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RESEARCH

FACTORS ASSOCIATED WITH HIV/AIDS IN PATIENTS WITH TUBERCULOSIS IN *MINAS GERAIS* BETWEEN 2006 AND 2015

FATORES ASSOCIADOS A HIV/AIDS EM PACIENTES COM TUBERCULOSE EM MINAS GERAIS ENTRE OS ANOS DE 2006 E 2015

FACTORES ASOCIADOS AL VIH/SIDA EN PACIENTES CON TUBERCULOSIS EN EL ESTADO DE MINAS GERAIS ENTRE 2006 Y 2015

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ABSTRACT

Objective: to analyze the factors associated with HIV/AIDS in patients with tuberculosis (TB) in *Minas Gerais* between 2006 and 2015. **Methods:** this is a cross-sectional study based on tuberculosis cases reported in the state of *Minas Gerais* between 2006 and 2015 in the database of the *Sistema de Informação de Agravos de Notificação* (SINAN). The prevalence of TB/HIV/AIDS patients associated with each explanatory variable was calculated, using multiple logistic regression with $p \leq 0.05$, and Pearson's chi-square and Fisher's exact tests with a significance level of 5%. **Results:** the prevalence of TB/HIV/AIDS co-infection during the study period was 9.4%, being associated with the following: gender; age; schooling; area of residence; alcohol consumption; clinical manifestation; associated disorders (diabetes and mental illness); diagnostic tests (X-Rays, sputum smear and sputum culture); and final status of individuals. Unknown values in the variables "area of residence", "schooling" and "alcohol consumption" were more frequent in individuals with TB/HIV/AIDS co-infection. **Conclusion:** the factors associated with TB/HIV/AIDS co-infection include socio-economic, clinical, diagnostic, and follow-up factors. Recognizing these factors may contribute to new strategies to avoid or delay undesirable prognoses in this population.

Keywords: Tuberculosis; Coinfection; HIV; Risk Factors; Diagnosis.

RESUMO

Objetivo: *analisar os fatores associados a HIV/AIDS em pacientes com tuberculose (TB) em Minas Gerais entre os anos de 2006 e 2015.* ***Métodos:*** *trata-se de estudo transversal realizado a partir dos casos de tuberculose notificados no estado de Minas Gerais entre 2006 e 2015 na base de dados do Sistema de Informação de Agravos de Notificação (SINAN). Calculou-se a prevalência de clientes TB/HIV/AIDS associada a cada variável explicativa, sendo utilizada regressão logística múltipla com $p \leq 0,05$ e testes qui-quadrado de Pearson e exato de Fisher com nível de significância de 5%.* ***Resultados:*** *a prevalência de coinfecção TB/HIV/AIDS no período estudado foi de 9,4%, sendo associada a: sexo; idade; escolaridade; área de residência; uso de álcool; forma clínica; agravos associados (diabetes e doença mental); exames diagnósticos (Raios-X, baviloscopia e cultura de escarro); e situação de encerramento dos indivíduos. Valores ignorados nas variáveis área de residência, escolaridade e uso de álcool foram mais frequentes em indivíduos com coinfecção TB/HIV/AIDS.* ***Conclusão:*** *os fatores associados à coinfecção TB/HIV/AIDS incluem aspectos socioeconômicos, clínicos, do diagnóstico e acompanhamento de casos. O reconhecimento desses fatores pode contribuir para o desenvolvimento de estratégias para evitar ou postergar prognósticos indesejáveis nessa população.*

Palavras-chave: *Tuberculose; Coinfecção; HIV; Fatores de Risco; Diagnóstico.*

RESUMEN

Objetivo: *analizar los factores asociados al VIH/SIDA en pacientes con tuberculosis (TB) en el estado de Minas Gerais entre 2006 y 2015.* ***Método:*** *se trata de un estudio transversal basado en casos de tuberculosis reportados en el estado de Minas Gerais entre 2006 y 2015 en la base de datos del Sistema de información de enfermedades de*

