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Characterization of tuberculosis cases in the indigenous population of Mato Grosso, 2011-2020

Caracterização dos casos de tuberculose na população indígena de Mato Grosso, 2011-2020

Caracterización de los casos de tuberculosis en la población indígena de Mato Grosso, 2011-2020

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ABSTRACT

Objective: To analyze the epidemiological and clinical profile of tuberculosis in the indigenous population of Mato Grosso (2011-2020).

Method: This is a descriptive study using data recorded in the Information System for Notifiable Diseases (*Sistema de Informação de Agravos de Notificação,* SINAN). Statistical analyses were performed, stratified by sociodemographic and clinical variables, comparing tuberculosis cases in the general and indigenous populations of Mato Grosso (Brazil), using the chi-square and Fisher's exact tests in SPSS® 25.0. The incidence rates were calculated per 100,000 inhabitants and analyzed over the years and by geographic area via GeoDa® 1.20.0.36 and Qgis® 3.32.1. The data were aggregated by regional health departments.

Results: A total of 11,288 tuberculosis cases were recorded in the general population and 879 cases in indigenous people, with mean incidence values of 36.3 and 173.1 cases per 100,000 inhabitants, respectively. Indigenous individuals had a higher proportion of women (48.8% *vs.* 30.3%, p<0.001), young people (10–17 years old: 21.4% *vs.* 2.3%, p<0.001), pulmonary forms (97.4% *vs.* 90.0%, p<0.001) and a higher cure rate (88.9% *vs.* 76.5%, p<0.001). The spatial distribution was heterogeneous in the indigenous population, with predominance in remote areas of the state.

Conclusion: Tuberculosis had higher incidence in the indigenous population of Mato Grosso (2011–2020) when compared to the general population. Among indigenous individuals, there was a higher proportion of affected women and young people, predominance of pulmonary forms and lower frequency of comorbidities.

Descriptors: Tuberculosis; Health of Indigenous Peoples; Epidemiology.

RESUMO

Objetivo: Analisar o perfil epidemiológico e clínico da tuberculose na população indígena de Mato Grosso (2011-2020).

Método: Trata-se de um estudo descritivo com dados registrados no Sistema de Informação de Agravos de Notificação (SINAN). Foram realizadas análises estatísticas estratificadas por variáveis sociodemográficas e clínicas comparativas entre os casos de tuberculose na população geral e indígena do estado do Mato Grosso (Brasil), utilizando os testes qui-quadrado e exato de Fisher no SPSS® 25.0. As taxas de incidência foram calculadas por 100 mil habitantes e analisadas ao longo dos anos e por área geográfica via GeoDa® 1.20.0.36 e Qgis® 3.32.1. Os dados foram agregados por regionais de saúde.

Resultados: Foram registrados 11.288 casos de tuberculose na população geral e 879 casos em indígenas, com incidência média de 36,3 e 173,1 casos/100.000 habitantes, respectivamente. Indígenas apresentaram maior proporção de mulheres (48,8% *vs.* 30,3%, p<0,001), jovens (10-17 anos: 21,4% *vs.* 2,3%, p<0,001), formas pulmonares (97,4% *vs.* 90,0%, p<0,001) e maior taxa de cura (88,9% *vs.* 76,5%, p<0,001). A distribuição espacial foi heterogênea na população indígena, predominando em áreas remotas do estado.

Conclusão: A tuberculose apresentou maior incidência na população indígena de Mato Grosso (2011-2020) em comparação à população geral. Entre indígenas, houve maior proporção de mulheres e jovens acometidos, além do predomínio das formas pulmonares e menor frequência de comorbidades.

Descritores: Tuberculose; Saúde de populações indígenas; Epidemiologia.

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RESUMEN

Objetivo: Analizar el perfil epidemiológico y clínico de la tuberculosis en la población indígena de Mato Grosso (2011–2020).

Método: Estudio descriptivo con datos registrados en el Sistema de Información de Agravios de Notificación (SINAN). Se realizaron análisis estadísticos estratificados por variables sociodemográficas y clínicas, comparando los casos de tuberculosis en la población general e indígena del estado de Mato Grosso (Brasil), utilizando la prueba de chi-cuadrado y la prueba exacta de Fisher en SPSS® 25.0. Las tasas de incidencia se calcularon por 100 mil habitantes y se analizaron a lo largo de los años y por área geográfica a través de GeoDa® 1.20.0.36 y Qgis® 3.32.1. Los datos fueron agregados por las regionales de salud.

Resultados: Se registraron 11.288 casos de tuberculosis en la población general y 879 casos en la población indígena, con una incidencia media de 36,3 y 173,1 casos por 100.000 habitantes, respectivamente. Los indígenas presentaron una mayor proporción de mujeres (48,8% *vs.* 30,3%, p<0,001), jóvenes (10–17 años: 21,4% *vs.* 2,3%, p<0,001), formas pulmonares (97,4% *vs.* 90,0%, p<0,001) y una mayor tasa de curación (88,9% *vs.* 76,5%, p<0,001). La distribución espacial fue heterogénea en la población indígena, con predominio en áreas remotas del estado.

Conclusión: La tuberculosis presentó una mayor incidencia en la población indígena de Mato Grosso (2011-2020) en comparación con la población general. Entre los indígenas, hubo una mayor proporción de mujeres y jóvenes afectados, con preponderancia de las formas pulmonares y una menor frecuencia de comorbilidades.

Descriptores: Tuberculosis; Salud de poblaciones indígenas; Epidemiología.

INTRODUCTION

Tuberculosis (TB) is among the oldest infectious diseases in the world and remains a major public health concern. Its etiological agent, *Mycobacterium tuberculosis*, primarily infects the lungs (pulmonary form). However, in more severe cases, it can also spread to and affect other organs and/or systems (extrapulmonary form), causing complications such as meningitis[1].

