EPIDEMIOLOGICAL PROFILE OF TUBERCULOSIS CARRIERS IN A MUNICIPALITY IN THE METROPOLITAN REGION OF PORTO ALEGRE, RS, BRASIL

PERFIL EPIDEMIOLÓGICO DE PERSONAS CON TUBERCULOSIS EN UN MUNICIPIO DE LA REGIÓN METROPOLITANA DE PORTO ALEGRE, RS, BRASIL

PERFIL EPIDEMIOLÓGICO DE PESSOAS COM TUBERCULOSE EM UM MUNICÍPIO DA REGIÃO METROPOLITANA DE PORTO ALEGRE, RS, BRASIL

[1]Jéssica Rosiane de Brito
[2]Janini Cristina Paiz
[3]Miria Bairros Camargo
[4]Maria Renita Burg

[1]Enfermeira. Residente do 2º ano da Residência Multiprofissional em Saúde da ULBRA. Canoas – RS. Brazil. Email: Jessicabrito.jessica@gmail.com. Orcid: 0000-0003-3680-7677

[2]Enfermeira. docente na Universidade de Caxias do Sul, Mestre e Doutora em Epidemiologia pela Universidade Federal do Rio Grande do Sul. Caxias do Sul- RS, Brazil. Email: jcpaiz@ucs.br. Orcid: 0000-0002-3160-8428

[3]Enfermeira. Mestre em Educação. Coordenadora da Comissão da Residência Multiprofissional em Saúde da ULBRA. Canoas – RS. Brazil. Email: miria.camargo@ulbra.br. Orcid: 0000-0003-3173-7681

[4]Enfermeira. Mestrado em saúde coletiva. Tutora do Núcleo da Enfermagem da Residência Multiprofissional em Saúde da ULBRA. Canoas – RS. Brazil. Email: renita@terra.com.br. Orcid: 0000-0002-7501-3151

Corresponding Author
Jéssica Rosiane de Brito
Lutheran University of Brazil - ULBRA, Canoas. Farroupilha Avenue, 8001, São José Neighborhood, Zip Code 92425-900, Canoas, RS - Brazil. Phone: +55 51 34779298. E-mail: Jessicabrito.jessica@gmail.com

ABSTRACT

This study aims to identify the epidemiological profile of people with tuberculosis (TB) in a municipality located in the metropolitan region of Porto Alegre, Rio Grande do Sul, between 2022 and 2023, aiming to provide support for the implementation of effective disease control and prevention strategies. This is a cross-sectional, quantitative study that used secondary data on TB cases reported in the Notifiable Diseases Information System (SINAN) and in the municipality's electronic medical records. A total of 109 cases reported between June 2022 and July 2023 were analyzed. Statistical analysis was performed using SPSS 25.0 software. The results revealed that 68.8% of TB cases were diagnosed in men; 70.6% of diagnoses occurred in new cases; 16.5% of diagnosed individuals underwent Directly Observed Treatment (DOT); Among the variables associated with the outcome of death, advanced age (p-value 0.01) and extrapulmonary tuberculosis were identified. The most frequent clinical form was pulmonary tuberculosis (84.4%), with most cases resulting in cure (40.3%), while treatment abandonment was 31.2%. Among the conditions analyzed, HIV-TB coinfection was associated with treatment abandonment (p 0.51); as were illicit drug use (p 0.01) and homelessness. These aspects highlight the vulnerability of these groups to continued treatment. It is concluded that strategies to reorganize care for people with tuberculosis in primary health care are necessary, including the training of health workers.
Keywords: Tuberculosis; Public Health; Epidemiology; Social Vulnerability.

RESUMEN

Este estudio tiene como objetivo identificar el perfil epidemiológico de las personas con tuberculosis (TB) en un municipio ubicado en la región metropolitana de Porto Alegre, Rio Grande do Sul, entre 2022 y 2023, con el objetivo de brindar apoyo para la implementación de estrategias efectivas de control y prevención de enfermedades. Se trata de un estudio cuantitativo transversal que utilizó datos secundarios sobre los casos de TB notificados en el Sistema de Información de Enfermedades de Notificación Obligatoria (SINAN) y en los registros médicos electrónicos del municipio. Se analizaron un total de 109 casos notificados entre junio de 2022 y julio de 2023. El análisis estadístico se realizó con el software SPSS 25.0. Los resultados revelaron que el 68,8% de los casos de TB se diagnosticaron en hombres; el 70,6% de los diagnósticos ocurrieron en casos nuevos; el 16,5% de los individuos diagnosticados se sometieron a Tratamiento Directamente Observado (TDO); Entre las variables asociadas con el desenlace de muerte, se identificaron la edad avanzada (valor p 0,01) y la tuberculosis extrapulmonar. La forma clínica más frecuente fue la tuberculosis pulmonar (84,4%), con la mayoría de los casos curados (40,3%), mientras que el abandono del tratamiento fue del 31,2%. Entre las afecciones analizadas, la coinfección por VIH y tuberculosis se asoció con el abandono del tratamiento (p = 0,51), al igual que el consumo de drogas ilícitas (p = 0,01) y la situación de calle. Estos aspectos resaltan la vulnerabilidad de estos grupos a la continuación del tratamiento. Se concluye que son necesarias estrategias para reorganizar la atención a las personas con tuberculosis en la atención primaria de salud, incluyendo la capacitación del personal sanitario.
Palabras clave: Tuberculosis; Salud Pública; Epidemiología; Vulnerabilidad Social.

