, and follow-up of TB and HIV, contributing to favorable patient outcomes and reducing transmission chain. The multidisciplinary team, especially nurses, is crucial for ensuring continuity of care after diagnosis via actions such as health education. Diagnostic delays can increase mortality from coinfection and are related to both patients' late health-seeking behavior and health services failures in conducting active case finding of symptomatic individuals, especially within PHC's designated coverage areas.[10–12]

Considering that Brazil have a high prevalence of TB and HIV and recognizing the clinical and social impacts of TB/HIV coinfection — such as difficulty with therapeutic adherence, worsening clinical status, isolation, and stigma — it is essential to identify the social and clinical factors associated with its occurrence. This knowledge can aid reduce flaws in care, accelerate the interruption of the transmission chain, and promote individuals' quality of life. Thus, this study aimed to analyze the factors associated with the occurrence of TB/HIV in adults in the municipality of Belo Horizonte from 2001 to 2020.

METHODS

Study design

This was a quantitative, cross-sectional, analytical, and exploratory study.

Setting

The study setting is the municipality of Belo Horizonte, the capital of the state of Minas Gerais, with an estimated population of 2,530,701 inhabitants. In 2021, the municipality's TB/HIV coinfection rate among new TB cases was 11.7%, which was higher than that of Minas Gerais (6.9%) and the Southeast region (7.4%), but lower than the national rate (8.3%).[13,14]

Study population

The study population consisted of 23,414 TB cases reported in the Brazilian Notifiable Diseases Information System (SINAN) from 2001 to 2020. Confirmed cases of pulmonary, extrapulmonary, or both forms of TB were included, regardless of the diagnostic method used (Xpert MTB/RIF, smear microscopy, or culture), provided that the patient was a resident of the municipality under study. Extrapulmonary TB cases included pleural, lymph node, bone and joint, genitourinary, intestinal, peritoneal, pericardial, central nervous system, ocular, cutaneous, or TB affecting any other organ, whether occurring before or after primary infection. Only one record per person was included; in cases of duplicate records, the most recent was considered.

Individuals under 18 years of age and records with data inconsistencies were excluded. Inconsistency was defined as the improper completion of the field for acquired immunodeficiency syndrome (AIDS), which must be marked "yes" for HIV-positive cases. However, 60 cases were marked "no," 130 were "unknown," and 30 were blank. Those records in which a patient was simultaneously classified into two different special populations (incarcerated population and homeless population) were also excluded.

Data Collection

Data for this study were obtained from SINAN records provided by the Municipal Health Department of Belo Horizonte. The form includes patient identification, sociodemographic data (sex, age,

ethnicity/skin color, schooling level, whether the individual belongs to any special population, and whether they are a beneficiary of a social program), and the clinical profile of TB (associated conditions).

Variables

TB/HIV coinfection was the study's dependent variable, identified by a positive status for the "HIV" item.

Independent variables were categorized as sociodemographic and clinical. Sociodemographic variables included: sex (male; female), age group (18–30; 31–49; 50–60; over 60 years), ethnicity/skin color (White; Black; Yellow; Mixed-race; Indigenous), schooling level (illiterate; middle, high, and higher education—completed and incomplete), beneficiary of cash transfer programs (yes; no), and special populations (incarcerated population, homeless population, healthcare professionals, and immigrants — all with yes/no options).

Clinical variables included associated diseases and conditions: diabetes mellitus, alcohol use, mental illness, illicit drug use, and smoking habit (all with yes/no options).

Notably, information on special populations, social program beneficiaries, illicit drug use, smoking habit, and the Xpert MTB/RIF test was only included in the notification forms starting in 2015.

Data analysis

For data analysis, an Excel spreadsheet was used as a database containing only the study's variables of interest. Initially, a descriptive analysis of the sociodemographic and clinical profile of HIV-positive cases in individuals aged over 18 years was performed using absolute and relative frequencies. For variables added to the forms after 2015, frequencies were estimated based on the total of 5,654 cases reported from 2015 to 2020, of which 1,002 were HIV-positive.