It is estimated that 8.2 million people were diagnosed with TB in 2023, making it the highest number of new cases reported in a single year since the World Health Organization (WHO) began global monitoring of TB in the mid-1990s. In addition, after the control of the COVID-19 pandemic, TB once again became the main cause of death from infectious diseases in the world[2]. In Brazil, 80,012 cases of TB were recorded (37.0/100,000 inhabitants) in 2023, and 5,935 deaths in 2023[3].

TB is considered a multicausal disease and, among the factors extrinsic to the individual, low socioeconomic indicators corroborate the proliferation of the disease[4,5]. Regarding epidemiological aspects, there are groups called "vulnerable populations" that present a higher risk of morbidity and mortality from tuberculosis, namely: individuals living with HIV, people deprived of liberty (PDL), homeless people, users of alcohol and other drugs, smokers and indigenous people[4,6]. These groups are identified as vulnerable due to factors such as poverty, lack of basic sanitation, limited access to health services, poor housing conditions, ineffective public policies, among others[5,7].

Studies indicate that indigenous communities have considerably higher TB incidence rates compared to the general population, reflecting inequalities in access to health services and social determinants that exacerbate vulnerability to infectious diseases[7]. In Brazil, the situation is no different. Among the Brazilian states, Mato Grosso, specifically, had the highest incidence rate of TB in indigenous people (303.6/100,000 inhabitants in the 2011- 2017 period), much higher than the general population's rate in 2017(36.3/100,000 inhabitants)[8,9].

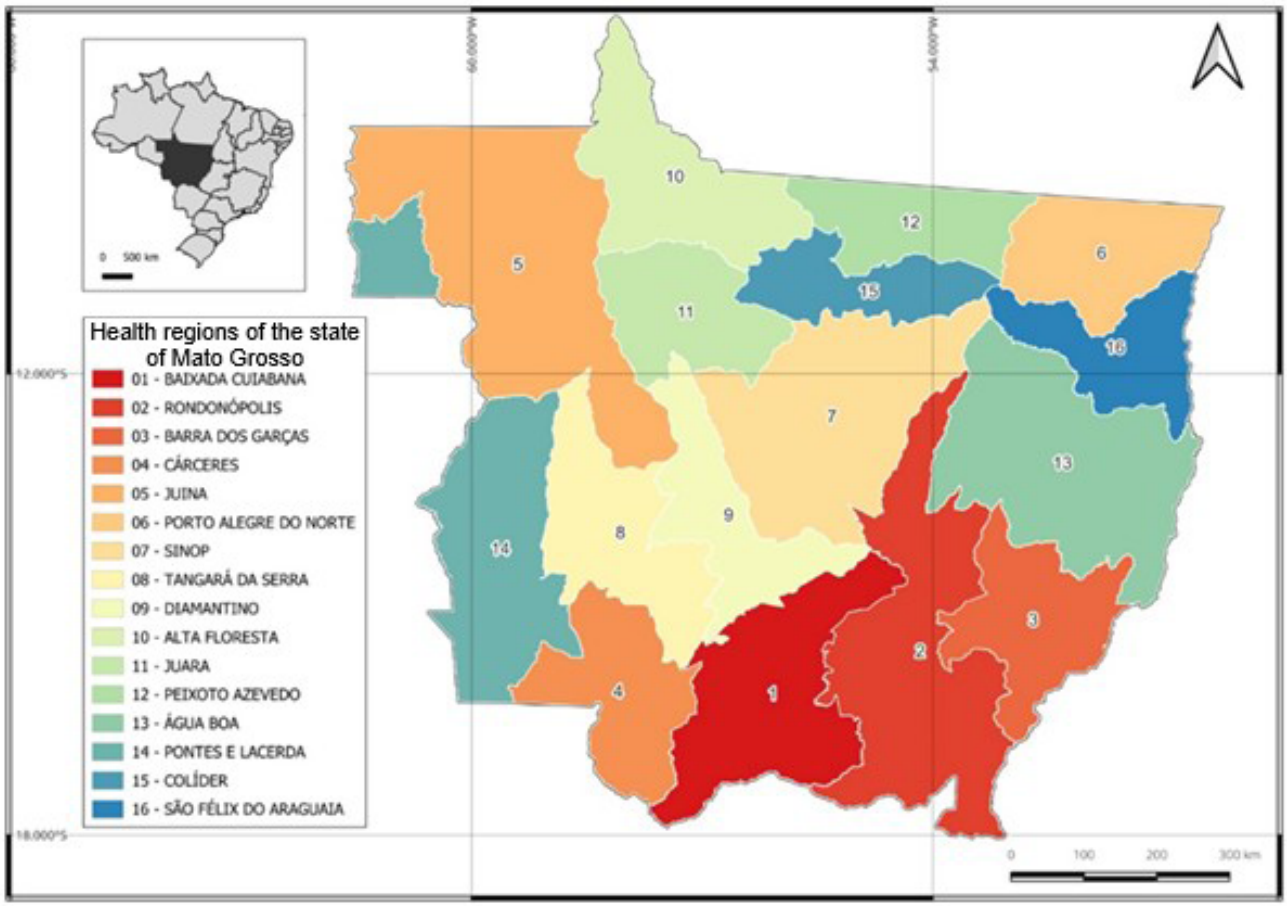
Despite the aforementioned data, little is known about the epidemiological and clinical characteristics of these cases, information that is essential to support effective and equitable interventions through public health policies. Therefore, the present study aims to analyze the epidemiological and clinical profile of TB cases in the indigenous population of Mato Grosso between 2011 and 2020.

METHOD

This is an observational, descriptive study, with a spatial component, based on secondary data on TB cases in the state of Mato Grosso, from 2011 to 2020, guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) instrument.

The state of Mato Grosso is located in the Central-West region of Brazil, has 141 municipalities organized in 16 health regions (Figure 1). Its capital is Cuiabá, and the state covers an area of 903,207.050 km^2. In 2021, the population of Mato Grosso was 3,658,813 inhabitants. The state has a population density of 4.05 inhabitants/km^2 and a high Human Development Index (HDI) (0.725)[10].

