ReGeo ISSN: 2177-3246

EPIDEMIOLOGICAL PROFILE OF TUBERCULOSIS PATIENTS IN THE STATE OF MARANHÃO

10.56238/revgeov16n5-049

Danielle Cavalcante Cruz Almeida[1], Yuri Alfredo Araújo Mendonça Silva[2], Igor Thiago Pinheiro Passos[3], Marcia Rodrigues Veras Batista[4], Francisca Bruna Arruda Aragão[5], André Rossanno Mendes Almeida[6], Janaina Maiana Abreu Barbosa[7], Flor de Maria Araújo Mendonça Silva[8]

ABSTRACT

Introduction: In Brazil, it is estimated that 7,092 deaths from tuberculosis (TB) could be avoided by 2035 due to the progressive reduction in treatment drop-out. Objective: To describe the clinical and epidemiological profile, as well as the georeferencing of TB cases reported in the Maranhão region from 2014 to 2021, in order to assist in the development of local strategies for better control of this disease. Materials and Methods: This was an ecological time-series study. Secondary data were collected through the Notifiable Diseases Infor-mation System (SINAN) covering the epidemiological period of patients who had TB from January 2019 to December 2023. Data were analyzed using STATA 15.0 software, and linear regression analysis was performed to verify the existence of a functional relationship between a dependent or response variable. Results: The variables related to clinical characteristics that showed the highest prevalence included diagnosis and confirmed cases in the north-ern region of the state of Maranhão, and the mode of transmission was pulmo-nary TB. On the other hand, the absence of TB showed a higher prevalence in relation to the year of diagnosis and the variables related to comorbidities such as AIDS, diabetes, alcoholism, mental illness, illicit drug use, and smoking. Conclusion: The high TB rates have significant implications for public health. Governments need to implement control strategies, especially in areas with the highest concentration of cases, located in urban areas, and among specific demographic groups, which require targeted interventions.

Keywords: Tuberculosis. Control. Treatment.

[1] Master in Health Program and Services Management. Institution: Universidade Ceuma (UNICEUMA). Address: Maranhão, Brasil. E-mail: dcscruz@gmail.com Orcid: https://orcid.org/ 0000-0003-0612-8470
[2] Master in Health Program and Services Management. Institution: Universidade Ceuma (UNICEUMA). Address: Maranhão, Brasil. E-mail: yurimendonca33@icloud.com Orcid: https://orcid.org/0000-0002-4760-8844
[3] Medical Student. Institution: Universidade Ceuma (UNICEUMA). Address: Maranhão, Brasil. E-mail: igor_passosp@hotmail.com Orcid: https://orcid.org/0009-0005-2245-3486
[4] Master in Health Program and Services Management. Institution: Universidade Ceuma (UNICEUMA). Address: Maranhão, Brasil. E-mail: mrveras1@hotmail.com Orcid: https://orcid.org/0000-0001-7127-3805
[5] PhD in Science. Institution: Universidade de São Paulo (USP). Address: São Paulo, Brasil. E-mail: aragao_bruna@hotmail.com Orcid: https://orcid.org/0000-0002-1191-0988
[6] Master in Health Program and Services Management. Institution: Universidade Ceuma (UNICEUMA). Address: Maranhão, Brasil. E-mail: andrerossanno@gmail.com Orcid: https://orcid.org/ 0000-0002-8735-7453
[7] PhD in Public Health. Institution: Universidade Federal do Maranhão (UFMA). Address: Maranhão, Brasil. E-mail: jana_mayana@hotmail.com Orcid: https://orcid.org/0000-0001-5263-6586
[8] PhD in Public Health. Institution: Universidade Federal do Maranhão (UFMA). Address: Maranhão, Brazil E-mail: floragyhn@gmail.com Orcid: https://orcid.org/0000-0002-2796-0939