Statistical analysis was performed using IBM SPSS software. The Chi-square test was applied for dichotomous variables, and the likelihood-ratio test was used for polytomous variables. Variables with a p-value <0.02 were considered statistically significant.[15] An analysis of adjusted standardized residuals was also performed to identify categories in which observed values deviated significantly from expected values (values >1.96 or <−1.96 indicate significance).[5] Finally, a multivariate Poisson regression model with robust variance was developed using variables with a p-value <0.20 in the bivariate analysis. Adjusted prevalence ratios and their respective confidence intervals were estimated. A significance level of 5% was adopted. This enabled a multivariate analysis of how these factors impact the prediction of the prevalence ratio.

Ethical aspects

The project was approved by the Research Ethics Committee of UFMG (COEP-UFMG), in accordance with Resolution No. 466/2012 of the Brazilian National Health Council and other regulatory guidelines for research involving human subjects. CAAE no. 16114619.6.0000.5149; Opinion no. 3.508.404.

RESULTS

From 2001 to 2020, 23,414 cases of tuberculosis were registered in Belo Horizonte. Of these, 4,067 tested positive for HIV, characterizing a TB/HIV coinfection. Regarding the sociodemographic profile of people with coinfection, most were male (73.7%), aged from 31 and 49 (61.9%), Mixed-race (38.5%), and had a schooling level corresponding to complete or incomplete middle school (22.8%). Only 1.8% were beneficiaries of social programs. Among the special populations, the most prevalent was the homeless population, at 2.97%. The most common associated condition was alcohol use (7.27%) (Table).

Table 1. Prevalence of tuberculosis cases with and without HIV coinfection, and p-value based on chi-square and likelihood ratio tests. Belo Horizonte, Minas Gerais, 2001 to 2020.

	HIV −	HIV +	p-value
	N (%)	N (%)	
Sex			
Female	1,068 (26.26)	6,597 (34.10)	
Male	2,999 (73.74)	1,275 (65.90)	**p<0.01‡**
Age			
18 to 30 years	845[i] (20.78)	4,755 (24.58)	
31 to 49 years	2,521[i] (61.99)	8,081[i] (41.77)	**p<0.01†**
50 to 60 years	558[i] (13.72)	3,446[a] (17.81)	
Over 60 years old	143[i] (3.52)	3,065[a] (15.84)	
Skin color			
White	976[i] (24.00)	5,289 (27.34)	
Black	646 (15.88)	2,862 (14.79)	
Yellow	17 (0.42)	117 (0.60)	
Mixed-race	1,580[a] (38.85)	6,698 (34.62)	**p<0.01†**
Indigenous	5 (0.12)	22 (0.11)	

	HIV −	HIV +	p-value
	N (%)	N (%)	
Schooling level			
Illiterate	51 (1.25)	396 (2.05)	
Incomplete and complete middle	929[a] (22.84)	5,039 (26.05)	**p<0.01†**
Incomplete and complete high school	365[a] (8.97)	2,156[i] (11.14)	
Incomplete and complete higher education	147 (3.61)	957 (4.95)	
Beneficiary*			
Yes	18 (1.80)	101 (0.52)	0.25‡
No	273 (6.71)	2,064 (10.66)	
Homeless population			
Yes	121 (2.97)	332 (1.71)	**p<0.01‡**
No	797 (19.59)	3,832 (19.80)	
Incarcerated population			
Yes	26 (0.63)	77 (0.39)	0.56‡
No	914 (22.39)	4,073 (21.05)	
Healthcare Professionals			
Yes	6 (0.14)	74 (0.38)	**0.13‡**
No	914 (0.22)	4,073 (21.05)	
Immigrants			
Yes	6 (0.14)	16 (0.08)	0.26‡
No	915 (0.22)	4,143 (21.41)	
Diabetes			
Yes	31 (0.76)	372 (1.92)	**p<0.01‡**
No	896 (22.03)	2,818 (14.56)	
Alcohol use			
Yes	296 (7.27)	1,069 (5.52)	0.24‡
No	609 (14.97)	2,225 (11.5)	
Mental disorder			
Yes	69 (1.69)	159 (0.82)	0.29‡
No	842 (20.70)	2,924 (5.11)	
Illicit drug use*			
Yes	265 (6.51)	486 (2.51)	**p<0.01‡**
No	548 (13.47)	3,274 (16.92)	
Smoking habit*			
Yes	266 (6.78)	1,211 (6.25)	**0.20‡**
No	536 (0.13)	2,707 (13.99)	

Abbreviations: ‡ Pearson's Chi-Square test for k independent samples; † Likelihood-Ratio Test; [a]Adjusted residual >1.96; [i]Adjusted residual <−1.96; HIV + = presence of HIV; HIV − = absence of HIV; *Data entered in the database after 2015.

