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Epidemiological analysis of tuberculosis cases in vulnerable populations in the state of Pará

Análise epidemiológica dos casos de tuberculose em populações vulneráveis no estado do Pará

Análisis epidemiológico de casos de tuberculosis en poblaciones vulnerables del estado de Pará

ABSTRACT

Objective: To describe the epidemiological profile of tuberculosis vulnerable populations in the state of Pará in a 10-year historical series. **Method:** Ecological, descriptive study, with a quantitative approach with cases of tuberculosis diagnosed in vulnerable populations, the data were acquired through the website of the Department of Informatics of the Unified Health System of Brazil, from the Tuberculosis Notification/Investigation Forms. For data analysis, descriptive statistics were applied by means of absolute and relative frequency (percentage). **Results:** Among the vulnerable populations, the following stood out: HIV (29.8%) and PPL (28.8%), with the health regions with the most cases, respectively, Metropolitan I and Metropolitan II. There was a predominance of cases in males (76.1%) and age group between 20 and 29 years (34.0%). **Final remarks:** The results indicate that the state of Pará still concentrates high rates of TB cases among vulnerable populations.
Descriptors: Tuberculosis; Vulnerable populations; Epidemiology; Public health surveillance.

RESUMO

Objetivo: Descrever o perfil epidemiológico dos casos de tuberculose nas populações vulneráveis do estado do Pará em uma série histórica de 10 anos. **Método:** Estudo ecológico, descritivo, de abordagem quantitativa com casos de tuberculose diagnosticados nas comunidades vulnerabilizadas; os dados foram adquiridos mediante o sítio do Departamento de Informática do Sistema Único de Saúde do Brasil, oriundos das Fichas de Notificação/Investigação de Tuberculose. Para analisá-los, aplicou-se estatística descritiva, por meio de frequência absoluta e relativa (percentual). **Resultados:** Entre o público vulnerável, destacaram-se: HIV (29,8%) e PPL (28,8%), sendo as regionais de saúde com mais casos, respectivamente, Metropolitana I e Metropolitana II. Houve predominância de casos no sexo masculino (76,1%) e faixa etária entre 20 e 29 anos (34,0%). **Considerações finais:** Os resultados apontam que o estado do Pará ainda concentra elevados índices de casos de TB entre as populações vulnerabilizadas.
Descritores: Tuberculose; Populações vulneráveis; Epidemiologia; Vigilância em saúde pública.

RESUMEN

Objetivo: Describir el perfil epidemiológico de la tuberculosis en poblaciones vulnerables del estado de Pará en un período de 10 años. **Método:** Estudio ecológico, descriptivo y cuantitativo de casos de tuberculosis diagnosticados en poblaciones vulnerables, los datos fueron adquiridos del sitio web del Departamento de Tecnología de la Información del Sistema Único de Salud de Brasil, a partir de los Formularios de Notificación/Investigación de Tuberculosis. Se utilizó estadística descriptiva para analizar los datos, utilizando frecuencias absolutas y relativas (porcentajes). **Resultados:** Entre las poblaciones vulnerables, se destacaron VIH (29,8%) y PDL (28,8%), siendo la Metropolitana I y la Metropolitana II las que presentaron más casos, respectivamente. Hubo un predominio de casos en varones (76,1%) y en el grupo de edad de 20 a 29 años (34,0%). **Consideraciones finales:** Los resultados muestran que el estado de Pará sigue teniendo altas tasas de casos de TB entre las poblaciones vulnerables.
Descriptores: Tuberculosis; Poblaciones vulnerables; Epidemiología; Vigilancia en Salud Pública.

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INTRODUCTION

Tuberculosis (TB) is an infectious, transmissible disease resulting from infection by Mycobacterium Tuberculosis, or Koch's bacillus. Transmission occurs via the respiratory route, from the elimination of aerosols from individuals with active TB (pulmonary or laryngeal) to the inhalation of these aerosols by a susceptible person. Although TB mostly affects the lungs, and the pulmonary form, it can also affect bones, meninges, and kidneys, among others, and is known as extrapulmonary TB(1).