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reporte obligatorio (Sistema de Informação de Agravos de Notificação, SINAN). Se calculó la prevalencia de clientes con TB/VIH/SIDA asociada con cada variable explicativa, utilizando regresión logística múltiple con ≤ 0,05, y las pruebas chi-cuadrado de Pearson y exacta de Fischer con un nivel de significancia del 5%. ***Resultados:*** *la prevalencia de coinfección entre TB/VIH/SIDA durante el período de estudio fue del 9,4% y estuvo asociada a los siguientes factores: sexo, edad, escolaridad, área de residencia, consumo de alcohol, forma clínica, trastornos asociados (diabetes y enfermedad mental), pruebas de diagnóstico (radiografía, baviloscopía y cultivo de esputo) y situación de encierro de los individuos. Los valores ignorados en las variables área de residencia, escolaridad y consumo de alcohol fueron más frecuentes en individuos con coinfección entre TB/VIH/SIDA.* ***Conclusión:*** *los factores asociados a la coinfección entre TB/VIH/SIDA incluyen aspectos socioeconómicos, clínicos, de diagnóstico y seguimiento de casos. El reconocimiento de estos factores puede contribuir al desarrollo de estrategias para evitar o postergar pronósticos no deseados en esta población.*

Palabras clave*: Tuberculosis; Coinfección; VIH; Factores de Riesgo; Diagnóstico.*

INTRODUCTION

Tuberculosis (TB) is an infectious, transmissible, and curable disease of high magnitude and importance worldwide that primarily affects the lungs. It is estimated that one third of the world's population is infected with the bacillus that causes the disease (*Mycobacterium tuberculosis*). In Brazil, TB is a serious public health problem, given that between 2005 and 2014, 73,000 new annual cases of tuberculosis were reported and, of this total, 10.1% were co-infected with TB-HIV. Around 4,600 deaths per year were reported.[1]

Brazil ranked in the 16th place in absolute cases among the 22 countries responsible for 80% of the total TB cases in the world, ranking in the 108th position in the incidence rate.[2,3] Regarding TB notification, the state of *Minas Gerais* has the 4th highest number (simple average of 6,085 cases/year), the 4th lowest incidence rate in Brazil (17.9/100,000 inhabitants) and the lowest rate in the southeast region.[3]

The most vulnerable populations to be infected with TB are indigenous people, people deprived of their liberty, people living with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), homeless people and health care practitioners.[2] With the advent of HIV/AIDS and the emergence of drug-resistant outbreaks of tuberculosis, the disease landscape is getting worse.[2]

The TB/HIV binomial interferes with the diagnosis, treatment and cure of patients with TB, since antiretroviral treatment is necessary from the beginning of the diagnosis, which often undermines TB treatment. Antiretroviral therapy (ART) reduces the lethality rate. On the other hand, its early onset during TB treatment increases the risk of anti-TB and anti-HIV adverse events and paradoxical effects.[2] Due to the side effects resulting from the combination of antiretroviral and anti-TB medication, patients often drop out of the treatment, which increases their risk of death.[2]

The high fatality rate of TB/HIV co-infection is due to the combination of several factors associated with it, such as the following: failure of the immune system to halt the growth of *Mycobacterium tuberculosis*, which leads to rapid disease progression; frequent atypical onset of the disease (extrapulmonary) and low positive results of sputum smear, which delays the diagnosis of TB; late diagnosis of HIV due to prejudice and insufficient provision of TB/HIV testing in centers that diagnose and treat TB; delayed antiretroviral treatment and TB-specific treatment due to the possibility of high rates of resistance to anti-TB drugs.[4]

Considering the aforementioned factors, this study is justified by the importance of knowing the situation of TB/HIV co-infection and the risk factors involved, so that interventions that help the better management of diseases are outlined, in search of more favorable prognoses. The aim of this study was to analyze the factors associated with HIV/AIDS in patients with tuberculosis (TB) in *Minas Gerais* between 2006 and 2015.

MATERIAL AND METHOD

This is a cross-sectional study conducted with secondary data recorded in *Sistema de Informação de Agravos de Notificação* (SINAN-TB). The study population consisted of new TB cases, aged 18 years old or older, reported at SINAN from January 2006 to December 2015 in the state of *Minas Gerais* and ending by October 2016. Cases which closure was "change of diagnosis" were excluded. 38,130 notifications were identified, of which 3,586 reported having AIDS or tested positive for HIV.