ReGeo

ISSN: 2177-3246

PERFIL EPIDEMIOLÓGICO DOS PACIENTES COM TUBERCULOSE NO ESTADO DO MARANHÃO

RESUMO

Introdução: No Brasil, estima-se que até 2035 poderia ser evitado 7.092 óbitos por Tuberculose (TB) em virtude da diminuição progressiva do abandono do tratamento. Objetivo: Descrever o perfil clínico, epidemiológico e o georreferenciamento dos casos de TB notificados na região do Maranhão, no período de 2014 a 2021, a fim de auxiliar no desenvolvimento de estratégias locais para o melhor controle deste agravo. Materiais e Métodos: O estudo ecológico de série temporal. A coleta foi realizada com dados secundários através do Sistema de Informação de Agravos de Notificação (SINAN) sobre o período epidemiológico dos pacientes que tiveram TB no período de janeiro de 2019 a dezembro de 2023. Os dados foram analisados no software STATA 15.0, foi realizada análise de regressão linear para verificar a existência de uma relação funcional entre uma variável dependente ou resposta. Resultados: As variáveis relacionadas às características clínicas que evidenciaram maior prevalência compreenderam em: realização de diagnóstico e os casos confirmados na região norte do estado do Maranhão e a forma de contágio foi a TB pulmonar. Por outro lado, apresentou maior prevalência a ausência de TB em relação ao ano do diagnóstico as variáveis relativas às comorbidades de: AIDS, diabetes, alcoolismo, doença mental, drogas ilícitas e tabagismo. Conclusão: As elevadas taxas de TB representam fortes implicações para a saúde pública, o poder publico necessita implementar estratégias de controle principalmente nas áreas de maior concentração de casos localizadas nas áreas urbanas e entre grupos demográficos específicos, os quais exigem intervenções direcionadas.

Palavras-chave: Tuberculose. Controle. Tratamento.

PERFIL EPIDEMIOLÓGICO DE LOS PACIENTES CON TUBERCULOSIS EN EL ESTADO DE MARANHÃO

RESUMEN

Introducción: En Brasil, se estima que 7.092 muertes por tuberculosis (TB) podrían evitarse para 2035 debido a la reducción progresiva del abandono del tratamiento. Objetivo: Describir el perfil clínico y epidemiológico, así como la georreferenciación de los casos de TB notificados en la región de Maranhão de 2014 a 2021, con el fin de ayudar en el desarrollo de estrategias locales para un mejor control de esta enfermedad. Materiales y métodos: Este fue un estudio ecológico de series de tiempo. Los datos secundarios se recopilaron a través del Sistema de Información de Enfermedades de Declaración Obligatoria (SINAN) que abarca el período epidemiológico de los pacientes con TB de enero de 2019 a diciembre de 2023. Los datos se analizaron utilizando el software STATA 15.0 y se realizó un análisis de regresión lineal para verificar la existencia de una relación funcional entre una variable dependiente o de respuesta. Resultados: Las variables relacionadas con las características clínicas que mostraron la mayor prevalencia incluyeron el diagnóstico y los casos confirmados en la región norte del estado de Maranhão, y la vía de transmisión fue la tuberculosis pulmonar. Por otro lado, la ausencia de tuberculosis mostró una mayor prevalencia en relación con el año de diagnóstico y las variables relacionadas con comorbilidades como el sida, la diabetes, el alcoholismo, las enfermedades mentales, el consumo de drogas ilícitas y el tabaquismo. Conclusión: Las altas tasas de tuberculosis tienen implicaciones significativas para la salud pública. Los gobiernos deben implementar estrategias de control, especialmente en las zonas con mayor concentración de casos, ubicadas en zonas urbanas y entre grupos demográficos específicos, que requieren intervenciones específicas.

Palabras clave: Tuberculosis. Control. Tratamiento.

1 INTRODUCTION

Tuberculosis (TB) remains one of the main public health challenges globally, especially in developing countries. According to the World Health Organization (WHO), millions of new cases are reported annually, and Brazil is among the countries with a high TB incidence (WHO, 2021) (Inocêncio, 2021).

Mycobacterium tuberculosis remains one of the leading causes of infectious disease-related deaths worldwide. It is estimated that around 2 billion people are infected with TB bacilli and each year, 54 million become infected, 6.8 million develop the disease, and 3 million die. In 2015, Brazil ranked 15th among the 22 countries responsible for 80% of all TB cases worldwide (Brasil, 2021).

In Brazil, it is estimated that by 2035, 7,092 deaths from TB could be avoided due to the progressive decrease in treatment dropout. However, in 2015, it was observed that TB continues to have negative outcomes, with a low cure rate (74.2%) and a high dropout rate (11%), which fall short of WHO's recommended targets of approximately 85% cure and a dropout rate up to 5%. (Brasil, 2016).

This study aims to analyze the epidemiological profile of patients who developed TB between 2019 and 2023, amid economic and health challenges. The analysis of this cohort may reveal relevant data on the impact of control policies and the challenges faced by health authorities in managing the disease. The research aims to contribute to strengthening TB control strategies, underscoring the need for a resilient healthcare system and comprehensive disease prevention strategies.