In Brazil, the Ministry of Health's Research and Development Program on Neglected Diseases, in partnership with the Ministry of Science and Technology, cites TB as one of the seven neglected diseases, with priorities for action in health actions and services. In this context, neglected diseases are a group of infectious diseases that mainly affect low-income populations and represent a major public health problem in various regions of the world, with vulnerable populations(2) being the group most affected by these pathologies.

In Brazil, 78,057 new TB cases were reported in 2022, which is equivalent to an incidence rate of 36.3 cases per 100,000 inhabitants and a mortality rate of around 2.8 cases per 100,000 inhabitants. In 2020, Brazil, along with 15 other countries, was responsible for reducing 93% of TB notifications worldwide. This reduction, however, is justified by the impacts caused by the COVID-19 pandemic on health services and systems(3-4).

In 2019, Pará stood out in the country as having one of the highest percentages of new TB cases notified and monitored in Primary Health Care. In addition, in 2022, the state showed an increase with an incidence of 49.4 cases per 100,000 inhabitants, considered the sixth state in the country with the highest incidence(3). Between 2019 and 2020, Pará maintained an average of 2.9 cases of death per 100,000 inhabitants, which is above the national norm. In 2021, there was a slight drop to 2.7 cases of death per 100,000 inhabitants(5).

People with greater biological, social, or economic vulnerabilities are more likely to develop the active form of the disease. This is due to poor living conditions, which affect eating habits, hygiene and housing. In addition, places with large crowds and poor ventilation favor the proliferation of the TB bacillus. The lack of access to rights and comprehensive health care, as well as rights violations, contribute to the increased risk of these population groups falling ill in the country (6).

In the period from 2015 to 2022, there was an increase in new TB cases among people considered vulnerable: the Population in Street Situations (PSS), the Population Deprived of Liberty (PDL), Health Professionals (HP), immigrants, and Indigenous people. In

addition, there is a greater risk of becoming ill among immunosuppressed individuals, especially those infected with the acquired Immunodeficiency Virus (HIV). Thus, the risk of becoming ill with TB in vulnerable groups is higher than in the general population[1].

In this sense, offering social support to TB patients is fundamental to providing resources that minimize the financial difficulties resulting from the disease, reducing direct and indirect costs, and helping to combat poverty and social vulnerability. Cash transfer programs are a form of social protection that provides financial assistance to vulnerable families, aiming to reduce risk, vulnerability, and chronic poverty, as well as improve human capital[7].

From this perspective, TB epidemiological surveillance aims to reduce morbidity and mortality and learn about the magnitude of the disease, its distribution and trend, as well as associated factors, providing support for control actions[8].

This study aimed to describe the epidemiological profile of tuberculosis cases in vulnerable populations in Pará over 10 years.

METODOLOGIA

This is an ecological, descriptive, quantitative study of TB cases diagnosed in vulnerable groups in the state of Pará over a 10-year time series (2013-2022). The research used the Strengthening the Reports of Observational Studies in Epidemiology (STROBE) criteria[9].

The state of Pará is one of the states that make up the Northern Region of Brazil, with Belém as its capital. It is the second largest state in the country in terms of territorial extension, with an area of 1,245,870.798 km². Pará has 144 municipalities and is divided into health regions: Araguaia, Baixo Amazonas, Carajás, Lago de Tucuruí, Metropolitana I, Metropolitana II, Metropolitana III, Rio Caetés, Tapajós, Xingu, Marajó I and Marajó II (IBGE, 2022) [10].

According to the Ministry of Health, vulnerable communities are considered to be: people deprived of their liberty, people living on the streets, indigenous people, people with AIDS and HIV, health professionals, and immigrants, who are listed on the Tuberculosis Notification/Investigation Form on NDIS.[11].

The data, which is in the public domain, was acquired from the website of the IT Department of the Brazilian Unified Health System (Datasus), and the Tuberculosis Notification/Investigation Forms in the Notifiable Diseases Information System (NDIS). All diagnosed TB cases living in the state of Pará were included if they were considered a "vulnerable population" in the item on the investigation form, which, in the case of the Indigenous population, was in the "race" field. The database was analyzed from April to May 2023, selecting the following variables: year of notification, resident health region, gen-

der, age group, type of entry, clinical form, diagnostic sputum smear tests performed, Directly Observed Treatment (DOT), and closure status.