RESUMO

Este estudo tem como objetivo identificar o perfil epidemiológico de pessoas com tuberculose(TB) em um município situado na região metropolitana de Porto Alegre/RS entre 2022 e 2023, visando fornecer subsídios para a implementação de estratégias eficazes de controle e prevenção da doença. Trata-se de um estudo de delineamento transversal, quantitativo que utilizou dados secundários de casos notificados de TB no Sistema de Informação de Agravos de Notificação (SINAN) e em prontuários eletrônicos do município. Foram analisados 109 casos notificados entre junho de 2022 e julho de 2023. A análise estatística foi realizada software SPSS 25.0. Os resultados revelaram que 68,8% dos casos de TB foram diagnosticados em homens; 70,6% dos diagnósticos ocorreram em casos novos; 16,5% das pessoas diagnostigadas realizaram Tratamento Diretamente Observado (TDO); Dentre as variáveis associadas com o desfecho óbito, identificou-se a idade avançada (*p-valor 0,01*); a forma extrapulmonar. A forma clínica mais frequente foi de tuberculose pulmonar (84,4%) e a maioria dos casos teve desfecho cura (40,3%) e o abandono foi de 31,2%. Entre os agravos analisados, a coinfecção HIV-TB teve associação com abandono (*p 0,51*); bem como o uso de drogas ilícitas (*p 0,01*) e estar em situação de rua. Esses aspectosevidenciam a vulnerabilidade desses grupos para a continuidade do tratamento. Conclui-se que são necessárias estratégias de reorganização do cuidado à pessoa com tuberculose na atenção primária à saúde incluindo a capacitação dos trabalhadores da saúde.
Palavras chaves: Tuberculose; Saúde Pública; Epidemiologia; Vulnerabilidade Social.

INTRTODUCTION

Tuberculosis (TB) is considered a major global public health problem, as its effects negatively impact the lives of individuals affected by the disease in various ways. TB is caused by Mycobacterium tuberculosis and is considered the oldest known disease in human history[1-4]. In Brazil, the tuberculosis (TB) mortality rate had been slowly declining for about two decades, but in 2021, this trend changed, with the country recording 5,072 deaths, representing a rate of 2.38 deaths per 100,000 inhabitants. Compared to 2019, there was a 10.7% increase in the mortality rate and an 11.9% increase in total deaths. The last time TB deaths exceeded 5,000 was in 2002[5,6].

Between 2018 and 2019, approximately 14 million Brazilians were diagnosed with tuberculosis, posing an extremely challenging scenario for the health of the global population[3]. During the COVID-19 pandemic, tuberculosis (TB) services were severely impacted, hampering treatment and active case-finding efforts. This resulted in a 12.1% reduction in the TB incidence rate, falling from 37.9 cases per 100,000 population in 2019 to 33.3 in 2020. In 2021, it increased to 34.9, and in 2022, to 36.3 cases, but still below pre-pandemic levels[6].

History allows us to understand that it was Europeans who, during their expeditions, brought tuberculosis to the Americas, and since its emergence, it has caused high incidence rates and high death rates among the population, especially among Indigenous peoples at that time[2]. Despite scientific and technological advances in healthcare, tuberculosis remains a significant challenge in developing countries, including Brazil, where incidence and mortality rates are alarming, especially among low-income populations[6].

TB transmission occurs primarily through droplets expelled by infected individuals during everyday activities such as talking, coughing, or sneezing[8,9]. Risk factors such as immunocompromise, substance abuse, poor socioeconomic conditions, and inadequate housing are associated with increased vulnerability to infection. TB treatment is effective when administered appropriately, reducing transmission and drug resistance[2].

A TB diagnosis creates numerous vulnerabilities for infected individuals, including social, physical, and emotional ones. Therefore, it is essential to consider the individual's social determinants of health. This will enable better comprehensive and effective care strategies, addressing each individual individually and mitigating potential gaps in individualized care[8,9]. Primary Health Care (PHC) plays a fundamental role in treatment adherence, coordinating actions aimed at mitigating the spread of the disease and improving patients' quality of life [7].

Since 2003, tuberculosis control in the country has been considered one of the Ministry of Health's main priorities, providing those involved in tuberculosis control with access to technical, scientific, administrative, and political knowledge to ensure tuberculosis control and

individual cure[8]. Tuberculosis treatment has been guided since 2004 by the National Tuberculosis Control Program (PNCT) and the 2011 Manual of Recommendations for Tuberculosis Control, and is offered exclusively by the Unified Health System (SUS).

Considering the implications of tuberculosis for public health, this study will seek to identify the profile of individuals with tuberculosis in the municipality, aiming to enable better TB control strategies to minimize treatment noncompliance, resistance, disease spread, and municipal costs resulting from failure to control this health problem. It is also of interest that this study can raise awareness among managers in the adoption of protocols and better tools for TB control in PHC.

In this context, the general objective of the research is to understand the epidemiological profile of tuberculosis in users of the municipality of the metropolitan region of Porto Alegre/RS, from June 2022 to July 2023. Other objectives of this study were to outline the epidemiological profile related to TB-HIV coinfection and the clinical form of the disease; and to identify associated diseases and conditions of users and understand the profile of users in relation to treatment outcomes.