2 MATERIALS AND METHODS

This is a descriptive ecological study employing a quantitative time-trend analysis approach, which allows the evaluation of patterns and variations over time. The study was conducted in the state of Maranhão, located in the Northeast region of Brazil.

The data analyzed refer to TB cases reported between January 2019 and December 2023, obtained from the Boletim Epidemiológico e da Secretaria de Estado da Saúde do Maranhão (SES).

The study population consisted of TB cases, including 9,848 new cases reported from 2019 to 2022.

All TB cases registered in SINAN were included in the study. Incomplete records or those that did not allow confirmation of the presence of the disease by laboratory criteria were excluded from the study, as were duplicate and inconsistent data that could compromise the accuracy of the results.

Data collection used secondary data extracted from SINAN. The collected data were organized into tables and spreadsheets, categorizing variables such as sex, age, municipality of notification, type of TB (pulmonary or extrapulmonary), stage of evolution (cure, treatment dropout, or death), among others.

Statistical analysis was performed using STATA 15.0 software (Stata Corp College Station, Texas, USA). Absolute and relative frequencies (percentages), standard deviations (SD), and confidence intervals (CI) were calculated for the main indicators to describe the sociodemographic and clinical profile of the study population. In addition, standard deviation

The project entitled “Perfil epidemiológico dos pacientes com tuberculose no estado do Maranhão" is part of a larger study, “Grandes Endemias e Doenças Negligenciadas no Estado do Maranhão”, approved by the UniCEUMA Research Ethics Committee, in accordance with Opinion No. 4,407,369. The research fully complied with the Conselho Nacional de Saúde (National Health Council's) guidelines for research involving human subjects, in accordance with Resolução 466/2012.

3 RESULTS

In the present study, the Sociodemographic variables with the highest prevalence included: age group between 20 and 39 years old; completed high school; brown race; and male sex.

Table 1
Distribution of sociodemographic characteristics of patients with pulmonary TB in the state of Maranhão from 2019 to 2023.

VARIABLE	2019 n(%)	2020 n(%)	2021 n(%)	2022 n(%)	2023 n(%)
Age Group					
< 1 a 14	63 (2.09)	60 (2.11)	60 (1.81)	78 (2.12)	81 (2.04)
15-19	169 (5.60)	134 (4.71)	152 (4.58)	183 (4.96)	144 (3.62)
20-39	1154 (38.22)	1079 (37.89)	1272 (38.30)	1330 (36.07)	1500 (37.71)
40-59	840 (27.82)	815 (28.62)	919 (27.67)	1017 (27.58)	1052 (26.45)
60-69	244 (8.08)	225 (7.90)	276 (8.31)	353 (9.57)	329 (8.27)
70 - 80 +	236 (7.82)	209 (7.34)	237 (7.14)	272 (7.38)	313 (7.87)
Ignored/Blank	313 (10.37)	326 (11.45)	405 (12.20)	454 (12.31)	559 (14.05)
Education					
Illiterate	280 (12.23)	212 (10.06)	193 (8.01)	206 (7.75)	235 (8.45)
Incomplete elementary	642 (28.03)	519 (24.63)	676 (28.05)	730 (27.45)	646 (23.24)
Complete elementary	656 (28.65)	618 (29.33)	701 (29.09)	822 (30.91)	877 (31.55)
High School	657 (28.69)	686 (32.56)	783 (32.49)	835 (31.40)	919 (33.06)
Not applicable	23 (1.00)	30 (1.42)	18 (0.75)	33 (1.24)	45 (1.62)
Ignored/Blank	32 (1.40)	42 (1.99)	39 (1.62)	33 (1.24)	58 (2.09)
Race					
White	313 (11.71)	276 (11.12)	324 (11.25)	305 (9.52)	332 (9.88)
Black	315 (11.78)	302 (12.17)	475 (16.50)	513 (16.02)	540 (16.07)
Yellow	37 (1.38)	25 (1.01)	20 (0.69)	14 (0.44)	34 (1.01)
Brown (mixed race	1950 (72.92)	1841 (74.20)	2031 (70.55)	2329 (72.71)	2396 (71.29)
Indigenous	59 (2.21)	37 (1.49)	29 (1.01)	42 (1.31)	59 (1.76)

Sex					
Male	1829 (67.27)	1652 (64.91)	1988 (67.69)	2256 (69.16)	2419 (70.42)
Female	877 (32.25)	871 (34.22)	930 (31.66)	980 (30.04)	1000 (29.11)
Ignored/Blank	13 (0.48)	22 (0.86)	19 (0.65)	26 (0.80)	16 (0.47)

In 2019, the age group with the highest prevalence was 20 to 39 years old, with 1,154 cases (38.22%). Regarding education, most patients had a high school education, with 657 cases (28.69%). The brown race predominated, with 1,950 cases (72.92%), and males also had a higher prevalence, with 1,829 cases (67.27%).