To analyze the above information, descriptive statistics were applied using absolute and relative (percentage) frequencies. The descriptive analysis of the data was carried out in the Epi info 7.2.5 program; for statistical testing, the Analysis of Variance (ANOVA) test was used, to compare the results (on average) in different groups (types of vulnerable groups), accepting as a statistically significant test p-value < 0.05 and having as a null hypothesis that there is no difference between TB cases among vulnerable populations. As the research used secondary data in the public domain, it was not necessary

to obtain approval from the Research Ethics Committee (REC), under Resolutions No. 466/2012 and no. 510/2016 of the National Health Council.

RESULTADOS

Between 2013 and 2022, in the state of Pará, NDIS notified 14,284 cases of TB in communities in situations of vulnerability. Figure 1 shows that 2019 had the highest number of notifications, highlighting PDL, HIV, and AIDS respectively. The "vulnerable population" item on the NDIS form was added in 2013, so there has been an increase in notified cases in all groups, especially PDL. In 2020 and 2021, there was a decrease, during the COVID-19 pandemic. In 2022, cases began to rise again, except for AIDS and HIV.

Figure 1 – Year of diagnosis and vulnerable population in the state of Pará (2013-2022).
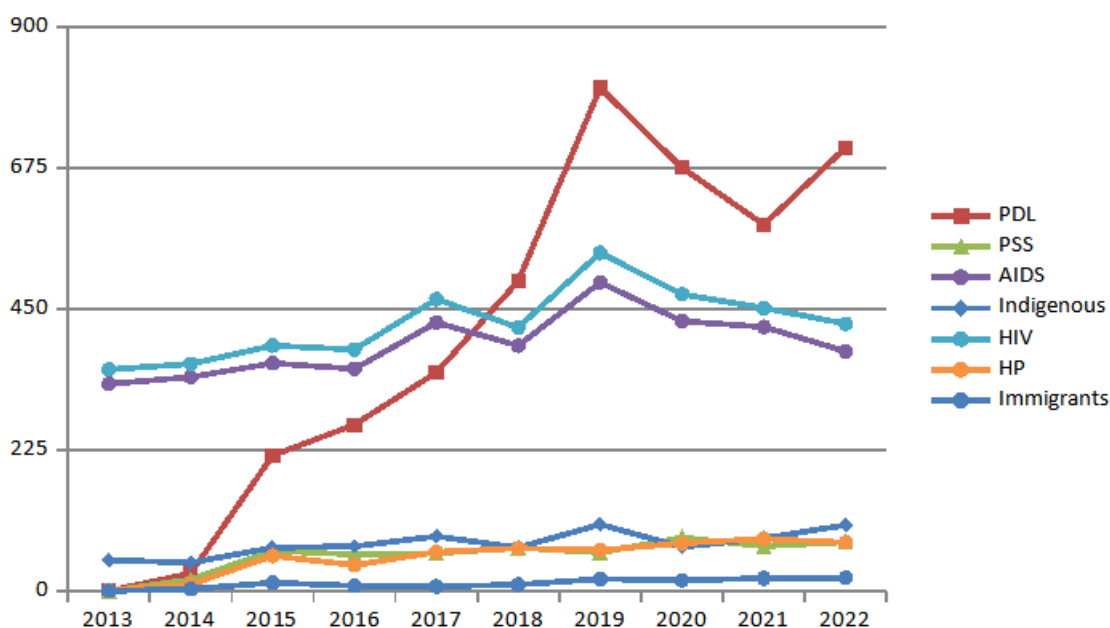
PDL: Population deprived of liberty; PSS: Street situation; HP: Health professionals.
Source: NDIS, 2023.

Among vulnerable populations, the following stood out: HIV (29.8%; 4,265), PDL (28.8%; 4,119), and AIDS (27.4%; 3,925), with the health regions with the most cases being, respectively, Metropolitana I, Metropolitana II, Carajás and Metropolitana III (Table 1).