METHODOLOGY

This is a cross-sectional, quantitative, exploratory, descriptive, and retrospective study that analyzed secondary data on tuberculosis prevalence from 2022 to 2023.

The study was conducted in a municipality in the metropolitan region of Porto Alegre, Rio Grande do Sul, with a population of 80,755 residents served by twelve Basic Health Units (UBS), six of which have Family Health Strategy (ESF) teams.

The research was conducted by examining the municipality's compulsory tuberculosis notification forms, registered in the Notifiable Diseases Information System (SINAN). All tuberculosis notification forms contained in the Epidemiological Surveillance database of the Municipal Health Department were analyzed. The epidemiological year used in this research was June 2022 to July 2023. The study population, during this period, consisted of 109 people with tuberculosis.

The inclusion criteria were: users notified to SINAN in 2022 and 2023 with a confirmed diagnosis of tuberculosis. The exclusion criteria were: users who started treatment in 2021 and were discharged in 2022. The same criteria were applied to those who started treatment in 2023 and completed treatment in 2024.

For data collection, a Microsoft Excel database was created with information from the SINAN form. The data were collected from the Epidemiological Surveillance Department and supplemented with information available in the electronic medical records of users in the municipality.

The following data were analyzed: sex, referral UBS, type of admission (new case or re-admission after treatment abandonment), clinical

presentation, associated diseases and conditions, HIV co-infection, and treatment outcome (cure, treatment abandonment).

The results of the nominal identification variables were expressed through frequency analyses. Continuous variables were expressed through position measures (mean and median) and dispersion (standard deviation, minimum, maximum), and categorical variables were expressed through frequency analyses. Fisher's exact test was used to verify the association between treatment outcome and sex, age, and clinical presentation. The chi-square test was used to verify the association between age, comorbidities, and co-infection, according to the test assumptions, which were met. The Kolmogorov-Smirnov test was used to verify data normality. In all tests, $p < 0.05$ was considered significant. Data analysis was performed using SPSS 23.0.

The research project was approved by the city's Center for Public Health Studies and Plataforma Brasil, through the Research Ethics Committee (CEP) of the Lutheran University of Brazil (ULBRA), under opinion number 7.106.530.

RESULTS

The results were presented in five tables that allow us to identify the characteristics of people with tuberculosis in the research municipality, including treatment.

Table 1 presents a descriptive analysis of the demographic and socioeconomic profile of the study participants. Variables such as sex, age, race, education level, and gestational status of the reported individuals were analyzed.

Table 1 - Analysis of the demographic and socioeconomic profile of participants in a municipality in the Metropolitan Region of Porto Alegre, RS, Brazil, 2022-2023.

Variables:	Year 2022 n(%)	2023 n(%)	General n(%)	P-value
Gender:				0,29
Male	34 (65,4)	41 (71,9)	75 (68,8)	
Female	18 (34,6)	16 (28,1)	34 (31,2)	
Age:	43,92±	44,30±	44,12±	0,92
Race:				0,33
White	39 (75)	36 (63,2)	75 (68,8)	
Black	2 (3,8)	8 (14)	10 (9,2)	
Yellow	0 (0)	1 (1,8)	1 (0,9)	
Brown	7 (13,5)	7 (12,3)	14 (12,8)	
Indigenous	0 (0)	0 (0)	0 (0)	
Ignored	4 (7,7)	5 (8,8)	9 (8,3)	
School history:				0,25
Imcomplete 4th grade elementary level	1 (1,9)	1 (1,8)	2 (1,8)	
Full 4th grade elementary level	0 (0)	3 (5,3)	3 (2,8)	

Imcomplete elementary level	2 (3,8)	8 (14)	10 (9,2)
4 –Full elementary level	2 (3,8)	4 (7)	6 (5,5)
5 – Imcomplete high school	2 (3,8)	3 (5,3)	5 (4,6)
Full high school	4 (7,7)	1 (1,8)	5 (4,6)
Imcomplete graduation	1 (1,9)	0 (0)	1 (0,9)
Full graduation	1 (1,9)	1 (1,8)	2 (1,9)
Ignored	17 (32,7)	14 (24,6)	31 (28,5)
BPC beneficiary:			0,01**
Yes	0 (0)	5 (8,8)	5 (4,6)
No	35 (67,3)	20 (35,1)	55 (50,4)
Ignored	17 (32,7)	32 (56,1)	49 (45)
Pregnant woman:			0,01**
No	17 (32,7)	5 (8,8)	22 (20,2)
Do not apply (male)	35 (67,3)	50 (87,7)	85 (78)
Ignored	0 (0)	2 (3,5)	2 (1,8)

Survey data (2024)

1 - Chi-square test 2 - Independent samples t-test 3 - Fisher's exact test

**Significant at the 0.05 level

The data indicate that, regarding gender, there was a male predominance in both years, with 65.4% in 2022 and 71.9% in 2023, for a total of 68.8% of cases. Regarding age, the average age remained stable, at 43.92 years in 2022 and 44.30 years in 2023, resulting in an overall average of 44.12 years.

The analysis by race shows that the majority of cases were recorded among White individuals, representing 75% in 2022 and 63.2% in 2023, for a total of 68.8% in the period. There was also an increase in the participation of Black individuals, rising from 3.8% in 2022 to 14% in 2023. Other racial categories, such as mixed race and Asian, showed stable or marginal values.