The dependent variable was TB/HIV co-infection (yes or no) and the independent variables were the following: gender; age; race; schooling; area of residence; alcohol consumption, drugs; closure situation; clinical manifestation; associated disorders (diabetes and mental illness); examinations (chest X-ray, sputum smear and sputum culture) and supervised treatment of patients. The following variables were excluded: drug use and tuberculin skin test, as absence of data was more than 20% in the information system.

A descriptive analysis of the quantitative variables was performed, calculating the prevalence of TB/HIV

co-infection and its association with each explanatory variable, using Pearson's chi-square and Fisher's exact tests, with a significance level of 5%.

The strength of the association between TB/HIV co-infection and the explanatory variables was assessed using the Odds Ratio (OR) and its respective 95% confidence intervals using bivariate and multivariate logistic regression. Considering the objectives of this research, the selection of the final logistic regression model was based on backward elimination with likelihood ratio (LR).

This method begins with the inclusion of all the significant explanatory variables in the model ($p<0.20$) in the bivariate analysis. The variables were then removed one at a time, starting with the one that reduces LR by the minimum amount. The equation was evaluated at each step and the procedure was repeated until each variable that remained in the model explained a significant portion of the variation observed in the response. In the multivariable model, variables with $p<0.05$ were considered significant. All analyses were performed with Epiinfo 7.0.

Since it refers to the analysis of secondary data, this study did not require the consideration and approval of the Ethics Committee on Researches with Human Beings. The project was authorized by the *Departamento de Análise e Situação de Saúde da Secretaria Estadual de Saúde de Minas Gerais* by signing the Commitment Term for the use of SINAN databases. It should be noted that the database provided did not contain names and/or any patient identification information.

RESULTS

Of the 38,130 new cases reported, most were male, living in the urban area and with up to eight years of schooling. The highest frequencies of tuberculosis cases are found in the age group of 18 to 49 years old and in individuals who reported being black, brown or indigenous (Table 1).

The prevalence of HIV/AIDS among tuberculosis patients was 9.4%. Regarding clinical characteristics, most individuals had the pulmonary form, approximately 3.2% had some type of mental illness, 58% did not use alcohol and 6.8% had diabetes. Regarding the diagnosis, most had suspicious X-rays and positive smear. However, sputum culture was not performed in 84.3% of the cases. Regarding treatment and closure, 50.5% underwent supervised treatment and 72.2% were cured (Table 1).

In the bivariate analysis (Table 2), the frequency of HIV/AIDS was higher in the age group of 30 to 49 years old, male gender, unknown area of residence, unknown

Table 1 - Socio-demographic and clinical characteristics of tuberculosis (TB) patients

Variables	n	%
Age Group		
18-29	7,460	19.56%
30-39	8,379	21.97%
40-49	8,472	22.22%
50-59	6,654	17.45%
60 or +	7,165	18.79%
Gender		
Female	12,071	31.66%
Male	26,059	68.34%
Area of residence		
Area	32,828	88.95%
Rural	3,617	9.80%
Peri-urban	222	0.60%
Unknown	240	0.65%
Race		
White/Yellow	13,217	35.96%
Black/Brown/Indigenous	20,238	55.06%
Unknown	3,304	8.99%
Schooling		
Up to 4 years	10,971	32.78%
5 to 8 years	6,658	19.90%
9 to 11 years	4,396	13.14%
Complete and incomplete higher education	1,532	4.58%
Unknown	9,896	29.57%
Does not apply	11	0.03%
Use of alcohol		
Yes	7,873	21.77%
No	21,088	58.32%
Unknown	7,199	19.91%
Diabetes		
Yes	2.424	6.79%
No	25,638	71.85%
Unknown	7,622	21.36%
Mental illness		
Yes	1,149	3.24%
No	26,700	75.23%
Unknown	7,643	21.53%
HIV/AIDS		
No	34,544	90.60%
Yes	3,586	9.40%

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Table 1 - Socio-demographic and clinical characteristics of tuberculosis (TB) patients