Table 1 – Total notified cases of tuberculosis (n = 14,284) by health region, according to the type of vulnerable population (2013 to 2022).

Regional Health Offices	Vulnerable population							
	Indigenous	PDL	PSS	AIDS	HIV	HP	Immigrant	Total*
Araguaia	244 (32.3)	97 (2.3)	21 (3.7)	45 (1.1)	55 (2.3)	13 (2.4)	6 (5.1)	484
Baixo Amazonas	52 (6.9)	81 (2.0)	20 (3.5)	241 (6.1)	244 (5.7)	31 (5.7)	17 (14.4)	686
Carajás	61 (8.0)	231 (5.6)	32 (5.7)	222 (5.6)	270 (6.3)	38 (7.0)	5 (4.3)	861
Lago de Tucuruí	10 (1.3)	144 (3.5)	20 (3.5)	86 (2.1)	102 (2.3)	12 (2.2)	3 (2.5)	377
Metropolitana I	67 (8.9)	1.253 (30.4)	345 (612)	2.395 (61.0)	2.532 (59.3)	320 (59.4)	59 (50.0)	6,972
Metropolitana II	4 (0.5)	1.744 (42.3)	30 (5.3)	162 (4.1)	173 (4.0)	16 (2.9)	6 (5.0)	2,135
Metropolitana III	13 (1.72)	170 (4.1)	39 (6.9)	270 (6.8)	308 (7.2)	30 (6.0)	4 (3.4)	834
Rio Caetés	11 (1.4)	144 (3.5)	14 (2.5)	137 (3.4)	164 (3.9)	26 (4.8)	5 (4.3)	501
Tapajós	130 (17.2)	15 (0.4)	15 (2.7)	123 (3.1)	146 (3.4)	13 (2.4)	3 (2.5)	446
Tocantins	6 (0.7)	131 (3.2)	13 (2.3)	133 (3.3)	148 (3.5)	19 (3.5)	5 (4.3)	455
Xingu	151 (20.0)	32 (0.8)	7 (1.2)	28 (0.7)	31 (0.7)	10 (1.8)	4 (3.4)	264
Marajó I	2 (0.2)	21 (0.5)	2 (0.4)	60 (1.5)	65 (1.5)	4 (0.7)	-	154
Marajó II	3 (0.3)	56 (1.4)	6 (1.1)	23 (0.5)	27 (0.7)	7 (1.2)	1 (0.8)	123
Total	**754**	**4,119**	**564**	**3,925**	**4,265**	**539**	**118**	**14,284**

Data is shown as n(%).
PDL: Population Deprived of Liberty; PSS: Population in Street Situation; HP: Health Professionals.
*ANOVA test: p = 0.11.
Source: NDIS, 2023.

Concerning sociodemographic characteristics, there was a predominance of male cases (76.1%, 10,873) and in the 20-29 age group (34.0%, 4,868), followed by individuals aged 30-39 (29.6%, 4,238). The least affected group was the over-80s (0.33%, 52), as shown in Table 2.

Table 2 – Sociodemographic characteristics according to vulnerable populations, n = 14,284 (2012-2022).