Regarding education, the data indicate a high proportion of missing responses (75.2% in 2022 and 63% in 2023), which may limit further analysis. However, a slight variation is observed in the categories of incomplete elementary and high school education.

In the Continuous Benefit Beneficiary (BPC) category, there was an increase in beneficiaries, with 8.8% in 2023, compared to no records in 2022, totaling 4.6% of cases. This increase was statistically significant ($p = 0.01$).

Finally, in the pregnant women category, there was a significant difference ($p = 0.04$) between the years, with a higher proportion of individuals for whom this condition "does not apply" in 2023 (87.7%) compared to 2022 (67.3%), as they are male.

These results, presented in percentage terms and with statistical analysis, provide a comprehensive overview of the profile of the study population, providing support for

discussions and future public health interventions.

Table 2 presents a detailed analysis of the methods of access to health services, population profile, and socioeconomic variables of the participants.

Table 2 - Clinical Profile and Socioeconomic Conditions of Participants from a Municipality in the Metropolitan Region of Porto Alegre, RS, Brazil, 2022-2023.

Variables:	Year 2022	2023	Geral	V- p
Entry form :				0,74
New case	37 (71,2)	40 (70,2)	77 (70,6)	
Relapse	5 (9,6)	6 (10,5)	11 (10,1)	
Re-entry after abandonment	6 (11,5)	9 (15,8)	15 (13,8)	
Transference	4 (7,7)	2 (3,5)	6 (5,5)	
Population deprived of liberty:				0,15
Yes	0 (0)	2 (3,5)	2 (1,8)	
No	52 (100)	53 (93)	105 (96,3)	
Ignored	0 (0)	2 (3,5)	2 (1,8)	
Homeless population:				0,8
Yes	8 (15,4)	7 (12,3)	15 (13,7)	
No	43 (82,7)	48 (84,2)	91 (83,5)	
Ignored	1 (1,9)	2 (3,5)	3 (2,8)	
Healthcare professional:				0,87
Yes	1 (1,9)	1 (1,8)	2 (1,8)	
No	50 (96,2)	54 (94,7)	104 (95,4)	
Ignored	1 (1,9)	2 (3,5)	3 (2,8)	
Imigrant:				0,55
Yes	0 (0)	1 (1,8)	1 (0,9)	
No	51 (98,1)	54 (94,7)	105 (96,3)	
Ignored	1 (1,9)	2 (3,5)	3 (2,8)	
Pulmonary	42 (80,8)	50 (87,7)	92 (84,4)	
Extrapulmonary	6 (11,5)	7 (12,3)	13 (11,9)	
Pulmonary + extrapulmonary	4 (7,7)	0 (0)	4 (3,7)	

Research data (2024) Fisher's Exact Test **Significant at the 0.05 level

Regarding the variable "method of entry into the health service," the majority of cases were recorded as new cases (71.2% in 2022 and 70.2% in 2023), totaling 70.6% of total admissions. Those admitted after treatment discontinuation accounted for 11.5% of cases in 2022 and increased to 15.8% in 2023, representing an overall percentage of 13.8%. Relapse cases remained stable, totaling 10.1% over the two years.

Regarding the prison population, only two (1.8%) previously incarcerated patients entered the service in 2023. The homeless population, however, showed slight variation between the years, with 15.4% of cases in 2022 and 12.3% in 2023, resulting in an overall percentage of 13.7%. In both years, healthcare professionals accounted for only 1.8% of total cases. Immigrants, on the other hand, recorded only one case in 2023, representing 0.9% of the total reported cases during the period.

Regarding the clinical form of tuberculosis, the pulmonary form was the most prevalent, accounting for 80.8% of cases in 2022 and 87.7% in 2023, for a total of 84.4%. Extrapulmonary tuberculosis cases accounted for 11.5% in 2022 and 12.3% in 2023. Combined cases of pulmonary and extrapulmonary tuberculosis were recorded only in 2022, totaling 3.7% of cases.

These results provide an overview of the characteristics of tuberculosis patients treated during the period, highlighting variables relevant to understanding and directing public health policies.

Table 3 provides a detailed analysis of the DOT, patient transfer, and the outcome of tuberculosis cases monitored in the research municipality during 2022 and 2023.

Table 3 - Analysis of the Treatment and Closure Status of Tuberculosis Cases in a Municipality in the Metropolitan Region of Porto Alegre, RS, Brazil 2022-2023.

Varibles:	Year			
	2022 n(%)	2023 n(%)	General n(%)	P-value
TDO done:				0,29
Yes	9 (17,3)	9 (15,8)	18 (16,5)	
No	32 (61,6)	29 (50,9)	61 (56)	
Ignored	11 (21,1)	19 (33,3)	29 (26,6)	0,62
Total contacts examined (average):	1 (0-4)	3 (0-5)	2 (0-4)	0,62
HIV/AIDS:				0,01**
Yes	12(23,1)	9(15,8)	21(19,3)	
No	40(76,9)	39(68,4)	79(72,4)	
Ignored	0(0)	9(15,8)	9(8,3)	
Transference:				0,39
Not transferred	47 (90,4)	51 (89,4)	98 (90)	
Same municipality	1 (1,9)	0 (0)	1 (0,9)	
Different municipality (same state)	4 (7,7)	3 (5,3)	7 (6,4)	
Same state	0 (0)	1 (1,8)	1 (0,9)	
Ignored	0 (0)	2 (3,5)	2 (1,8)	
Closing status:				0,27