Figure 1. Health regions of the state of Mato Grosso. Brazil, 2023.



Source: Elaborated by the authors using Qgis® software.

Data from the 2022 Census show that Mato Grosso is the seventh state with the largest indigenous population in Brazil (58,231 indigenous people), corresponding to 1.59% of the state's population[11]. According to the Organization of Indigenous Peoples of Brazil, this population is organized into 39 ethnic groups and 17 linguistic families[12]. The state of Mato Grosso has a total of 79 indigenous lands, with 56 regularized, 3 approved, 7 declared, 3 delimited, and 10 under study[13]. The Special Department for Indigenous Health (SESAI), created in 2010, is responsible for coordinating the National Policy for Health Care for Indigenous Peoples (PNASPI). Therefore, SEDAI organizes health actions within the 34 Special Indigenous Health Districts (DSEI). State and municipal programs work in a complementary manner and in coordination with Sesai. In total, Mato Grosso has 5 DSEI (Cuiabá, Araguaia, Caiapó de Mato Grosso, Xavante and Xingu)[12].

The study population consisted of all new cases of TB in people aged 10 years or older, residing in the state of Mato Grosso, registered in SINAN between 2011 and 2020. A new case was considered to be one that was reported in the "type of entry" variable in the TB notification form as: new case(1), unknown (4) and post-mortem (cases identified late, that is, at the time or after the patient's death)[6].

Cases marked as "diagnosis change" were excluded, as they were not cases of tuberculosis. Also excluded were those that contained the IBGE code of a municipality of residence not located in the state of Mato Grosso, those cases closed as "transfer" (patient referred to another service for further treatment) and those that were closed due to indication of use of treatment regimens other than the basic regimen. The Ministry of Health recommends that these cases are closed in SINAN and reported in the Information System for Special

Treatments of Tuberculosis – SITETB). The number of cases in the area during the study period subject to these criteria determined the sample size.

The variables of interest were information regarding laboratory diagnosis (date and laboratory tests performed), classification of the clinical form of the disease, age, gender, race/color, education, HIV co-infection, use of antiretroviral drugs, use of alcohol, tobacco and other drugs, mental illness, whether the patient receives any assistance from a government income transfer program and termination status.

Laboratory confirmation was included in the analysis after grouping the variables relating to diagnostic tests (sputum smear microscopy, culture and rapid molecular test) into a single variable, so that performing any of the three tests was considered sufficient for laboratory confirmation of TB.

Data on TB cases were obtained from the Information **S**ystem for Notifiable Diseases (SINAN) provided by the Epidemiological Surveillance of the Mato Grosso State Health Department. Demographic data and digital grids were obtained from the Brazilian Institute of Geography and Statistics (IBGE)[14].

A descriptive analysis was carried out with the aim of understanding the distributions of the characteristics of the study population. For comparisons of categorical variables, Pearson's chi-square test and Fisher's exact test and their respective p-values were used. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS® version 25.0) software. Missing data were treated by automatic exclusion in the statistical analyses performed, without imputation of values.

Incidence rates of reported TB cases were estimated. The number of cases was taken as the numerator and the resident population during the study periods as the denominator, and multiplied by 100,000. The incidence ratio was obtained by dividing the incidence rate of the indigenous population by the incidence rate of the general population, allowing comparison of the magnitude of the risk of tuberculosis between the two groups. In addition, the rates were presented in annual series and according to their spatial distribution using thematic maps, with incidences by regional health department in the general population and in indigenous people, using the geoprocessing software GeoDa® version 1.20.0.36 and Qgis® version 3.32.1. The calculation of incidence rates by health regions was made to aggregate the municipalities due to operational difficulties in establishing the denominator for the indigenous population per municipality.

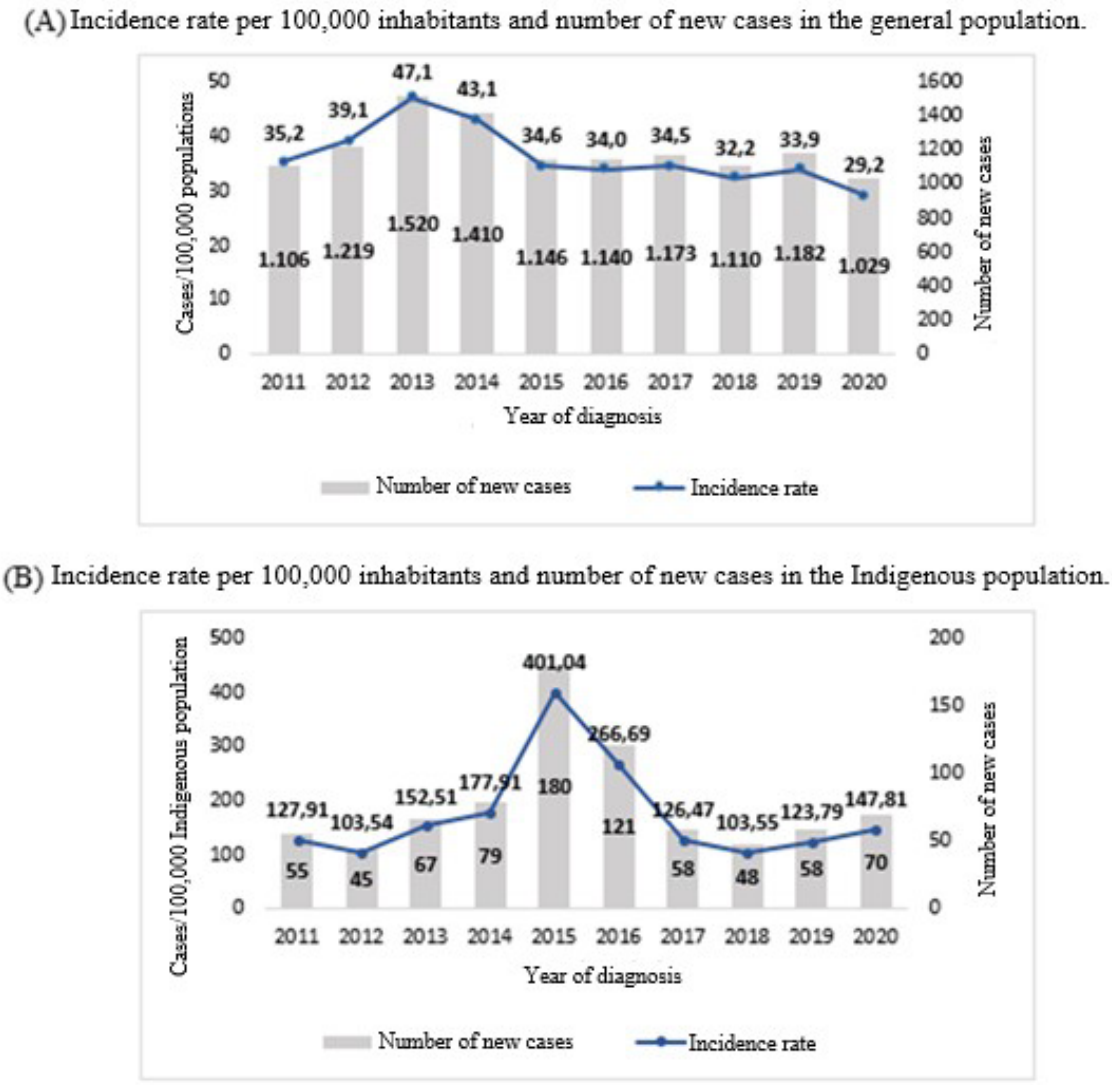
The research project was approved on August 18, 2021 by the Research Ethics Committee of Universidade Federal do Mato Grosso. Certificate of Presentation for Ethical Consideration: 47657721.7.0000.8124.