Variable		Vulnerable Population							Total**
		Indigenous	PDL	PSS	AIDS	HIV	HP	Immigrant	
Sex	Fem.	368 (48.8)	133 (3.2)	111 (19.6)	1.168 (29.7)	1,256 (29.4)	329 (61.0)	46 (38.9)	3,411
	Male	386 (51.1)	3.986 (96.7)	453 (80.3)	2.757 (70.2)	3.009 (70.5)	210 (38.9)	72 (61.0)	10,873
Age group	< 1 ano	12 (1.6)	10 (0.2)	2 (0.3)	13 (0.3)	14 (0.3)	3 (0.5)	3 (2.5)	57
	1 a 4	52 (6.9)	-	-	12 (0.3)	11 (0.2)	-	4 (3.3)	79
	5 a 9	51 (6.7)	2 (0.04)	3 (0.5)	16 (0.4)	17 (0.3)	-	6 (5.0)	95
	10 a 14	50 (6.6)	8 (0.1)	5 (0.8)	13 (0.3)	15 (0.3)	1 (0.1)	6 (5.0)	98
	15 a 19	92 (12.2)	108 (2.6)	15 (2.6)	70 (1.7)	81 (1.8)	2 (0.3)	10 (8.4)	378
	20 a 29	164 (21.7)	2.538 (61.6)	101 (17.9)	923 (23.5)	999 (23.4)	112 (20.7)	31 (26.2)	4,868
	30 a 39	91 (12.0)	1.038 (25.2)	156 (27.6)	1.322 (33.6)	1.426 (33.4)	187 (34.6)	18 (15.2)	4,238
	40 a 49	69 (9.1)	271 (6.57)	147 (26.0)	951 (24.2)	1.019 (23.8)	129 (23.9)	15 (12.7)	2,601
	50 a 59	65 (8.6)	73 (1.7)	94 (16.6)	427 (10.8)	475 (11.1)	70 (12.9)	15 (12.7)	1,219
	60 a 69	38 (5.0)	48 (1.1)	33(5.8)	135 (3.4)	155 (3.6)	26 (4.8)	6 (5.0)	441
	70 a 79	46 (6.1)	18 (0.43)	7 (1.2)	37 (0.9)	40 (0.9)	7 (1.2)	3 (2.5)	158
	80+	24 (3.1)	5 (0.12)	1 (0.1)	6 (0.1)	13 (0.3)	2 (0.3)	1 (0.8)	52
Total		**754**	**4,119**	**564**	**3,925**	**4,265**	**539**	**118**	**14,284**

Data is shown with n(%).
PDL: Population Deprived of Liberty; PSS: Population in Street Situation; HP: Health Professionals.
*ANOVA test: p = 0.02.
Source: NDIS, 2023..3.

Concerning the type of entry of communities in situations of vulnerability, there were more new cases (11,076, 77.5%), followed by re-entry after abandonment (1,461, 10.22%). The vulnerable social groups that stood out most in terms of the type of entry as a new case were HIV and PDL; on the other hand, taking into account re-entry after abandonment, PDL predominated, followed by HIV. The most prevalent clinical form was pulmonary (11,569, 80.9%), extrapulmonary (1,858, 13%) and pulmonary + extrapulmonary (857, 6%). The most frequently identified closure situation was cure (7,209, 50.4%), followed by abandonment of treatment (1,882, 13.1%), with a higher number in the PSS population (Table 3).

Table 3 – Type of entry, clinical form and closure status of TB patients in the state of Pará (2012–2022).

Variable		Vulnerable Population							Total**
		Indigenous	PDL	PSS	AIDS	HIV	HP	Immigrant	
Type of entry	New case	631 (83.6)	3,172 (77.0)	381 (67.5)	3,009 (76.6)	3,297 (77.3)	490 (90.9)	96 (81.3)	11,076
	Recurrence	47 (6.2)	283 (6.8)	32 (5.6)	253 (6.44)	267 (6.2)	15 (2.7)	5 (4.2)	902
	Re-entry	38 (5.0)	438 (10.6)	127 (22.5)	409 (10.4)	427 (10.0)	14 (2.5)	8 (6.7)	1461
	Not known	2 (0.2)	4 (0.09)	2 (0.3)	10 (0.2)	10 (0.2)	1 (0.1)	0	29
	Transfer	35 (4.6)	222 (5.3)	22 (3.9)	229 (5.8)	248 (5.8)	19 (3.5)	9 (7.6)	784
	Post-death	1 (0.1)	0	0	15 (0.3)	16 (0.3)	0	0	32
Clinical form	Pulmonary	693 (91.9)	4,015 (97.4)	532 (94.3)	2,743 (69.8)	3,041 (71.3)	433 (80.3)	112 (94.9)	11,569
	Extrapulmonary	49 (6.4)	77 (1.8)	18 (3.1)	790 (20.1)	829 (19.4)	90 (16.6)	5 (4.2)	1,858
	Pulmonary + extrapulmonary	12 (1.5)	27 (0.6)	14 (2.4)	392 (9.9)	395 (9.2)	16 (2.9)	1 (0.8)	857
	Ign§/ Blank	108 (14.1)	574 (13.9)	100 (0.1)	586 (14.9)	632 (14.8)	82 (15.2)	30 (25.4)	2,112
SE*	Healing	513 (68.0)	2,519 (61.1)	186 (32.9)	1,696 (43.2)	1,876 (43.9)	367 (68.0)	52 (44.0)	7,209
	Abandonment	27 (3.5)	514 (12.4)	150 (26.5)	553 (14.0)	594 (13.9)	31 (5.7)	13 (11.0)	1,882
	Death from TB	11 (1.4)	17 (0.4)	19 (3.3)	93 (2.3)	102 (2.3)	6 (1.7)	2 (1.6)	250
	Death from other causes	22 (2.9)	39 (0.9)	43 (7.6)	603 (15.3)	629 (14.7)	8 (1.4)	2 (1.6)	1,346
	Transfer	68 (9.0)	420 (10.1)	48 (8.5)	305 (7.7)	335 (7.8)	21 (3.8)	15 (12.7)	1,212
	DR-TB	2 (0.2)	17 (0.4)	11 (1.9)	36 (0.9)	38 (0.8)	13 (2.4)	0	117
	Change of regimen	2 (0.2)	1 (0.02)	3 (0.5)	44 (1.1)	47 (1.1)	10 (1.8)	1 (0.8)	108
	Failure	0	6 (0.1)	0	4 (0.1)	5 (0.1)	1 (0.1)	0	16
	Primary abandonment	1 (0.1)	12 (0.2)	4 (0.7)	5 (0.1)	7 (0.1)	0	3 (2.5)	32