In 2020, individuals aged 20 to 39 remained the most affected group, accounting for 1,079 cases (37.89%). Most patients had a high school education, totaling 686 cases (32.56%). The racial predominance remained among brown people, with 1,841 cases (74.20%), and males accounted for 1,652 cases (64.91%).

In 2021, the 20-39 age group remained the most prevalent, with 1,272 cases (38.30%). Once again, high school education was the most common, with 783 cases (32.49%), and brown race remained predominant, with 2,031 cases (70.55%). Males had the highest number of cases, with 1,988 cases (67.69%).

In 2022, the 20-39 age group comprised 1,330 cases (36.07%). Most patients had a high school education, totaling 835 cases (31.40%). The brown race was prevalent, with 2,329 cases (72.71%), and males accounted for 2,256 cases (69.16%).

Finally, in 2023, the 20-39 age group had the highest prevalence, with 1,500 cases (37.71%). High school education was the most frequent, with 919 cases (33.06%), and brown race continued to be predominant, with 2,396 cases (71.29%). Males accounted for 2,419 cases (70.42%), confirming their predominance over the years.

Among clinical characteristics, the highest prevalence was observed in patients diagnosed in the northern region of Maranhão, with pulmonary TB being the predominant form of transmission. Furthermore, the variables related to comorbidities of AIDS, diabetes, alcoholism, mental illness, illicit drugs, and smoking showed a higher prevalence of absence of these comorbidities among TB patients

Table 2
Distribution of clinical characteristics of patients with pulmonary TB in the state of Maranhão from 2019 to 2023

VARIABLE	2019 n(%)	2020 n(%)	2021 n(%)	2022 n(%)	2023 n(%)
Diagnosis					
South	372 (13.97)	300 (12.07)	323 (11.17)	381 (11.88)	404 (12.01)
North	1915 (71.91)	1863 (74.97)	2168 (74.99)	2378 (74.17)	2551 (75.85)
West	376 (14.12)	322(12.96)	400 (13.84)	447 (13.94)	408 (12.13)
Form of Contagion					
Pulmonary	2428 (82.95)	2278 (85.70)	2660 (87.99)	2964 (88.19)	3143 (88.19)
Extrapulmonary	256 (8.75)	218 (8.20)	225 (7.44)	234 (6.96)	234 (6.57)
Pulmonary + Extrapulmonary	22 (0.75)	27 (1.02)	33 (1.09)	38 (1.13)	38 (1.07)
Ignored/Blank	221 (7.55)	135 (5.08)	105 (3.47)	125 (3.72)	149 (4.18)
AIDS X Year of Diagnosis					
Yes	236 (9.22)	209 (8.47)	246 (8.48)	248 (7.77)	290 (8.63)
No	2249 (87.82)	2179 (88.33)	2567 (88.52)	2863 (89.72)	2980 (88.69)
Ignored/Blank	76 (2.97)	79 (3.20)	87 (3.00)	80 (2.51)	90 (2.68)
Alcoholism X Year of Diagnosis					
Yes	540 (19.87)	485 (19.16)	586 (20.08)	674 (20.82)	788 (23.03)
No	2090 (76.89)	1959 (77.40)	2245 (76.91)	2482 (76.65)	2541 (74.28)
Ignored/Blank	88 (3.24)	87 (3.44)	88 (3.01)	82 (2.53)	92 (2.69)
Diabetes X Year of Diagnosis					
Yes	279 (10.32)	299 (11.87)	349 (11.92)	378 (11.63)	420 (12.26)
No	2339 (86.53)	2137 (84.80)	2481 (84.76)	2776 (85.44)	2907 (84.85)
Ignored/Blank	85 (3.14)	84 (3.33)	97 (3.31)	95 (2.92)	99 (2.89)
Mental illness X Year Diagnosis					
Yes	43 (1.58)	37 (1.46)	64 (2.19)	59 (1.83)	82 (2.40)
No	2578 (94.50)	2402 (94.72)	2757 (94.42)	3082 (95.65)	3238 (94.60)
Ignored/Blank	107 (3.92)	97 (3.82)	99 (3.39)	81 (2.51)	103 (3.01)
Illegal drugs x Year Diagnosis					
Yes	379 (13.99)	304 (12.05)	397 (13.62)	485 (14.98)	689 (20.18)
No	2220 (81.95)	2122 (84.14)	2422 (83.09)	2670 (82.48)	2627 (76.93)
Ignored/Blank	110 (4.06)	96 (3.81)	96 (3.29)	82 (2.53)	99 (2.90)
Smoking x Year of Diagnosis					
Yes	589 (13.75)	474 (11.84)	592 (12.46)	722 (13.81)	923 (16.96)
No	2007 (46.84)	1953 (48.76)	2230 (46.93)	2432 (46.53)	2397 (44.05)
Laboratory confirmed	1689 (39.42)	1578 (39.40)	1930 (40.61)	2073 (39.66)	2121 (38.98)