No data	1 (1,9)	4 (7,1)	7 (4,6)
Cure	21 (40,4)	23 (40,4)	44 (40,3)
Abandonment	16 (30,7)	18 (31,6)	33 (31,2)
Death by TB	0 (0)	2 (3,5)	2 (1,8)
Death from other causes	5 (9,6)	2 (3,5)	7 (6,4)
Transference	4 (7,7)	6 (10,5)	10 (9,2)
Change of Diagnosis	1 (1,9)	2 (3,5)	3 (2,8)
TB drug resistant	1 (1,9)	0 (0)	1 (0,9)
Change of program	3 (5,8)	0 (0)	3 (2,8)

Research data (2024) 1 - Fisher's Exact Test 2 - Mann Whitney Test **Significant at the 0.05 level

Regarding DOT, 16.5% of cases were performed (17.3% in 2022 and 15.8% in 2023). A portion of 56% of cases were recorded as not performed. The percentage of missed records increased from 19.2% in 2022 to 33.3% in 2023, totaling 26.6%.

It was observed that 23.1% of cases in 2022 and 15.8% of cases in 2023 tested positive for HIV/AIDS, totaling 19.3% of cases, with a statistically significant difference (p = 0.01) between the years.

Regarding patient transfers, the majority of cases were not transferred, accounting for 90% of cases overall. Transfers to other municipalities within Rio Grande do Sul occurred in 6.4% of cases, and only one case of transfer to another state occurred in 2023.

Cures were achieved in 40.3% of cases, more frequent in both 2022 and 2023 (40.4% in both years). Treatment noncompliance, an important health indicator, was high, at 31.2% of total cases (28.8% in 2022 and 31.6% in 2023).

Deaths from tuberculosis accounted for 1.8% of cases, while deaths from other causes accounted for 6.4%.

These results reflect the challenges in tuberculosis treatment and monitoring, with a significant noncompliance rate and a substantial proportion of cases lacking complete information, especially regarding DOT and outcome status.

Table 4 presents the sociodemographic variables associated with the different tuberculosis treatment outcomes, including cure, abandonment, death, transfer and change of diagnosis/regimen.

Table 4 - Analysis of Variables Associated with Tuberculosis Treatment Outcomes in a Municipality in the Metropolitan Region of Porto Alegre, RS, Brazil, 2022-2023.

Variables	Cure n(%)	Abandonment(%)	Death(%)	Transference n(%)	Change of program(%)	P-value
Gender:						0,15
Male	26 (31,3)	28 (42,4)	7 (41,2)	5 (26,3)	4 (33,3)	
Female	18 (21,7)	6 (9,1)	2 (11,8)	5 (26,3)	2 (16,7)	
Race:						0,71
White	29 (34,9)	24 (36,4)	5 (29,4)	7 (36,8)	5 (41,7)	
Black	6 (7,2)	2 (3)	0 (0)	2 (10,5)	0 (0)	
Yellow	0 (0)	1 (0,5)	0 (0)	0 (0)	0 (0)	
Brown	4 (4,8)	5 (7,6)	3 (17,6)	0 (0)	1 (8,3)	
Age:	45,36 ± 18,7	37,12 ± 14	60,11 ± 19	42,30 ± 23,9	44,17 ± 17,6	0,01**
Pop. deprived of liberty:						0,77
Yes	0 (0)	2 (5,9)	0 (0)	0 (0)	0 (0)	
No	43 (97,7)	31 (91,2)	9 (100)	10 (100)	6 (100)	
Ignored	1 (2,3)	1 (2,9)	0 (0)	0 (0)	0 (0)	
Homelessness:						0,06
Yes	2 (4,5)	5 (14,7)	2 (22,2)	5 (50)	1 (16,7)	
No	40 (90,9)	28 (82,4)	7 (77,8)	5 (50)	5 (83,3)	
Ignored	2 (4,5)	1 (2,9)	0 (0)	0 (0)	0 (0)	
Health professionals:						0,69
Yes	1 (2,3)	0 (0)	0 (0)	1 (10)	0 (0)	
No	41 (93,2)	33 (97,1)	9 (100)	9 (90)	6 (100)	
Ignored	2 (4,5)	1 (2,9)	0 (0)	0 (0)	0 (0)	
BPC:						0,83
Yes	3 (12,5)	1 (4,8)	0 (0)	0 (0)	0 (0)	
No	21 (87,5)	20 (95,2)	4 (100)	5 (100)	2 (100)	
Clinical form:						0,37
Pulmonary	36 (81,8)	32 (94,1)	6 (66,7)	9 (90)	4 (66,7)	
Extrapulmonary	6 (13,6)	2 (5,9)	2 (22,2)	1 (10)	1 (16,7)	
Pulmonary + extrapulmonary	2 (4,5)	0 (0)	1 (11,1)	0 (0)	1 (16,7)	

Research data (2024) 1 - Fisher's exact test 2 - Mann-Whitney test **Significant at the 0.05 level BPC: Continuous Benefit Beneficiary

Regarding gender, most noncompliance cases occurred among men (42.4%). For the cure outcome, 31.3% of cases occurred in men and 21.7% in women. Tuberculosis-related deaths were also more frequent among men (41.2%) compared to women (11.8%). The analysis indicates a trend, although not significant (p = 0.15), toward higher noncompliance and deaths among men.