RESULTS

Of the initial total of 16,899 tuberculosis cases reported in SINAN, referring to the 10 years of the period analyzed (2011 to 2020), the following were excluded: 86 duplicate records (0.5%); 633 changes in diagnosis (3.7%); 587 cases with ages up to 9 years (3.5%); 2 records without gender identification (0.01%); 1,204 transfers (7.1%); 2,056 cases of drug resistance, regimen changes and failures (12.2%); 60 cases (0.4%) because the individuals did not reside in the state of Mato Grosso. Therefore, 12,271 records remained (73%).

From 2011 to 2020, 12,271 new cases of TB occurred in the state of Mato Grosso. Of these, 11,288 occurred in the general population (92.84%) and 879 (7.16%) in the indigenous population, corresponding to an average of 1,227 annual cases in the general population and 88 annual cases in the indigenous population. The incidence in the general population ranged from 29.2 to 47.1/100,000 inhabitants, with an average of 36.3 cases, and in the indigenous population, between 103.5 and 401.0/100,000 inhabitants, with an average of 173.1 cases. The highest incidence rates were recorded in 2013 (47.1 cases/100,000 inhabitants) and 2015 (401 cases/100,000 inhabitants), respectively for the general population and indigenous population. The incidence ratio of developing TB in the indigenous population compared to the general population was approximately 4.66 (95% CI 4.37–4.97) (Figure 2).

Figure 2. Incidence rates (per 100,000 inhabitants) and numbers of new cases of tuberculosis in the general and indigenous populations, Mato Grosso, 2011-2020. Brazil, 2023.



Source: Elaborated by the authors based on data from the Information System for Notifiable Diseases (SINAN).

When analyzing TB cases in both populations, it was possible to observe a higher proportion of cases in the male population (68.4% *vs.* 31.6%, *p<0.001*), aged between 18 and 39 years (44.1%, *p<0.001*) and individuals with incomplete elementary education (48.6%, *p<0.001*). On the other hand, comparing the female populations, indigenous women had a higher proportion of cases than those in the general population (48.8% *vs.* 30.3%, *p<0.001*). The mean age in the general population was 53 years, while in the indigenous population it was 46 years. However, the highest proportions found were in the age group of 18 to 39 years in both populations (39.7% *vs.* 44.5%, *p<0.001* – indigenous and general, respectively). The indigenous population had a higher incidence of receiving government benefits (61.9% *vs.* 7.1%, *p<0.001*) (Table 1).

Table 1. Sociodemographic characteristics of individuals with tuberculosis in the general and indigenous population, Mato Grosso, 2011-2020. Brazil, 2023.

Characteristics of individuals	Total n=12,271		Tuberculosis Cases				*p* -value
			General Population n=11,288		Indigenous Population n=879		
	n	%	n	%	n	%	
Gender*							
Female	3,844	31.6	3.415	30.3	429	48.8	*<0.001*
Male	8.323	68.4	7,873	69.7	450	51.2	
Age distribution* (years)							
10 to 17	446	3.7	260	2.3	186	21.4	*<0.001*
18 to 39	5.306	44.1	4,961	44.5	345	39.7	
40 to 59	4.034	33.5	3,857	34.6	177	20.3	
60+	2.243	18.6	2.081	18.6	162	18.6	
Average age (years)	52		53		46		
Median age (years)	41		41		32		
Education*							
Illiterate	801	8.1	664	7.1	137	23.0	*<0.001*
Incomplete elementary education	4.817	48.6	4,477	48.1	340	57.0	
Complete elementary education	3,509	35.4	3,407	36.6	102	17.1	
Complete or incomplete higher education	780	7.9	763	8.2	17	2.9	
Government benefit*							
Yes	733	12.3	380	7.1	353	61.9	*<0.001*
No	5.226	87.7	5.009	92.9	217	38.1	

Source: Prepared by the authors based on data from the Information System for Notifiable Diseases (SINAN).
*The difference in the total number of cases/year (100%) corresponds to the number of ignored cases, blank cases or cases without correspondence in the TB disease data dictionary.