The Poisson model with robust variance was used with the nine variables identified as having a p-value < 0.20 in the bivariate analysis. In this analysis, the variables significantly associated with the outcome of coinfection were: male sex, which showed 47.5% more cases compared to female sex (PR = 1.45; 95%CI: 1.34–1.56; p < 0.01); age group 31–49 years, which had 58.4% more cases than the group aged over 60 years (PR = 2.12; 95%CI: 1.35–2.28; p < 0.01); Mixed-race, with 14.3% more cases than White individuals (PR = 1.26; 95%CI: 0.98–1.45; p < 0.01); diabetes mellitus, with 21% more cases compared to individuals without the comorbidity (PR = 0.22; 95%CI: 0.17–0.28; p < 0.01); and illicit drug use, which showed 6.69% more cases compared to individuals who do not use such substances (PR = 3.25; 95%CI: 2.73–3.68; p < 0.01). These variables are presented in bold in the p-value column (Table 2).

Table 2. Poisson model and adjusted prevalence ratio of variables with a statistically significant difference in the study, among HIV+ cases. Belo Horizonte, Minas Gerais, 2001 to 2020.

Characteristic	Adjusted PR	95%CI	p-value
Sex			
Female	1	1	1
Male	1.45	1.34 (1.56%)	**p<0.01**
Age			
Over 60 years old	1	1	1
31 to 49 years	2.12	1.35 – 2.28	**p<0.01**
Skin color			
White	1	1	1
Mixed-race	1.26	0.98 – 1.45	**p<0.01**
Schooling level			
Incomplete and complete higher education	1	1	1
Incomplete and complete middle	1.15	1.03 – 1.67	0.25
Homeless population			
No	1	1	1
Yes	1.75	1.4 – 2.1	0.75

Characteristic	Adjusted PR	95%CI	p-value
Healthcare Professionals			
No	1	1	1
Yes	0.36	0.15 – 0.83	0.29
Diabetes			
No	1	1	1
Yes	0.22	0.17 – 0.28	**p<0.01**
Illicit drug use*			
No	1	1	1
Yes	3.25	2.73 – 3.68	**p<0.01**
Smoking habit*			
No	1	1	1
Yes	1.1	0.94 – 1.3	0.74

Abbreviations: PR: Prevalence ratio; CI: Confidence interval; *Data entered in the database after 2015.

DISCUSSION

In this study, the sociodemographic variables significantly associated with TB/HIV coinfection were male sex, younger age, being Mixed-race, low schooling level, being homeless, and being a healthcare professional. Among the associated conditions, a diagnosis of diabetes mellitus (DM), illicit drug use, and smoking habit were prominent. The prevalence of tuberculosis cases coinfected with HIV was 17.36%.

A higher number of cases occurred among males, with this group predominating in the prevalence ratio compared to females. This result may reflect men's lower engagement with health services and self-care. Studies indicate that men often associate seeking healthcare with a female practice, which contributes to vulnerabilities in male health. Research conducted in Paraíba and Rio Grande do Norte also identified a male predominance in coinfection cases. This study highlights a predisposition to early death from tuberculosis among men, which was found to occur later among women.[3,16]

The age variable was significant in this study, especially in the 31–49 years range, followed by the 18–30 years group. An integrative review of Brazilian national studies identified a predominance of coinfection in the 20–40 age group, a phase of life associated with greater exposure to risk factors such as alcohol and drug use, and unprotected sexual practices with multiple partners, which increases susceptibility to both infections.[17]

The most prevalent ethnicity/skin color in this study was Mixed-race, followed by White. The literature indicates that Black and Mixed-race people are in a situation of greater social vulnerability, with higher rates of illiteracy and lower schooling levels, based on data from the 2010 population census conducted by the Brazilian Institute of Geography and Statistics. Moreover, this group faces challenges in accessing and using healthcare services, which are often marked by discrimination and violence.[18]