Data shown with n(%).
PDL: Population deprived of liberty; PSS: Population in Street Situation; HP: Health professionals.
*LS: Locked up situation; §Ign: Ignored.
**ANOVA test: p = 0.00.
Source: NDIS, 2023.

Taking into account the test carried out for diagnosis in vulnerable populations with TB, in the first bacilloscopy, positive tests accounted for a higher percentage (52.3%; 7,484); in the second bacilloscopy, tests with Ignored/Blank results formed the majority (90.8%; 12,984) and, in DOT (44.9%; 6,420), the majority had no record. The PSS population had only 29.4% (166) of patients on DOT (Table 4).

Table 4 – Sputum smear test and DOT in patients diagnosed with TB in the state of Pará (2012–2022).

Variable		Vulnerable Population							
		Indigenous	PDL	PSS	AIDS	HIV	HP	Immigrant	Total**
1st sample	Positive	377 (50.0)	3,247 (78.8)	383 (67.9)	1,475 (37,5)	1,686 (39.5)	250 (46.3)	66 (55.9)	7,484
	Negative	175 (23.2)	369 (8.9)	59 (10.4)	1,064 (27.1)	1,134 (26.5)	142 (26.3)	16 (13.5)	2,959
	Not done	175 (23.2)	456 (11.0)	112 (19.8)	1,192 (30.3)	1,245 (29.1)	124 (23.0)	30 (25.4)	3,334
	Not applicable	27 (3.5)	47 (1.1)	10 (1.7)	194 (4.9)	200 (4.6)	23 (4.2)	6 (5.0)	507
	Ign§/blank	672 (89.1)	4,113 (99.8)	555 (98.4)	3,348 (85.2)	3,642 (85.3)	536 (99.4)	118 (100.0)	12,984
2nd sample	Positive	32 (4.2)	6 (0.1)	6 (1.0)	171 (4.3)	199 (4.6)	1 (0.1)	-	415
	Negative	19 (2.5)	-	2 (0.3)	156 (3.9)	163 (3.8)	0	-	340
	Not performed	31 (4.1)	-	1 (0.1)	250 (6.3)	261 (6.1)	2 (0.3)	-	545
	Ign§/blank	286 (37.9)	2,031 (49.3)	260 (46.0)	1,764 (44.9)	1,859 (43.5)	167 (30.9)	53 (44.9)	6,420
DOT*	Yes	361 (47.8)	1,600 (38.8)	166 (29.4)	602 (15.3)	716 (16.7)	142 (26.3)	36 (30.5)	3,623
	No	107 (14.1)	488 (11.8)	138 (24.4)	1,559 (39.7)	1,690 (396)	230 (42.6)	29 (24.5)	4,241
Total		754	4,119	564	3,925	4,265	539	118	14,284

§Ign: ignored
Data is shown with n(%).
PDL: Population Deprived of Liberty; PSS: Population in Street Situation; HP: Health professionals.
*DOT: Directly Observed Treatment.
**ANOVA test: $p = 0.00$.
Source: NDIS, 2023.