Regarding the clinical variables of TB, there was a higher percentage of individuals presenting the pulmonary form in the indigenous population (97.4% *vs.* 90.0%, *p<0.001*). However, laboratory confirmation was lower in this population (54.4% *vs.* 45.6%, p<0.001). The diseases and associated conditions occurred more frequently in the general population (14.0% *vs.* 3.9%, *p<0.001*). The indigenous population had higher rates of cure when compared to the general population (88.9% *vs.* 76.5%, *p<0.001*) (Table 2).

Figure 3 shows the incidence rates by health region in the general population (A) and in indigenous people (B). In all years analyzed (2011-2020), the incidence of TB in the indigenous population was higher than in the general population. However, the distribution of cases among indigenous people varied heterogeneously over the years, predominating mainly in the most remote regions of the state. In contrast, in the general population, cases were concentrated mainly in the Baixada Cuiabana region. Furthermore, the lowest incidence rates in the general population were observed in the health regions of Diamantino, Cáceres, and Pontes e Lacerda.

Table 2. Clinical characteristics of individuals with tuberculosis in the general and indigenous population, Mato Grosso, 2011-2020. Brazil, 2023.

Clinical features	Total n=12,271		Tuberculosis Cases				*p* -value
			General Population n=11,288		Indigenous Population n=879		
	n	%	n	%	n	%	
Form*							
Pulmonary	10,839	90.5	9,984	90.0	855	97.4	*<0.001*
Extrapulmonary	924	7.7	910	8.2	14	1.6	
Pulmonary + extrapulmonary	212	1.8	203	1.8	9	1.0	
Laboratory Confirmation*							
No confirmation	5,739	47.2	5.150	45.6	589	67.0	*<0.001*
With confirmation	6,428	52.8	6.138	54.4	290	33.0	
Associated diseases and conditions*							
Yes	1,173	13.1	1,143	14.0	30	3.9	*<0.001*
No	7,751	86.9	7.018	86.0	733	96.1	
Alcohol condition*							
Yes	1,700	15.5	1,651	16.3	49	5.9	*<0.001*
No	9,262	84.5	8,480	83.7	782	94.1	

Table 2. Cont.

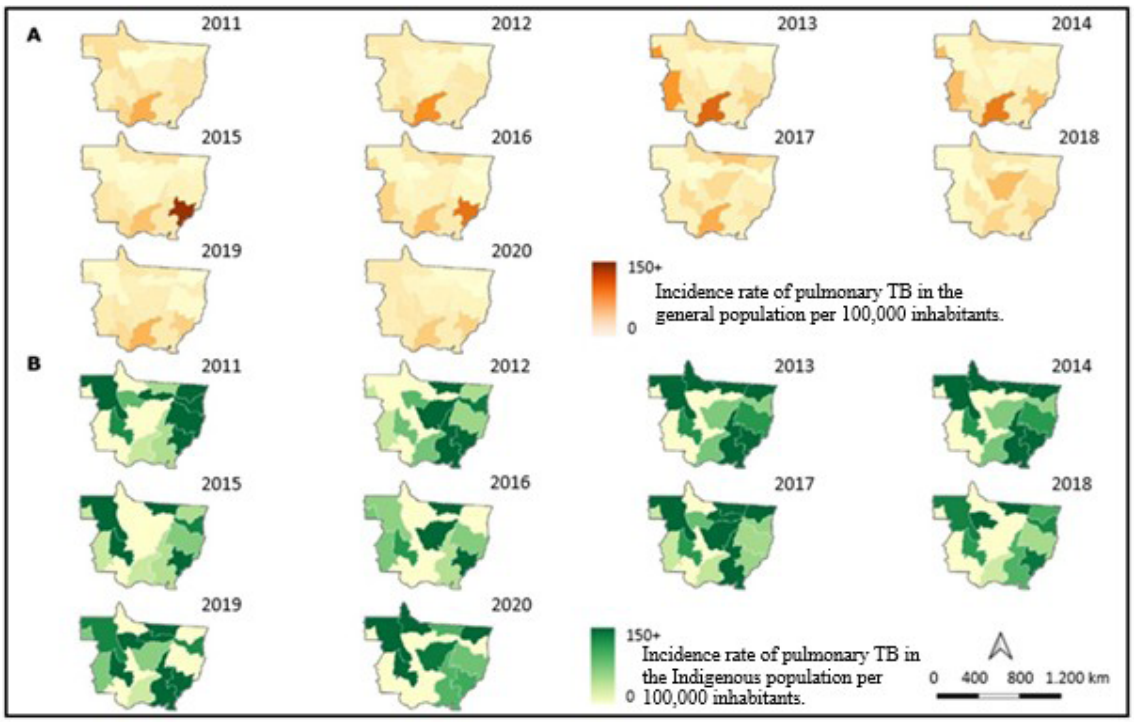
Clinical features	Total n=12,271		Tuberculosis Cases				*p* -value
			General Population n=11,288		Indigenous Population n=879		
	n	%	n	%	n	%	
Diabetes condition*							
Yes	793	7.3	724	7.2	69	8.3	*0.264*
No	10.034	92.7	9,271	92.8	763	91.7	
Mental Illness condition*							
Yes	267	2.5	264	2.6	3	0.4	*<0.001*
No	10,563	97.5	9,737	97.4	826	99.6	
Drug use condition*							
Yes	708	10.4	706	11.5	2	0.3	*<0.001*
No	6.061	89.5	5,435	88.5	626	99.6	
Smoking condition*							
Yes	1,479	21.7	1,437	23.2	42	6.7	*<0.001*
No	5.348	78.3	4,760	76.8	588	93.3	
HIV*							
Positive	933	7.8	926	8.3	7	0.8	*<0.001*
Negative	6,628	55.3	5.908	53.2	720	82.0	
In progress	147	1,2	132	1.2	15	1.7	
Not performed	4.267	35.6	4.131	37.2	136	15.5	
Antiretroviral Therapy*							
Yes	484	26.7	483	27.9	1	1,2	*<0.001*
No	1,329	73.3	1,247	72.1	82	98.8	

Table 2. Cont.