The majority of coinfected individuals in this study showed a low schooling level—most being illiterate or with complete/incomplete middle school, totaling 20% of cases. This condition can compromise knowledge about the disease and, consequently, hinder the adoption of health promotion measures. Low schooling directly impacts self-care, treatment adherence, and the frequency with which an individual seeks healthcare services. Another important socioeconomic aspect to consider is the receipt of social benefits; in this study, less than 2% of patients were beneficiaries. The lack of resources for transportation or subsistence during treatment contributes to low adherence or abandonment. Social support, such as in-kind food packages and transportation vouchers, is therefore crucial. A study in Salvador showed that direct or indirect beneficiaries of social programs showed a higher TB cure rate.[7,19–20]

The special populations that showed significant differences in coinfection were the homeless population and healthcare professionals. For the homeless, three dimensions of vulnerability can be cited: individual, related to high exposure to alcohol, tobacco, and drugs; social, marked by challenges in accessing education, food, and adequate housing conditions; and policy-related, reflected in the fragility of public and institutional state resources, which can lead to treatment interruption and resistance to drug therapy. The prejudice surrounding tuberculosis and HIV is even more pronounced when the person is homeless. This population is frequently a target of social stigmas—such as associations with violence, drug use, and extreme poverty—which contributes to their avoidance of or difficulty in accessing health services.[21–22]

Regarding healthcare professionals, a study using SINAN data from Rio Grande do Sul indicated a higher prevalence of coinfection among nursing professionals. This finding may be related to the occupational risk these professionals face, which can be minimized via continuing education activities. It is essential that these workers correctly use personal protective equipment (PPE), report sharps injuries in a timely manner, and use post-exposure prophylaxis for HIV when indicated.[23]

Illicit drug use showed the highest prevalence ratio among the analyzed conditions when compared to

individuals who do not use such substances. This factor may be related to coinfection via two main mechanisms: biological, by increasing the risk of contracting infections or aggravating existing diseases; and behavioral, by compromising decision-making, encouraging risky practices, reducing treatment adherence, and negatively impacting self-care, especially regarding hygiene, nutrition, and daily routine. Individuals who abuse drugs may have an unstable routine and poor sleep quality, which directly impacts treatment effectiveness.[24]

Another condition associated with coinfection was the presence of diabetes mellitus, a condition that increases susceptibility to infections due to hyperglycemia and reduced insulin production, which compromises immune cell function. A study conducted in Minas Gerais (2006–2015) indicated a higher incidence of coinfection among individuals without diabetes; however, it also discussed complications of glycemic dysregulation, such as reduced immunity, which can be exacerbated even by the medications used to treat the disease.[5,17]

The diagnostic and treatment processes for both conditions can generate feelings of sadness, fear, stigma, and social isolation, often aggravated by the individuals' economic situation. These factors, combined with the sociodemographic profile, contribute to non-adherence or treatment abandonment. Early diagnosis, therapeutic follow-up, and retention in care require intersectoral actions capable of meeting the multiple needs of coinfected people.[25]

Populations recognized by the Brazilian Ministry of Health as special — such as incarcerated persons, the homeless, healthcare professionals, and immigrants — are at higher risk for coinfection and therefore require special attention. Each group has specific needs, lifestyles, and exposures that differ from the general population. Healthcare professionals must be prepared to manage this diversity, understanding the populations most impacted by coinfection and aligning their practices with the Ministry guidelines. It is crucial that these professionals perform timely testing for TB and HIV and promote continuity of care — essential strategies for interrupting the transmission chain of both infections.

The sociodemographic and clinical profile found in this study confirms the direct relationship between TB/HIV coinfection and social determinants of health. The findings reinforce the need for targeted care for vulnerable populations — especially Black individuals and those with low income and low schooling. Regarding the clinical profile, the importance of actions aimed at people with associated conditions is highlighted, particularly users of alcohol, illicit drugs, and tobacco.

Tools such as manuals and protocols are available to assist healthcare professionals in management and decision-making related to TB/HIV coinfection. Easily accessible diagnostic tests also contribute to early detection and the interruption of the transmission chain. It is essential to strengthen control, prevention, and treatment actions for coinfection in Primary Health Care (PHC), the ideal setting for this care. The focus should be on health promotion, monitoring of associated conditions, prevention and management of complications, treatment monitoring, and ensuring patients' quality of life.