Variables	n	%
Clinical manifestation		
Pulmonary	29,848	78.28%
Extrapulmonary	6,688	17.54%
Pulmonary + extrapulmonary	1,594	4.18%
X-Rays		
Suspicious	31,107	82.47%
Normal	2,779	7.37%
Another disease	600	1.59%
Not performed	3,231	8.57%
Diagnostic sputum smear		
Positive	21,539	56.60%
Negative	7,942	20.87%
Not performed	8,573	22.53%
Diagnostic sputum culture		
Positive	2,512	6.59%
Negative	1,527	4.00%
Pending	1,934	5.07%
Not performed	32,157	84.34%
Supervised treatment		
Supervised	17,246	50.46%
Self-Administered	13,480	39.44%
Unknown	3.451	10.10%
Closure		
Cure	27,538	72.22%
Interruption	4,470	11.72%
Death from tuberculosis	1,379	3.62%
Death due to other causes	2,444	6.41%
Transference	2,299	6.03%

Source: SINAN 2006-2015.

race and unknown schooling. Among the clinical variables, the highest frequency of HIV/AIDS was among individuals who reported alcohol consumption, not having diabetes, with some mental illness, pulmonary + extrapulmonary form, X-rays suggestive of another disease, smear negative, pending culture, unknown supervised treatment and death from other causes.

After the multivariate analysis (Table 3), the following variables remained associated with the outcome: gender; age; race; schooling; area of residence; alcohol consumption; clinical manifestation; diabetes and mental illness; examinations (chest X-ray, sputum smear and sputum culture); and final situation of the patients.

Table 2 - Socio-demographic and clinical characteristics related to HIV/AIDS prevalence

Variables	HIV		p-value
	No n(%)	Yes n(%)	
Age Group			
18-29	6,854(91.88)	606(8.12)	≤0.001
30-39	7,090(84.62)	1,289(15.38)	
40-49	7,439(87.81)	1,033(12.19)	
50-59	6,184(92.94)	470(7.06)	
60 or +	6,977(97.38)	188(2.62)	
Gender			
Female	11,116(90.02)	955(7.91)	≤0.001
Male	23,428(89.90)	2631(10.10)	
Area of residence			
Urban	28,589(90.13)	3,239(9.87)	≤0.001
Rural	3,489(96.46)	128(3.54)	
Peri-urban	208(93.69)	14(6.31)	
Unknown	156(65.00)	84(35.00)	
Race			
White/Yellow	12,044(91.13)	1,173(8.87)	≤0.001
Black/Brown/ Indigenous	18,423(91.03)	1,815(8.97)	
Unknown	2,795(84.59)	509(15.41)	
Schooling			
Up to 4 years	10,398(94.78)	573(5.22)	≤0.001
5 to 8 years	6,090(91.47)	568(8.53)	
9 to 11 years	4,058(92.31)	338(7.69)	
Complete and incomplete higher education	1,413(92.23)	119(7.77)	
Unknown	8,249(83.36)	1,647(16.64)	
Does not apply	10(90.91)	1(9.09)	
Use of alcohol			
Yes	7,088(90.03)	785(9.97)	≤0.004
No	19,248(91.27)	1,840(8.73)	
Unknown	6,547(90.94)	652(9.06)	
Diabetes			
Yes	2,313(95.42)	111(4.58)	≤0.001
No	23,107(90.13)	2,531(9.87)	
Unknown	7,010(91.97)	612(8.03)	
Mental illness			
Yes	1,006(87.55)	143(12.45)	≤0.001
No	24,239(90.78)	2,461(9.22)	
Unknown	7,003(91.63)	640(8.37)	

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Table 2 - Socio-demographic and clinical characteristics related to HIV/AIDS prevalence

Variables	HIV		p-value
	No n(%)	Yes n(%)	
Clinical manifestation			
Pulmonary	27,935(93.59)	1,913(6.41)	≤0.001
Extrapulmonary	5,611(83.90)	1,077(16.10)	
Pulmonary + extrapulmonary	998(62.61)	596(37.39)	
X-Rays			
Suspicious	2,8551(91.78)	2,556(8.22)	≤0.001
Normal	2,180(7845)	599(21.55)	
Another disease	459(76.50)	141(23.50)	
Not performed	2,975(92.08)	256(7.92)	
Sputum smear			
Positive	20,358(94.52)	1,181(5.48)	≤0.001
Negative	6,756(85.07)	1,186(14.93)	
Not performed	7361(85.86)	1,212(14.14)	
Sputum culture			
Positive	2,301(91.60)	211(8.40)	≤0.001
Negative	1,276(83.56)	251(16.44)	
Pending	1,554(80.35)	380(19.65)	
Not performed	29,413(91.47)	2,744(8.53)	
Supervised treatment			
Supervised	15,773(91.46)	1,473(8.54)	≤0.001
Self-Administered	12,225(90.69)	1,255(9.31)	
Unknown	2,972(86.12)	479(13.88)	
Closure			
Cure	25,882(93.99)	1,656(6.01)	≤0.001
Interruption	3,859(86.33)	611(13.67)	
Death from tuberculosis	1,182(85.71)	197(14.29)	
Death due to other causes	1,631(66.73)	813(33.27)	
Transference	1,990(86.56)	309(13.44)	