Clinical features	Total n=12,271		Tuberculosis Cases				*p* -value
			General Population n=11,288		Indigenous Population n=879		
	n	%	n	%	n	%	
AIDS*							
Yes	833	8.4	827	9.1	6	0.7	*<0.001*
No	9.043	91.6	8226	90.9	817	99.3	
Closing*							
Cure	9.061	77.4	8,294	76.5	767	88.9	*<0.001*
Discontinuation	1,659	14.2	1.614	14.9	45	5.2	
Death from TB	351	3.0	328	3.0	23	6.6	
Death from other causes	632	5.4	604	5.6	28	3.2	

Source: Elaborated by the authors based on data from the Information System for Notifiable Diseases (SINAN).
*The difference in the total number of cases/year (100%) corresponds to the number of ignored cases, blank or with no corresponding fields in the TB disease data dictionary.

Figure 3. Spatial distribution of the incidence (per 100,000 inhabitants) of TB in the general (A) and indigenous (B) population, Mato Grosso, by health region, 2011-2020. Brazil, 2023.



Source: Elaborated by the authors using Qgis *software* based on data from the Information System for Notifiable Diseases (SINAN).

DISCUSSION

Based on the results of this study, it was possible to observe a significant disparity in the incidence of tuberculosis between the indigenous population and the general population of Mato Grosso in the period from 2011 to 2020. The incidence of TB in the indigenous population was approximately 4.66 times higher than in the general population, with an annual average of 173.1 cases per 100,000 inhabitants, compared to the average of 36.3 cases per 100,000 inhabitants in the general population. In addition, the analysis revealed different epidemiological and clinical characteristics between the two populations, with a higher proportion of indigenous women affected, a higher prevalence of pulmonary forms of the disease, a higher proportion of cure, and lower rates of comorbidities. The distribution of incidence in the indigenous population showed annual and regional variations, with a higher concentration of cases in the most remote regions of the state, while in the general population, cases were mainly concentrated in the Baixada Cuiabana region.

At the end of the study period, the incidence rate decreased by 6.0/100,000 inhabitants in the general population, while in the indigenous population the rate increased by 19.9/100,000 inhabitants. This increase may be related to technical training actions implemented in 2015, which improved the sensitivity for diagnosing the disease, allowing greater detection of cases among indigenous peoples[15]. On the other hand, it should be stressed that high incidence rates in Brazilian indigenous populations have been observed at least since 1997 in other states, such as Rondônia[16], and this persistence may indicate that prevention and control measures are still insufficient to significantly reduce TB transmission among indigenous people[17].

The analysis showed that incidence rates in the indigenous population remained high throughout the period. Analysis by health region showed that in some regions the incidence rates are even higher. The highest incidence rates in the period analyzed (2011-2020) in the general population were concentrated mainly in the regions of Baixada Cuiabana and Barra do Garças, while the indigenous population has high incidence rates throughout the state, mainly in the regions of Barra do Garças and Peixoto de Azevedo. These regional patterns may be related to the location of the villages, which are usually more geographically isolated[5,6,9].

The proportion of TB cases in the indigenous population was more equally distributed between the genders, deviating from the pattern in the general population, where men are the most affected, often more exposed both as a result of work relationships and because they are far from health services[17,18]. On the other hand, this aspect can be related to cultural and social factors, since, traditionally in some communities, women spend more time in closed environments with inadequate sanitary conditions, being more exposed to conditions that favor the transmission of TB[19,20].

The higher proportion of TB cases among individuals aged 10 to 17 years in the indigenous population, compared to the general population, may be associated with high household density, difficulties in accessing health services, and geographic and cultural barriers, which delay diagnosis and appropriate treatment. In addition, malnutrition and the higher prevalence of respiratory infections may compromise the immune response of indigenous youth, making them more susceptible to illness. Close contact between individuals of different age groups within villages, including children and adolescents living with untreated symptomatic adults, may also increase the risk of exposure[21].

The higher proportion of TB cases among indigenous people with lower levels of education (illiterate individuals and those with incomplete primary education) when compared to the general population is directly associated with worse socioeconomic conditions, greater vulnerability to malnutrition and less access to information on preventive measures and symptoms of the disease, which can delay diagnosis and aggravate transmission[9,18]. This hypothesis is supported by the fact that approximately 52.5% of this population receives government benefits, suggesting that they face greater socioeconomic vulnerabilities due to conditions of poverty, food insecurity and difficulties in accessing the formal labor market. Furthermore, this disparity may reflect historical structural inequalities that impact indigenous peoples, including less access to education and economic opportunities[9,22].

Regarding the clinical form, pulmonary TB was the most frequent among cases of TB in indigenous people, with a lower percentage of extrapulmonary forms when

compared to the general population. This appears to be closely related to the lower rate of TB-HIV coinfection in this population. Experts point out that people with this type of coinfection tend to present more often with the extrapulmonary clinical form[23] In addition, a low supply of ART and a higher rate of laboratory confirmation were observed among indigenous people when compared to the general population. These findings, although seemingly contradictory, suggest that there may be active testing and adequate use of diagnostic methods, possibly due to surveillance strategies in indigenous areas, such as the presence of primary health care teams. However, the low supply of ART may indicate barriers to access to continuous care, either due to the limitation of specialized services close to indigenous communities, logistical difficulties in following up patients, or less integration between TB and HIV programs[24].

In addition to the low prevalence of TB-HIV coinfection, indigenous people also had lower proportions of all other comorbidities examined (alcohol abuse, mental illness, drug addiction, smoking and AIDS). Culturally, some indigenous populations may have different patterns of substance use and exposure to risk factors, whether due to the influence of community norms, sociocultural restrictions or lower urbanization, which could result in a lower actual prevalence of these conditions. However, this difference may also be related to the underdiagnosis of these comorbidities [17].