A strength of this study was the partnership with the Municipal Health Department of Belo Horizonte and the use of the SINAN database, a robust and widely used source in Brazil for reporting health issues. A limitation was the large amount of missing data. Unfilled or "unknown" variables were excluded to avoid interfering with the associations. This challenge can be minimized by implementing continuing education programs for professionals responsible for completing notification forms, thereby ensuring greater accuracy and completeness of the information registered in the system.

REFERENCES

1. Nogueira MH, Silva CL, Souza SHS, et al. Prevalência e aspectos epidemiológicos da coinfecção da tuberculose e HIV no Estado do Tocantins, 2001-2020. Res Soc Dev. 2021; 10 (14): e278101422279. http://dx.doi.org/10.33448/rsd-v10i14.22279

2. Sousa TFL. Coinfecção Tuberculose/HIV: Estudo da distribuição de casos no Brasil. Ciênc Saúd Desaf Perspect. 2021; 3:114-22. http://dx.doi.org/10.37885/211006323

3. Cortez AO, Melo AC, Neves LO, et al. Tuberculosis in Brazil: one country, multiple realities. J Bras Pneumol. 2021; 47 (2): e20200119. http://dx.doi.org/10.36416/1806-3756/e20200119

4. Brasil. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. 2ª ed. 2020. Disponível em: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/publicacoes-svs/tuberculose/manual-de-recomendacoes-e-controle-da-ttuberculose-no-brasil-2a-ed.pdf/view

5. Moreira TR, Gonçalves ESM, Colodette RM, et al. Fatores associados a HIV/Aids em pacientes com tuberculose em Minas Gerais entre os anos de 2006 e 2015. Rev Min Enferm. 2019; 23: e-1211. Disponível em: https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1051564

6. Paiva SS, Pedrosa NL, Galvão MTG. Análise espacial da Aids e os determinantes sociais de saúde. Rev Bras Epidemiol. 2019; 22: e190032. http://dx.doi.org/10.1590/1980-549720190032

7. Bastos SH, Taminato M, Tancredi MV, et al. Coinfecção tuberculose/HIV: perfil sociodemográfico e de saúde de usuários de um centro especializado. Acta Paul Enferm. 2020; 33: eAPE20190051. http://dx.doi.org/10.37689/acta-ape/2020AO00515

8. Brasil. Ministério da Saúde. Protocolo Clínico e Diretrizes Terapêuticas para Manejo da Infecção pelo HIV em Adultos. 2018. Disponível em: https://www.gov.br/Aids/pt-br/central-de-

conteudo/pcdts/2013/hiv-Aids/pcdt_manejo_adulto_12_2018_web.pdf/view

9. Aridja UM, Duarte EC. Casos de tuberculose com notificação após o óbito no Brasil, 2014. Epidemiol. Serv. Saúde. 2020; 29 (5): e2020060. http://dx.doi.org/10.1590/s1679-49742020000500014

10. Ferreira BCA, Lima MKC, Barbosa JSS, et al. Ação potencial do enfermeiro no enfrentamento ao tratamento da tuberculose na estratégia de saúde da família. Res Soc Dev. 2021; 10 (8): e17375. http://dx.doi.org/10.33448/rsd-v10i8.17375

11. Teixeira BS, Machado DS, Sousa VKS, et al. Desafios da enfermagem na assistência às pessoas com tuberculose. Enferm. Brasil. 2021; 20 (4):1-10. http://dx.doi.org/10.33233/eb.v20i4.4726

12. Nunes CC, Sousa RJ, Costa AG, et al. Aspectos socioeconômicos e a coinfecção tuberculose/HIV no Brasil: uma revisão da literatura. Educ Ciênc Saúde. 2020; 7(2): e294. http://dx.doi.org/10.20438/ecs.v7i2.294

13. Minas Gerais. Instituto Brasileiro de Geografia e Estatística. Belo Horizonte. Disponível em: https://www.ibge.gov.br/cidades-e-estados/mg/belo-horizonte.html

14. Brasil. Ministério da Saúde. Boletim Epidemiológico de Tuberculose 2022. 2022. Disponível em: http://antigo.Aids.gov.br/pt-br/pub/2022/boletim-epidemiologico-de-tuberculose-2022

15. Callegari-Jacque SM. Bioestatística: Capítulo 15 – Distribuição qui-quadrado. Disponível em: http://www.liaaq.ccb.ufsc.br/files/2013/10/Bioestat%C3%ADstica-Cap15-Distribui%C3%A7%C3%A3o-chi-quadrado.pdf.