Source: SINAN 2006-2015. Tests used: Pearson's chi-square and Fisher's exact tests, with $p \leq 0.05$.

Regarding the association with socio-demographic characteristics, there was a high chance of TB/HIV/AIDS co-infection in individuals aged 30 to 49 years old compared to those in the age group of 18 to 29 years old. On the other hand, individuals aged 50 years old and older were less likely to have co-infection than those from 18 to 29 years old. Males had a 30% higher chance (OR = 1.30; 95% CI: 1.19-1.45) of HIV/AIDS when compared to females. Those with five to eight years of schooling or an unknown education level were more likely to have HIV/AIDS compared to individuals with up to four years of schooling.

Table 3 - Gross and adjusted analysis of the association between TB/HIV/AIDS co-infection and socio-demographic and clinical variables

Variables	Gross OR (95% CI)	Adjusted OR (95% CI)
Age group		
18-29	1	1
30-39	*2.06(1.86-2.28)	*1.91(1.68-2.17)
40-49	*1.57(1.41-1.75)	*1.41(1.23-1.61)
50-59	*0.86(0.76-0.97)	*0.67(0.57-0.79)
60 or +	*0.30(0.26-0.36)	*0.19(0.15-0.23)
Gender		
Female	1	1
Male	*1.31(1.21-1.41)	*1.31(1.19-1.45)
Area of residence		
Area	1	1
Rural	*0.34(0.28-0.40)	*0.43(0.34-0.53)
Peri-urban	0.61(0.36-1.06)	0.69(0.36-1.30)
Unknown	*4.92(3.76-6.43)	*2.39(1.69-3.36)
Race		
White/Yellow	1	-
Black/Brown/Indigenous	1.01(0.94-1.09)	-
Unknown	*1.87(1.67-2.09)	-
Schooling		
Up to 4 years	1	1
5 to 8 years	*1.69(1.50-1.91)	*1.26(1.10-1.46)
9 to 11 years	*1.51(1.32-1.74)	0.98(0.82-1.16)
Complete and incomplete higher education	*1.53(1.24-1.88)	0.92(0.72-1.18)
Unknown	*3.62(3.28-4.00)	*2.18(1.94-2.46)
Does not apply	1.81(0.23-14.20)	2.16(0.24-19.30)
Use of alcohol		
Yes	1	1
No	*0.86(0.79-0.94)	0.96(0.86-1.08)
Unknown	*0.90(0.81-1.01)	*1.36(1.10-1.68)
Diabetes		
Yes	1	1
No	*2.28(1.88-2.77)	*1.89(1.47-2.41)
Unknown	*1.82(1.48-2.24)	1.03(0.73-1.45)
Mental illness		
Yes	1	1
No	*0.71(0.60-0.86)	*0.75(0.61-0.95)
Unknown	*0.64(0.53-0.78)	*0.69(0.49-0.98)

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Table 3 - Gross and adjusted analysis of the association between TB/HIV/AIDS co-infection and socio-demographic and clinical variables