Regarding race, most cases of cure and noncompliance occurred among white patients (34.9% and 36.4%, respectively). Mixed race

patients accounted for 17.6% of deaths and 7.6% of noncompliance. Black patients were more likely to have been transferred (10.5%) or cured (7.2%). These data were not statistically significant (p = 0.71).

The mean age of patients varied across treatment outcomes, with the death group having a higher mean age (60.11 years), while the noncompliance group had a lower mean age (37.12 years). This factor was significant (p = 0.01), suggesting an association between age and the risk of death.

For the homeless population, 50% of the referral cases and 14.7% of the noncompliance cases were from this population. Cure cases among this population were less common (4.5%). This variable showed a trend, with a marginal p-value (p = 0.06), indicating that homelessness may be associated with more challenging treatment outcomes.

Among healthcare professionals, only one case resulted in cure and one in transfer. The majority of patients were not healthcare professionals (93.2% to 100% for the various outcomes), with no significant association (p = 0.69).

Regarding the form of tuberculosis, most cases of cure, treatment abandonment, and transfer involved patients with the pulmonary form (81.8%, 94.1%, and 90%, respectively). Patients with extrapulmonary tuberculosis had a higher frequency of death (22.2%) and treatment regimen change (16.7%). These data were not statistically significant (p = 0.37), but they demonstrate a prevalence of the pulmonary form among the different outcomes.

These results provide a comprehensive overview of the characteristics associated with treatment outcomes, highlighting the impact of age on deaths and a trend toward higher treatment abandonment and death among men and homeless patients.

Table 5 presents the health problems and habits associated with the different tuberculosis treatment outcomes in the municipality, including cure, treatment abandonment, death, transfer, and treatment/diagnosis change.

Table 5 - Analysis of Issues Associated with Tuberculosis Treatment Outcomes in a Municipality in the Metropolitan Region of Porto Alegre, RS, Brazil, 2022-2023.

Aggravations	Cure	Abandonment	Death	Transference	Change of program	P-value
HIV/Aids						0,51
Yes	6 (14,3)	7 (22,7)	4 (50)	3 (30)	1 (20)	
No	36 (85,7)	24 (77,4)	4 (50)	6 (60)	4 (80)	
Alcohol:						0,03**

	Col1	Col2	Col3	Col4	Col5	p-value
Yes	3 (7,7)	4 (15,4)	2 (28,6)	5 (55,6)	1 (25)	
No	36 (92,3)	22 (84,6)	5 (71,4)	4 (44,4)	3 (75)	
Diabetes:						0,02**
Yes	3 (7,3)	2 (6,9)	3 (50)	0 (0)	1 (25)	
No	38 (92,7)	27 (93,1)	3 (50)	9 (100)	3 (75)	
Mental illness:						0,01**
Yes	1 (2,6)	1 (3,6)	0 (0)	4 (50)	0 (0)	
No	37 (97,4)	27 (96,4)	6 (100)	4 (50)	4 (100)	
Smoking:						0,76
Yes	12 (33,3)	13 (52)	3 (42,9)	6 (66,7)	2 (50)	
No	24 (66,7)	12 (48)	4 (57,1)	3 (33,3)	2 (50)	
Illicit drugs						0,01**
Yes	6 (15,4)	19 (67,9)	2 (33,3)	6 (66,7)	1 (25)	
No	33 (84,6)	9 (32,1)	4 (66,7)	3 (33,3)	3 (75)	

Research data (2024)1 - Fisher's Exact Test **Significant at the 0.05 level

For HIV/AIDS-related exacerbations, 50% of co-infected patients died, while 22.7% abandoned treatment, 30% were transferred, and 14.3% were cured. Among patients without this exacerbation, cure rates were higher (85.7%), and deaths accounted for only 50%. Despite the observed differences, the association with outcomes was not statistically significant (p = 0.51).

Alcohol use was associated with a significant impact on outcomes (p = 0.03). Of the patients who consumed alcohol, 55.6% were transferred and 28.6% died. Noncompliance rates were also high, at 15.4%. Most patients who did not consume alcohol were cured (92.3%).

With diabetes, the association with outcomes was significant (p = 0.02). Among diabetic patients, 50% died and 25% had their treatment regimen changed. Most patients without diabetes were cured (92.7%) and had lower death rates.

Cases with mental health problems showed a strong association with outcomes (p = 0.01). Of the patients with mental health problems, 50% were transferred, while patients without mental health problems had higher cure rates (97.4%).

Regarding smoking, 52% of smokers abandoned treatment and 66.7% of those transferred were smokers, although the association with outcomes was not significant (p = 0.76).

Illicit drug use was significantly associated with outcomes (p = 0.01). Among drug users, 67.9% abandoned treatment and 66.7% were transferred, while among non-users, 84.6% were cured.

These results show that certain conditions and behaviors, such as alcohol use, diabetes, the presence of mental health problems,

and illicit drug use, are associated with less favorable outcomes in tuberculosis treatment, highlighting the importance of specific interventions for these groups.