16. Vital Júnior AC, Guedes DRS, Lima MGR, et al. Avaliação do perfil epidemiológico da tuberculose e a sua coinfecção TB-HIV nos estados da Paraíba e Rio Grande do Norte. Braz. J. of Develop. 2020; 6 (1):441-456. https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/5856/5384

17. Silva LNS, Silva LNS, Silva LNS, et al. Perfil sociodemográfico e determinantes sociais da coinfecção tuberculose-HIV no Brasil: uma revisão integrativa. Res Soc Dev. 2022; 11 (3): e29481. http://dx.doi.org/10.33448/rsd-v11i3.29481

18. Silva NN, Lima MGR, Lima MGR, et al. Acesso da população negra aos serviços de saúde: revisão integrativa. Rev Bras Enferm. 2020; 73 (4): e20180834. http://dx.doi.org/10.1590/0034-7167-2018-0834

19. Berra TZ, Bruce ATI, Alves YM, et al. Fatores relacionados, tendência temporal e associação espacial do abandono de tratamento para tuberculose em Ribeirão Preto-SP. Rev. Eletr. Enferm. 2020; 22: e58883. http://dx.doi.org/10.5216/ree.v22.58883

20. Andrade KVF, Nery JS, Araujo GS, et al. Associação entre desfecho do tratamento, características sociodemográficas e benefícios sociais recebidos por indivíduos com tuberculose em Salvador, Bahia, 2014-2016. Epidemiol Serv Saude. 2019; 28 (2): e2018220. http://dx.doi.org/10.5123/S1679-49742019000200004

21. Brito C, Silva LN. Tuberculose, vulnerabilidades e HIV em pessoas em situação de rua: revisão sistemática. Rev. Saúde Pública. 2022; 56: e71. http://dx.doi.org/10.1590/1413-81232022261.19662021

22. Brito C, Silva LN. População em situação de rua: estigmas, preconceitos e estratégias de cuidado em saúde. Ciênc. saúde coletiva. 2022; 27 (1):151-160. http://dx.doi.org/10.1590/1413-81232022271.19662021

23. Martins MDR, Spagnolo LMDL, Tomberg JO, et al. Casos de tuberculose entre trabalhadores da saúde, 2014-2018. Res Soc Dev. 2022; 11 (8): e31041. http://dx.doi.org/10.33448/rsd-v11i8.31041

24. Morojele NK, Shenoi SV, Shuper PA, et al. Uso de álcool e risco de doenças transmissíveis. Nutrients. 2021; 13 (10): e3317. http://dx.doi.org/10.3390/nu13103317

25. Braga SKM, Oliveira TS, Flavio FF, et al. Estigma, preconceito e adesão ao tratamento: representações sociais de pessoas com tuberculose. Rev Cuid. 2020; 11 (1): e785. http://dx.doi.org/10.15649/cuidarte.785

AUTHORS' CONTRIBUTIONS

Thaís Rodrigues de Souza participated in the literature search, writing of the abstract, introduction, methods, and discussion, interpretation and description of results, creation of tables and conclusions, revision, and statistical analysis. **Vitória Lopes de Castro Silva** contributed to the literature search, writing of the abstract, introduction, and discussion, interpretation and description of results, development of conclusions, revision, and statistical analysis. **Alexandra Dias Moreira** worked on the methodology, interpretation of results, development of conclusions, revision, and statistical analysis. **Fernanda Penido Matozinhos** contributed to the methodology, interpretation of results, development of conclusions, revision, and statistical analysis. **Giselle Lima de Freitas** was responsible for project administration, supervision, literature search, writing of the abstract, introduction, methods, and discussion, interpretation and description of results, development of conclusions, revision, and statistical analysis.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

Please cite this article as: de Souza TR, Silva VLC, Moreira AD, Matozinhos FP, de Freitas GL. Factors associated with HIV infection in people with tuberculosis in Belo Horizonte (2001-2020). Rev Epidemiol Control Infect [Internet]. 2025 Jun. 25; 15(2). Available from: https://seer.unisc.br/index.php/epidemiologia/article/view/20010