Variables	Gross OR (95% CI)	Adjusted OR (95% CI)
Clinical manifestation		
Pulmonary	1	1
Extrapulmonary	*2.80(2.59-3.04)	*1.50(1.31-1.72)
Pulmonary + extrapulmonary	*8.72(7.80-9.75)	*4.54(3.92-5.27)
X-Rays		
Suspicious	1	1
Normal	*3.07(2.78-3.39)	*2.32(2.00-2.68)
Another disease	*3.43(2.83-4.16)	*2.35(1.81-3.05)
Not performed	0.96(0.84-1.10)	1.03(0.87-1.23)
Sputum smear		
Positive	1	1
Negative	*3.03(2.78-3.30)	*2.01(1.79-2.26)
Not performed	*2.84(2.61-3.09)	*1.71(1.50-1.94)
Sputum culture		
Positive	1	1
Negative	*2.15(1.76-2.61)	*1.19(0.93-1.53)
Pending	*2.67(2.23-3.19)	*1.56(1.23-1.96)
Not performed	1.02(0.88-1.18)	*0.78(0.65-0.94)
Supervised treatment		
Supervised	1	-
Self-Administered	1.10(1.02-1.19)	-
Unknown	*1.73(1.55-1.93)	-
Closure		
Cure	1	1
Interruption	*2.47(2.24-2.73)	*2.19(1.94-2.48)
Death from tuberculosis	*2.60(2.22-3.05)	*2.99(2.45-3.65)
Death due to other causes	*7.79(7.07-8.59)	*8.89(7.76-10.19)
Transference	*2.43(2.13-2.76)	*1.42(1.65-2.27)

Source: SINAN 2006-2015.

For rural residents, the chance of HIV/AIDS was 138% lower (OR = 0.42; 95% CI: 0.34-0.52) compared to urban residents. It was also observed that individuals with TB/HIV/AIDS co-infection were more likely to present unknown values in the variable "area of residence". Alcohol users are less likely to have TB/HIV/AIDS than those with unknown data (36% more likely).

Regarding the association with clinical characteristics, there was an 89% greater chance (OR = 1.89; 95% CI: 1.47-2.41) of TB/HIV/AIDS co-infection among patients without diabetes when compared to diabetics. Individuals who reported mental illness are more susceptible to TB/HIV/AIDS co-infection than those who did not report or with unknown information. Higher chances of TB/HIV/AIDS co-infection were also described among individuals with extrapulmonary and pulmonary + extrapulmonary tuberculosis, with 1.5 and 4.54 times a greater chance of outcome, respectively, when compared to individuals with the pulmonary form.

Regarding the diagnosis and treatment of tuberculosis, there was a greater chance of TB/HIV/AIDS co-infection among patients with normal X-ray or results indicating another disease, when compared to those with suspicious results. For sputum smear, there were higher chances of outcome among individuals with negative results or those who did not undergo this exam compared to those with positive smear. Regarding the sputum culture, the chances of TB/HIV/AIDS co-infection were higher among patients with negative or pending culture results, when compared to those with a positive culture result. However, the absence of the sputum culture is related to a 28% lower chance of co-infection with TB/HIV/AIDS (OR = 0.78; 95% CI: 0.65-0.94) compared to patients with a positive culture. Considering closure, there was a greater chance of TB/HIV/AIDS co-infection for all categories (interruption, death from tuberculosis, death from other causes and transfer to the same township) compared to the reference category (cure), highlighting patients who died from other causes, whose chances were 8,89 times (95% CI: 7.76-10.19) higher than those who were cured.

DISCUSSION

In this study, *Mycobacterium tuberculosis* - HIV co-infection was present in 9.4% of the individuals studied. This prevalence was similar to that observed in a study conducted in the Brazilian population with data collected between 2006 and 2010, which found that 8.9% of the individuals with tuberculosis were co-infected with HIV.[5] Another study, also conducted with the Brazilian population between 2007 and 2011, found a prevalence of 19%.[6] On the other hand, other surveys with data from individuals from different regions of the country have shown quite divergent results. Among TB patients from the state of Amazonas between 2001 and 2012, there was a co-infection rate of 7.7%.[7] In the city of *Ribeirão Preto* (SP), from 2003 to 2011, a prevalence of 26.5% was identified.[8] And in the state of *Maranhão*, TB/HIV/AIDS co-infection had a prevalence of 39% between 2001 and 2010.[9] These differences reflect the economic condition of the place where the research was conducted and/or the central focus of tuberculosis control and may also be associated with the coverage and quality of case reports.