DISCUSSION

Nurses play a crucial role in the care of tuberculosis (TB) patients, responsible for various activities, such as screening for respiratory symptoms, reporting cases, and monthly follow-up. Furthermore, they promote health education, aiming at the protection, rehabilitation, and empowerment of patients and their communities. These actions are essential for effective care and the creation of bonds with patients[8,9].

Accurate reporting of tuberculosis cases relies on the active participation of nurses, enabling the establishment of effective goals and actions for patient recovery and prevention. Since 1998, tuberculosis has been subject to mandatory reporting, and surveillance aims to provide information to improve decision-making, in addition to facilitating the investigation of suspected cases and the follow-up of confirmed cases until their resolution[10].

In this study, the results regarding age (mean 44.12 years) and male gender (68.8%) corroborate the findings of other studies, which confirmed that males accounted for the highest incidence of tuberculosis[11,12]. Of the total new TB cases reported between 2020 and 2022 in Brazil, 136,324 (70%) occurred in males. In

2022, males were at higher risk of developing the disease in the 20-64 age group[5].

Regarding race, this study differs from studies conducted in the Southeast region[11] and the North region[12], as well as by the Ministry of Health [5], in which the mixed-race and/or Black population represented the majority of tuberculosis cases. In this study, the highest prevalence was 68.8% among individuals who self-identified as white, with only 12.8% among mixed-race individuals and 9.2% among Black individuals. Those who self-identified as white had the best cure rates (34.9%) and treatment abandonment rates (36.4%).

Regarding education, the results show that the highest rates of TB cases are found among individuals with the lowest level of education. The analysis was hampered by the fact that this data was missing in 75.2% (2022) and 63% (2023) of the records. A small variation was observed in the categories of incomplete elementary and high school education. These results are consistent with several studies conducted in Brazil, which associate low education levels with the incidence of tuberculosis cases and with the increased occurrence of unfavorable outcomes attributed to difficulty in understanding how to follow treatment, thus resulting in poor adherence and abandonment of tuberculosis treatment [10,13,14,15].

The results indicated that the main source of notification was new cases of the disease, a similar finding in other studies [14,16]. In this study, the number of readmissions after

treatment abandonment was only 15, confirming findings from another study that emphasizes this small number. Furthermore, cases of readmission, relapse, and resistance are rarely addressed in the literature, representing a major challenge for tuberculosis control in Brazil [14].

According to the Ministry of Health [6], tuberculosis in vulnerable populations (inmates of liberty, homeless individuals, and healthcare professionals) increased, ranging from 17,442 to 24,710 cases between 2015 and 2019. When stratifying the frequency of cases by type of vulnerable population (from 2015 to 2021), a variation of 5,860 to 6,773 TB cases was recorded in the incarcerated population; 1,689 to 1,809 in the homeless population; and 837 to 1,023 in healthcare professionals. In these groups, the proportion of new TB cases resulting in treatment abandonment increased slightly between 2018 and 2019, followed by a decrease in 2020 for those deprived of liberty and those living on the streets. In this study, there were only two cases of TB among people deprived of liberty, and both abandoned treatment. It is worth noting that the research municipality has only one semi-open prison. However, in the study by Simoni et al. [16] in Porto Alegre, Rio Grande do Sul, an increase in the incidence of tuberculosis among people deprived of liberty was identified from 2016 to 2020. The incidence of tuberculosis in this population was 47.1 times higher than that recorded in the general population of Rio Grande do Sul[16].

Pulmonary tuberculosis was the most common clinical form found in this study, in line with other studies in the country[11,17]. TB-HIV co-infection was present in only 19.3%, in agreement with the study by Silva et al. [11], with 52.6% of individuals testing negative for HIV, and Pereira, Zanin and Flório[14] with 73.9% negative results. However, according to the rates recorded by the state of Rio Grande do Sul in 2022, TB-HIV co-infection represented 14.5% of registered cases[6]. According to the Ministry of Health[6], in 2020 (82.6%, n=58,266) and 2021 (82.7%, n=61,490), there was a stabilization in HIV testing among people with TB, with a subsequent reduction in 2022 (79.7%, n=62,230).

The use of licit and illicit drugs is considered by several authors as important factors in tuberculosis control. Drug and alcohol use increases the propensity to develop tuberculosis and has a significant impact on treatment abandonment, compromising various aspects of the immune system in the fight against TB [2,17]. In this study, alcohol consumption was statistically significant (p<0.03), with 15.4% of treatment abandonment, 55.6% of transfers, and 28.6% of deaths. Patients using illicit drugs had treatment abandonment rates of 67.9% (p < 0.01).

Smoking was reported in 40 patients (36.7%) across the study years. As with other data, this finding was ignored in 17.4% of reports. However, the high smoking rate identified in the tuberculosis population in the

research municipality is similar to the WHO [18] finding that more than 20% of tuberculosis cases worldwide are associated with smoking.

A study aimed to understand the influence of mental health on tuberculosis cases found that users with some type of mental illness are more susceptible to developing tuberculosis, given the stigma associated with mental illness and the difficulty in managing it by professionals [19]. In 2023, 6 patients with mental health problems were reported (10.5%).

Treatment noncompliance is a concern in tuberculosis management. To reduce these rates, the World Health Organization (WHO) implemented the Directly Observed Treatment (DOT) strategy in 1998. This strategy aims to support patients, strengthen bonds, and promote shared responsibility between patients and healthcare professionals. Adequate adherence to medication is essential for patient recovery and to prevent drug resistance [2,8].