The higher proportion of cure among indigenous people with tuberculosis, compared with the general population, may be related to factors such as the organization of indigenous health services, which often include a unique primary care model, with indigenous health teams and active search strategies. Furthermore, the fact that a significant portion of this population receives government assistance may favor adherence to treatment, reducing socioeconomic barriers that could lead to discontinuation[9]. These results indicate that more efficient prevention programs are probably lacking. However, the finding of a higher proportion of deaths from tuberculosis among indigenous people, combined with the lower occurrence of other outcomes, such as discontinuation and death from other causes, suggests a profile of greater clinical vulnerability. This may indicate that, although there is greater adherence to treatment, some indigenous people may have more serious health conditions at the time of diagnosis, potentially due to difficulties in early access to care. Furthermore, the low proportion of associated diseases in this population may also be positively influencing the cure rate.

In the spatial analysis of health regions during the historical series, the regions of Barra do Garças (DSEI Xavante) and Peixoto de Azevedo (DSEI Kaiapó do Mato Grosso) stood out. The city of Peixoto de Azevedo is an important base hub of the DSEI Kaiapó-MT, concentrating indigenous health care in the region, a factor that may explain its high incidence. The same event is repeated in the cities of Barra do Garças, Porto Alegre do Norte and Rondonópolis, which give their names to their respective health regions. These areas are characterized by historical challenges, such as precarious basic sanitation, inadequate housing and lack of adequate infrastructure in indigenous health services that hinder early diagnosis and adequate treatment[5,7,19]. The direct link between SESAI and the Ministry of Health enabled an increase in investment, the creation of Multidisciplinary Indigenous Health Teams (EMSI) and greater organization to provide health care in Mato Grosso. However, the policy is relatively new and its implementation and structuring are below expectations[25].

The results of this study should be interpreted considering its limitations, especially the possibility of underreporting of cases in SINAN[26]. It is worth noting the difficulty in accessing census data on indigenous people disaggregated by municipality and year, which interfered with the visualization of the data. Given the lack of intercensal population data specific to race/color, the average population growth rate estimated by IBGE had to be used [11,14], which may impact the accuracy of the incidence rates. In addition, due to the small population size, even a single case of TB can result in a high incidence rate, exemplifying the small numbers problem in epidemiology, where minimal variations in the numerator can generate large fluctuations in the estimates, compromising the stability and interpretation of the data. Finally, it is recognized that the aggregation of data by health regions for spatial analysis may imply ecological inference, which is a factor to be considered in the interpretation of the results.

Despite these limitations, the study fills a gap in the literature by characterizing the epidemiology of TB among indigenous people in Mato Grosso, one of the states with the largest indigenous populations in Brazil. Our findings are consistent with studies that indicate greater vulnerability of this population to TB, reinforcing the need for specific strategies to control the disease.

CONCLUSION

The present study provided an overview of the characteristics and spatial distribution of TB that influence the continued transmission of the disease in a region with a significant concentration of indigenous population. The results demonstrated that the indigenous population has a higher incidence of TB (173.1 cases/100,000 inhabitants) when compared to the general population (36.3 cases/100,000 inhabitants), indicating the persistence of the disease in territories of socioeconomic vulnerability, inadequate housing conditions, difficulties in accessing health services, failures in some of the programmatic strategies for controlling the disease (whether in case detection, adherence to treatment or in strategic actions for special populations) and also that current policies are not sufficient to control TB cases in this population, highlighting that these are factors that historically impact indigenous populations.

The disparities found in this study demonstrate that it is essential to strengthen TB prevention policies in indigenous health, expanding the active search for respiratory symptoms and expanding access to molecular diagnosis, especially in remote areas. In addition, the integration of health and social assistance policies can contribute to improving living conditions and reducing the social determinants of TB. Continuous training of health professionals on indigenous cultural specificities and the active participation of these communities in the planning and implementation of strategies are essential to ensure more effective control of the disease.

The implementation of intersector actions, combined with the production of research involving indigenous communities, can contribute to the development of solutions adapted to local reality. These measures will not only strengthen the prevention, detection and treatment of TB, but will also promote greater equity in access to health care and reduce social inequalities, essential elements for combating tuberculosis among indigenous people.

REFERENCES

1. Cardoso RF, Braga FAG, Marçal PHEC, Abreu STQ, Carvalho DM, Silva Junior JP, *et al.* Aspectos clínicos e epidemiológicos da tuberculose no estado do Amapá. Braz J Health Rev. 2023;6(3):12689-703. https://doi.org/10.34119/bjhrv6n3-333
2. World Health Organization (WHO). Global tuberculosis report 2023 [Internet]. Geneva: WHO; 2023[cited 2024 Apr 09]. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2023
3. Ministério da Saúde (BR). Boletim epidemiológico de tuberculose 2024 [Internet]. Brasília: MS; 2024 [cited 2024 Apr 09]. Available from: https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/t/tuberculose/situacao-epidemiologica
4. Ministério da Saúde (BR). Manual de recomendações para o controle da tuberculose no Brasil [Internet]. Brasília: MS; 2019[cited 2024 Apr 09]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/manual_recomendacoes_controle_tuberculose_brasil_2_ed.pdf
5. Gopie FA, Hassankhan A, Ottevanger S, Krishnadath I, Lange W, Zijlmans CWR, *et al.* Ethnic disparities in tuberculosis incidence and related factors among indigenous and other communities in ethnically diverse Suriname. J Clin Tuberc Other Mycobact Dis. 2021;23:100227. https://doi.org/10.1016/j.jctube.2021.100227
6. Lima IB, Nogueira LMV, Trindade LNM, Rodrigues ILA, André SR, Sousa AI. Geospatialization of tuberculosis and income transfer programs among Indigenous peoples in an endemic territory. Rev Bras Enferm. 2023;76:e20220216. https://doi.org/10.1590/0034-7167-2022-0216
7. Cilloni L, Dowdy DW. Tuberculosis in US Indigenous Communities: a need for public health prioritization. Am J Public Health. 2024;114:2:149-51. https://doi.org/10.2105/AJPH.2023.307544
8. Ferreira TF, Santos AMD, Oliveira BLCA, Caldas AJM. Trend of tuberculosis in Brazilian indigenous people in the 2011-2017. Cien Saude Colet. 2020;25(10):3745–52. https://doi.org/10.1590/1413-812320202510.28482018.
9. Jesus GS, Gestal PF, Silva AF, Cavalcanti DM, Lua I, Ichihara MY, *et al.* Effects of conditional cash transfers on tuberculosis incidence and mortality according to race, ethnicity and socioeconomic factors in the 100 Million Brazilian Cohort. Nat Med. 2025;31: 653–62. https://doi.org/10.1038/s41591-024-03381-0
10. Instituto Brasileiro de Geografia e Estatística (IBGE). Cidades e Estados [Internet]. Rio de Janeiro: IBGE; 2023[cited 2024 Apr 09]. Available from: https://www.ibge.gov.br/cidades-e-estados/mt/
11. Instituto Brasileiro de Geografia e Estatística (IBGE). Censo Demográfico 2022: indígenas: primeiros resultados do universo [Internet]. Rio de Janeiro: IBGE; 2023 [cited 2024 Apr 09]. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2102018
12. Instituto Socioambiental (ISA). Povos indígenas no Brasil [Internet]. São Paulo: ISA; 2023[cited 2024 Apr 09]. Available from: https://pib.socioambiental.org/pt/P%C3%A1gina_principal.