Regarding the variables associated with HIV/AIDS in patients with tuberculosis, more chances of HIV/AIDS were detected among men, which has also been reported in other

investigations.[5-7,9-11] These results may be related to women's higher search for health services, lower alcohol consumption by women and different types of jobs.[10]

Age was another factor associated with the outcome, with significant chances of HIV/AIDS in individuals aged 30 to 49 years old. Very similar results were found in other studies in the Brazilian population, which found a higher frequency of tuberculosis and HIV/AIDS in the age groups of 30 to 49[11] and 40 to 59.[5] In a city of *Paraíba*, the highest chance of co-infection occurred in the range of 20 to 39 years old;[10] and in the state of *Amazonas*, between 25 and 39 years old.[7] Young adults are the main targets of tuberculosis and HIV/AIDS epidemics, and considering they are in the full productive phase of their professional life, this scenario has important social repercussions for patients, families and the society. [5,7,10-12]

Tuberculosis patients with five to eight years of study had the highest chance of HIV/AIDS. A study conducted in the state of *Paraíba* obtained a similar result, evidencing that most co-infected individuals had up to eight years of study.[10] It was also inferred that individuals with unknown schooling had a higher chance of co-infection. Failure to fill SINAN notification form fields regarding schooling limits the analysis of this variable. Low schooling may reflect poor living and employment conditions, which may increase the chances of developing the disease due to poor access to information.[10]

The results of this research showed that individuals living in rural areas were less likely to have HIV/AIDS than those living in urban areas. Other studies also found a higher frequency of HIV/AIDS among tuberculosis patients living in urban areas.[7,13] Intense urbanization favors the creation of urban settlements, slums and outskirts, exposing individuals to very poor housing and food conditions and lack of sanitation, which are risk factors for the spread of diseases and infections.[14]

In their research, Prado *et al.*[6] concluded that alcoholism was not associated with TB/HIV/AIDS co-infection. In this study, the chance of co-infection was higher when information on this variable was unknown, which limited the analysis of this variable. Alcoholism associated with sexual behavior is a risk factor for the spread of sexually transmitted diseases, such as HIV/AIDS, since the use of alcohol before or during the sexual act may favor unprotected sex.[15]

Considering the clinical manifestation of tuberculosis, the chance of co-infection was higher in individuals with extrapulmonary or pulmonary + extrapulmonary tuberculosis. In the study by Prado *et al.*[6] between 2007 and 2011, the chances of co-infection were higher only in individuals with pulmonary + extrapulmonary tuberculosis. In TB individuals older than 15 years old who did not have AIDS, about 90% of the cases are expected to develop pulmonary tuberculosis. In its turn, in cases of tuberculosis associated with HIV/AIDS, there is a greater number of extrapulmonary TB. In spite of that, pulmonary TB is still the most important in frequency, and many cases present cavitary radiological image compatible with active tuberculosis, so this observation has been changing the approach of TB/HIV/AIDS co-infection in Brazil.[14]

In this study, there was a higher chance of HIV/AIDS among people with tuberculosis who did not have diabetes when compared to diabetics, similar to another study with TB patients in Brazil.[6] However, authors have shown that uncontrolled diabetes is associated with numerous complications, including increased susceptibility to infections, since hyperglycemia and decreased insulin interfere with the immune response, acting directly on the cellular function of macrophages and lymphocytes, altering chemotactic function, phagocytosis and antigen presentation.[16] In addition, the literature has shown that diabetes medication is also somehow associated with impaired immune responses to pathogens.[17]

The absence of mental illness, on the other hand, was associated with a reduced chance of HIV/AIDS in tuberculosis patients. Patients with mental disorders have their symptoms underestimated by health teams and themselves. And after the disease is confirmed, there is difficulty in treatment due to the need to establish a medication routine.[18]

In the case of patients with mental disorders, this is a problematic factor, as they may have a crisis that, added to the side effects of the medication, may lead to non-acceptance of the tuberculosis medication, with consequent treatment interruption.[18] Individuals with unknown information on this variable were at low risk compared to patients who reported mental illness. However, the absence of mental illness may also be due to poor completion of notification forms and not due to the absence itself. This can be a problem for not showing the real magnitude of the problem.[10]