The decentralization of tuberculosis (TB) control to Primary Health Care (PHC) aims to expand the population's access to health services. PHC is responsible for promotion, prevention, diagnosis, treatment, and referral actions, including monthly follow-up, contact investigation, and investigation of latent Mycobacterium tuberculosis infection (LTBI), in addition to Directly Observed Treatment (DOT). In the municipality under study, patient monitoring is decentralized by PHC teams, and it was observed that only 16.5% of patients undergoing treatment received DOT.

Directly Observed Treatment (DOT) is a crucial strategy for adherence to TB drug treatment. Its practicality lies in the fact that it can be delivered at the health facility and in the home of the person living with TB by trained professionals or guided family members. This can reduce the chances of noncompliance and, consequently, increase cure rates. The study by Silva et al. [19] mapped the evidence on the actions health professionals perform during the monitoring of tuberculosis cases in Primary Health Care. Among these actions, DOT stands out.

The Ministry of Health[6] recommends DOT for 100% of tuberculosis cases, aiming for treatment adherence and cure. However, coverage may vary due to regional challenges, such as a lack of professionals and infrastructure[3,9]. Based on this research, we can understand that this care and monitoring strategy is still deficient, as 56% of users did not perform DOT, and the percentage of this information being reported as missing has increased over the years, reaching a rate of 26.6% in 2023. The low DOT performance rates are explained by the fact that professionals, especially nursing professionals, feel overburdened with work and administrative activities. However, studies indicate that, in the professionals' view, decentralization, inadequate service infrastructure, and lack of supplies also negatively impact the performance of DOT [7].

Although cure is the main outcome of TB treatment, the cure rate observed in this study

(40.3%) is lower than that recommended by the WHO for global tuberculosis control, which establishes a minimum cure rate of 85.0% for detected cases. The noncompliance rate, recorded at 30.3%, significantly exceeds the WHO's recommended limit of less than 5% [19]. The study scenario mirrors the current situation in Rio Grande do Sul, which is experiencing a significant increase in cases, characterized by high rates of HIV coinfection and treatment noncompliance, in addition to low cure rates. This reality impacts both the general population and specific groups, particularly the prison population [16].

The WHO has established goals to be achieved by 2035: a reduction in the TB incidence rate by 90% and the number of deaths from the disease by 95% compared to 2015[6]. In Brazil, the TB mortality rate had been declining until this trend reversed in 2021, when 5,072 deaths were recorded, resulting in a rate of 2.38 TB deaths per 100,000 inhabitants. In this study, only two patients (3.5%) died from the disease in 2023, and another seven (6.4%) died from other causes.

Tuberculosis is treatable and curable; however, difficulties in adequately managing cases still result in treatment and cure rates below the target of the WHO and the Ministry of Health. Therefore, the contribution of this study is even more evident, as it contributes to the implementation of new TB control strategies and policies in municipalities, Rio Grande do Sul,

and the country, in order to obtain more positive data regarding tuberculosis control.

FINAL CONSIDERATIONS

The analysis of tuberculosis treatment outcomes in the research municipality between 2022 and 2023 reveals important associations between clinical, behavioral, and social variables of patients and their various outcomes, such as cure, noncompliance, death, referral, and change in diagnosis/regimen.

Conditions such as alcohol use, diabetes, mental disorders, and illicit drug use showed a significant association with unfavorable outcomes, indicating that these conditions can compromise treatment continuity and success. Patients with these conditions were found to have higher rates of noncompliance and death, reinforcing the need for a more integrated and specific approach to care for this population.

Furthermore, demographic haracteristics, such as male gender and older age, are associated with higher rates of noncompliance and death, although without statistical significance. These findings suggest the relevance of health policies that promote personalized interventions and the strengthening of social support networks and intensive monitoring for vulnerable groups, such as individuals with comorbidities and those in situations of social risk.

These data contribute to understanding the challenges of tuberculosis control in settings with high rates of noncompliance and adverse

outcomes, highlighting the importance of intervention strategies that prioritize not only the treatment of the disease but also the management of risk factors and comorbidities affecting patients.

This study revealed that the management of tuberculosis patients is permeated by various difficulties and challenges. Disease control is challenging for everyone involved, whether they are users, healthcare professionals, or managers. It is crucial to understand the patient's life situation and their challenges.

Training professionals in treatment and appropriate monitoring of cases are essential strategies for reducing noncompliance rates and thus enabling better cure rates. It also allows healthcare professionals, especially nursing professionals, to feel more confident in providing appropriate care for these cases.

It is hoped that this research will contribute to a possible reorganization of care strategies for people with tuberculosis and serve as a tool for healthcare managers to formulate new policies.

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Funding and Acknowledgments:

Declaration of Conflict of Interest:

Nothing to declare.

Authorship Criteria (Author Contributions)

Jéssica Rosiane de Brito 1,2,3
Janini Cristina Paiz 2,3
Miria Bairros de Camargo 2,3
Maria Renita Burg 1,2,3

1. contributed substantially to the conception and/or planning of the study;
2. to obtaining, analyzing, and/or interpreting the data;
3. to writing and/or critically reviewing and final approval of the published version.

Sientific Editor: Italo Arão Pereira Ribeiro. Orcid: https://orcid.org/0000-0003-0778-1447