13. Sistema Indigenista de Informações. Terras indígenas [Internet]. Brasília: FUNAI; 2023 [cited 2024 Apr 09]. Available from: http://sii.funai.gov.br/funai_sii/informacoes_indigenas/visao/visao_terras_indigenas_situacao.wsp?tmp.uf_codigo=3
14. Instituto Brasileiro de Geografia e Estatística (IBGE). Os índios no Censo Demográfico de 2010 [Internet]. Rio de Janeiro: IBGE; 2023[cited 2024 Apr 09]. Available from: https://www.ibge.gov.br/indigenas/indigena_censo2010.pdf.
15. Ministério da Saúde (BR). Equipes do Pará promovem capacitação em prevenção e controle de tuberculose [Internet]. Brasília: Ministério da Saúde; 2015 [cited 2024 Apr 09]. Available from: https://www.gov.br/saude/pt-br/assuntos/noticias/2015/julho/equipes-do-para-promovem-capacitacao-em-prevencao-e-controle-de-tuberculose
16. Melo TE, Resendes AP, Souza-Santos R, Basta PC. Distribuição espacial e temporal da tuberculose em indígenas e não indígenas de Rondônia, Amazônia Ocidental, Brasil. Cad Saúde Pública. 2012;28(2):267–80. https://doi.org/10.1590/S0102-311X2012000200006.
17. Varughese M, Heffernan C, Li MY. Time to diagnosis and treatment of pulmonary tuberculosis in indigenous peoples: a systematic review. BMC Infect Dis 2023;23:131-45. https://doi.org/10.1186/s12879-023-08098-y
18. Lopes VDS, Couto RM, Luz APD, Silva PRS, Lima JC. Factors associated with deaths by tuberculosis in the state of Mato Grosso, 2011-2020: retrospective cohort study. Epidemiol Serv Saude. 2024;11;33:e20231402. https://doi.org/10.1590/S2237-96222024V33E20231402.EN
19. Ministério da Saúde (BR). Fundação Nacional de Saúde. Política Nacional de Atenção à Saúde dos Povos Indígenas [Internet]. 2ª edição. Brasília: Ministério da Saúde; 2002 [cited 2024 Apr 09]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/politica_saude_indigena.pdf
20. Silva LLM, Garrido RG. COVID-19/tuberculosis interaction: how the persistence of a millennial disease impacts the severity of an emerging pandemic. RSD. 2021;10(11):e305101119754. https://doi.org/10.33448/rsd-v10i11.19754
21. Viana PVS, Codenotti SB, Bierrenbach AL, Basta PC. Tuberculose entre crianças e adolescentes indígenas no Brasil: fatores associados ao óbito e ao abandono do tratamento. Cad Saúde Pública. 2019;35:e00074218. https://doi.org/10.1590/0102-311X00074218
22. Vaz IF, Paiva NS, Viana PVS. Evolução espaço-temporal da incidência de tuberculose em indígenas e não indígenas no Brasil, no período de 2011 a 2022. Rev Bras Epidemiol. 2023;26:e230055. https://doi.org/10.1590/1980-549720230055.2
23. Ministério da Saúde (BR). Boletim epidemiológico: coinfecção TB-HIV 2022. Brasília: MS; 2023[cited 2024 Apr 09]. Available from: https://www.gov.br/aids/pt-br/central-de-conteudo/boletins-epidemiologicos/2022/coinfeccao-tb-hiv/boletim_coinfeccao_tb_hiv_2022.pdf
24. León-Giraldo H, Rivera-Lozada O, Castro-AIzate ES, Aylas-Salcedo R, Pacheco-López R, Bonilla-Asalde CA. Factors associated with mortality with tuberculosis diagnosis in indigenous populations in Peru 2015-2019. Int J Environ Res Public Health. 2022;15;19(22):15019. https://doi.org/10.3390/ijerph192215019
25. Castro CMGL, Dan VLC, Dan EMC, Arruda ECP. A situação de vulnerabilidade dos povos indígenas do Mato Grosso e em especial dos Xinguanos frente à Covid-19 e às omissões estatais. Forum Sociol. 2021;(39):53–64. https://doi.org/10.4000/sociologico.10265
26. Lima SVMA, Cruz LZ, Araújo DC, Santos AD, Queiroz AAFLN, Araújo KCGM, *et al*. Quality of tuberculosis information systems after record linkage. Rev Bras Enferm. 2020;73:e20200536. https://doi.org/10.1590/0034-7167-2020-0536.

Availability of data and material

Access to the dataset may be granted upon request to the corresponding author.

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