Regarding the diagnosis, there was a low percentage of sputum culture. This can be explained by the fact that sputum culture is indicated only in cases of clinical and/or radiological suspicion of repeatedly negative-smear tuberculosis,[2] and in most of the individuals studied smear was positive. There are other indications for mycobacterial culture, as in suspected cases of TB with diagnostic difficulties (paucibacillary TB and children), suspected extrapulmonary TB. In addition, regardless of the result of the sputum smear, the culture is also indicated in contacts of patients with resistant tuberculosis; patients with a previous treatment history, regardless of the time elapsed; immunosuppressed patients, especially those with HIV; patients with a positive smear at the end of the second month of treatment; failure of anti-B treatment (see chapter on Treatment); investigating populations at high risk of presenting strains of resistant *Mycobacterium tuberculosis*.[19]

With regard to the tuberculosis diagnostic methods, greater chances of TB/HIV/AIDS co-infection were documented among individuals with negative sputum smear and culture, as well as among those who did not have sputum smear and whose sputum culture was pending. These results may be related to the materials collected for such examinations, considering that the extrapulmonary (predominant clinical manifestation in HIV/AIDS) sample throughput for detection of mycobacteria through sputum smear and sputum culture differs according to the anatomical site involved and the type of material collected for examination.[1]

At closure, the cure and dropout rate in this study was around 73% and 11%, respectively. Despite being a serious disease that can lead to death, chemotherapy can cure almost all cases of TB. In addition, patients can now count on easy access to the diagnosis and medication used in their treatment[5]. However, in practice, the problem of tuberculosis treatment is the high dropout rate that, in some Brazilian capitals, can reach 25% of patients. The major concern about interruption is due to irregular treatments that, in addition to not curing the patients, can make them resistant to the usual drugs.[16]

In this study, there were higher chances of HIV/AIDS for all categories, including the following: interruption, death from tuberculosis, death from other causes and transfer to another city, when compared to those that were cured. Interruption has been approached in the literature regarding the need to review the strategies for monitoring tuberculosis patients, given the high rate of treatment interruption and tuberculosis prophylaxis, as well as due to the association between this interruption and non-adherence to AIDS treatment.[17]

Regarding closure with death from tuberculosis, according to the World Health Organization, although most deaths caused by tuberculosis are preventable, it is still the second leading cause of infectious-disease deaths in the world and, in 2013, 1,5 million people died from tuberculosis, of which 0.4 million were associated with co-infection with HIV/AIDS.[20]

In the case of death from other causes, it is not possible to rule out the possibility of underestimation of records that had tuberculosis as the basic cause of death, to the prejudice of other causes.[13]

Regarding the greater chance of TB/HIV/AIDS co-infection among patients who were transferred, this may be related to the greater complexity of tuberculosis cases associated with HIV/AIDS, in which pulmonary surgery is often indicated, and there is therefore a need for referral to hospitals able to perform this procedure.[15]

In this study there was a high percentage of unknown data of patients co-infected with TB/HIV in the variables "area of residence", "schooling", "alcohol consumption" and "mental illness". Nevertheless, these categories were used in the analysis to draw attention to the problem of inadequate filing of SINAN records and to identify whether they were a differential between patients co-infected or not with HIV/AIDS, which indeed occurred. In this sense, the results should be interpreted with caution, as unknown data can make it difficult to identify the actual factors associated with TB/HIV co-infection.

The study was limited by the low quality of data available in the SINAN. The findings revealed failures in filling records for several system variables. The SINAN should receive all TB case reporting and follow-up data from their identification to their outcome. However, there are many gaps in data completion and patient follow-up until discharge.[21] In addition to the large amount of unknown information, it is important to highlight the need to exclude the following variables: drug use and tuberculin skin test, as they presented more than 20% lack of information.

Completing this information in the notification form should be encouraged, aiming to know the association of the disease with other health problems, which will enable strategies to reduce new cases, relapses, interruptions, deaths and complications, in addition to influencing the treatment option to be used and the health service(s) in which the patient should be monitored.

CONCLUSION

The prevalence of TB/HIV/AIDS co-infection was 9,4% and was associated with gender, age, area of residence, schooling, alcohol consumption, associated diseases (diabetes and mental illness), clinical manifestation, diagnostic tests (X-rays, sputum smear and sputum culture) and closure. Recognizing these factors may contribute to new strategies to avoid or delay undesirable prognoses in this population.

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