DISCUSSION

Characterized by the World Health Organization (WHO) as a global emergency, TB is a public health problem to this day and has been prioritized in several countries for transmission control[12]. In Brazil, factors such as poverty, migration, precarious health infrastructure, and aging interfere with prevention, diagnosis, and treatment, increasing the number of diseases arising from the social context, such as TB. From this perspective, some social groups lead the indices in Brazil, known as vulnerable populations - so-called because they are more prone to contracting Mycobacterium Tuberculosis, which is directly linked to precarious living conditions[13].

Among these vulnerable populations, the highest number of registered TB cases was identified in 2019 - data that also coincides with the overall total for the state of Pará[14] - while, in 2020, these notifications fell sharply. However, this decrease in TB cases in 2020 may not be in line with the reality of the disease, since, due to the pandemic period caused by the Coronavirus, there was a reduction in the number of diagnoses and/or notifications compared to the previous year[15].

In Brazil, which has the fourth largest prison population in the world, the incidence of TB in prisons is approximately 20 times higher than in the general population. In Pará, the highest number of cases among vulnerable populations was recorded in PDL. This high rate may be associated with individual behavioral variables present mainly in this population, such as illicit drug abuse, malnutrition, low schooling, alcoholism, and co-infection with HIV. In addition, the precarious conditions of the Brazilian prison system, especially overcrowding and poor ventilation in cells, may explain the high number of TB infections in PDL[16].

People infected with HIV are 26 times more likely to develop active TB when compared to the general population, and TB-HIV co-infection is responsible for increased mortality rates, making it a challenge for public health. In this context, the study in question identified people living with HIV as the second most affected population by TB, since Mycobacterium Tuberculosis is capable of increasing the replication rate of HIV, thus reducing the number of CD4+ T cells in the peripheral blood, especially in those individuals with recent TB[17,18].

The research brought alarming data regarding the indigenous population, given the high number of cases. Surveys have shown that TB is one of the main causes of morbidity and mortality among indigenous peoples, affecting them disproportionately, with infection rates up to ten times higher than those found in the non-indigenous Brazilian population. As they are considered to be vulnerable people, they demand equitable health care and social protection. Research has shown that this higher number of cases may be due to people moving from the villages to urban centers, where bank branches are located, to receive financial aid from social benefits, which are important for ensuring a decent standard of living[19,20].

The sex most affected by TB, according to the Ministry of Health, is male[21]. In the state of Pará, cases of the disease, according to gender, are similar to the national level and may be related to personal lifestyle, such as the use of alcohol, and illicit drugs, and interfering with immunity, predisposing to becoming ill with the disease[22]. This could be observed

in the study, as there was a predominance of males among all vulnerable populations. Another important factor for this result is the lower level of care and lower demand for health care services compared to females, which may be the result of a stereotyping of male care[23].

Adults (20-59 years old) with TB were predominant in this analysis. This can be explained by the fact that this age group is highly active in the labor market, thus exposing them easily to infectious agents. This statistical result follows the national pattern, demonstrating that the economically active population is an important group affected by TB[24].

In terms of the clinical variables in this study, the most common form was pulmonary. Although TB can affect several organs, this is the most common because of its transmissibility. In addition, this predominance may be related to the fact that the etiological agent, an aerobic bacillus, mainly affects the lungs, organs rich in oxygen, an important factor for its development[1].

The new cases in this study correspond to the most frequent type of entry in vulnerable populations. This situation may be related to the consolidation of TB control strategies, which allow for early detection of the disease, leading to more notifications[25,26].

Metropolitan Region I had a high number of TB cases, and this growth may be related to the increasing presence of population areas in the five municipalities that make it up, including the city of Belém, the capital of the state of Pará. Although the result is not significant, the number of notifications can be explained by the fact that these centers have a greater range of

health services and better conditions for diagnosing and treating TB cases[27].

Regarding the case closure situation in this study, it is estimated that, although there has been an increase in the proportion of cured cases, the indicator is far below the minimum target of 85% recommended by the WHO. In this respect, the figures are important markers of the results of TB control actions and the quality of the services provided and are all the more worrying when related to vulnerable populations[28].

The second most frequent outcome was treatment abandonment, since it is related to several factors, such as the rapid improvement of signs and symptoms in the initial phase of treatment, giving patients a false sense of cure, as well as co-infection with HIV[29]. Another reason is the use of licit and/or illicit drugs, which can be a contributing factor to negative TB treatment outcomes since abuse implies forgetting to take medication[30].

It is worth noting that the high rate of alcoholism and illicit drug use is found mainly in two populations: PDL and PSS. In PDL, the use of these substances may come from a context before incarceration or be influenced by it. In PSS, the use of alcohol and other narcotics is described as one of the reasons why people move away from their families and take to the streets, and the perpetuation of this habit, combined with other risk factors, increases the likelihood of developing TB in PSS. In this way, abandoning treatment leads to drug resistance and recurrence of the disease, causing an impasse in the healing process[31].

The study points out that sputum smear microscopy was widely used in the investigation of TB cases, helping to elucidate the alarming scenario of the

disease in the region and revealing the importance of this and other tests for the effective recognition of the disease, for example, the Rapid Molecular Test (RMT) and the sensitivity test. The disadvantages of not carrying out the tests are many: there is an increase in diagnosis time and late treatment. Early detection and correct treatment of these cases are the best means of prevention available in the health system[32].

On the other hand, the majority of DOTs are not carried out, although the lack of DOTs is considered a major problem in the treatment of the disease; in this sense, DOT coverage in the northern region of Brazil is only 27.6%[33]. The low rate of DOT in the PSS population is justified by the chronic use of alcohol and other drugs, sleep deprivation, lack of safety, and poor health care. This type of treatment is therefore the most recommended treatment strategy for this population[34]. In addition to this scenario, it should preferably be adopted in prison systems[32].

FINAL CONSIDERATIONS

Despite efforts to tackle TB in the last 10 years, the state of Pará still has high rates of TB cases among vulnerable populations due to various risk factors, such as low living conditions. Although treatment for this disease is offered free of charge by the Unified Health System (UHS), there has been an increase in the number of cases of abandonment, especially among individuals with HIV. Thus, there is a need for government measures for the most exposed groups, to promote prevention, treatment, and a cure for the disease.

In addition, the research identified that, among the social groups in situations of vulnerability, the one with the most cases is PDL, as they are located in unhealthy places and have difficult access to health services. Therefore, effective measures to control the disease should be introduced in the health and justice spheres, to prevent and treat TB cases among the incarcerated population at an early stage.

Some factors stood out as being more decisive in causing a higher incidence of TB cases among vulnerable populations: being male, living in a region with a large population, and being between 20 and 29 years old. As for the type of entry into the health services, there are high numbers of new cases, which makes the population in this location more prone to becoming ill with TB, due to the infectious form.

Although DOT is one of the strategies recommended for controlling the disease, the survey found that the field referring to DOT most often marked on the TB notification form was ignored/white and not carried out. This means that DOT needs to be more widespread among vulnerable populations in the state of Pará, to strengthen treatment adherence and prevent the emergence of drug-resistant strains.

Notification forms still need to be more visible in their importance, as many are recorded incorrectly or with some fields not filled in, which leads to a limitation in epidemiological studies and, consequently, interferes with the formulation of more specific public health strategies. Therefore, since these populations find themselves in a context of social vulnerability, it is necessary to take into account the cultural scenario in which they are inserted, adopting a professional, empathetic, and social justice-promoting stance. It is in this context that epidemiological studies can serve as a scientific basis for public policies

to encourage adherence to treatment and, consequently, control of the disease.

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