In terms of diagnosis, the North region was the most prevalent over the years, especially in 2023, when it had 2,551 cases (75.85%). Among confirmed cases, the proportions remained constant in all regions and years, with the North having 1,915 cases (71.91%), followed by the East with 376 cases (14.12%), and the South with 372 cases (13.97%). The pulmonary form of infection was predominant in all years, reaching 3,143 cases (88.19%) in 2023. Regarding the coexistence of AIDS, the majority of cases did not have the disease, with 2,980 cases (88.69%) in 2023. Alcoholism was more prevalent in patients with no previous history of the condition, totaling 2,541 cases (74.28%).

Similarly, the diagnosis of diabetes was also predominant (84.85%) among those with no history, with 2,907 cases in the same year.

In relation to mental illness, cases with no history were the most prevalent, with 3,238 cases (94.60%) in 2023. Illegal drug use also followed the same pattern, with the majority of patients not using drugs, totaling 2,627 cases (76.93%) in 2023. Regarding smoking, the highest prevalence was among patients who did not smoke, with 2,432 cases (46.53%) in 2022.

The variables related to laboratory tests that showed the highest prevalence included: No laboratory confirmation; 1st sputum smear with a "positive" result; sputum culture that "was not performed"; rapid TB test "not performed"; HIV 'negative'; and "cure" as Closed Status.

Table 3
Distribution of laboratory characteristics of patients with pulmonary TB in the state of Maranhão from 2019 to 2023

VARIABLE	2019 n(%)	2020 n(%)	2021 n(%)	2022 n(%)	2023 n(%)
Laboratory confirmation x Year of diagnosis					
Without laboratory confirmation	1017 (100.00)	945 (100.00)	988 (100.00)	1163 (100.00)	1298 (100.00)
1st Bac Sputum x Year Diagnosis					
Positive	1203 (22.23)	1250 (24.78)	1498 (25.68)	1578 (24.38)	1610 (23.56)
Negative	424 (7.83)	421 (8.34)	417 (7.15)	446 (6.89)	582 (8.52)
Not performed	979 (18.09)	762 (15.10)	927 (15.89)	1115 (17.23)	1127 (16.49)
Not applicable	100 (1.85)	90 (1.78)	76 (1.30)	97 (1.50)	96 (1.40)
Ignored/Blank	2706 (50.00)	2522 (49.99)	2916 (49.98)	3236 (50.00)	3419 (50.03)
Sputum Culture x Year of Diagnosis					
Positive	272 (9.77)	134 (5.14)	189 (6.25)	164 (4.91)	157 (4.42)
Negative	166 (5.96)	121 (4.64)	101 (3.34)	88 (2.64)	112 (3.15)
In progress	59 (2.12)	37 (1.42)	20 (0.66)	21 (0.63)	106 (2.98)
Not performed	2209 (79.32)	2231 (85.54)	2608 (86.30)	2963 (88.79)	3040 (85.51)
Ign/ Blank	79 (2.84)	85 (3.26)	104 (3.44)	101 (3.03)	140 (3.94)
Rapid TB test x Diagnostic year					
Sensitive rifamp detection	544 (20.71)	414 (16.98)	579 (20.58)	629 (20.06)	761 (23.21)
Detect resistant rifamp	39 (1.48)	53 (2.17)	61 (2.17)	54 (1.72)	48 (1.46)
Not detectable	142 (5.41)	112 (4.59)	124 (4.41)	95 (3.03)	186 (5.67)
Inconclusive	80 (3.05)	55 (2.26)	54 (1.92)	48 (1.53)	105 (3.20)
Not performed	1822 (69.36)	1804 (74.00)	1996 (70.93)	2309 (73.65)	2179 (66.45)
HIV x Year of Diagnosis					
Positive	251 (8.17)	234 (7.78)	276 (7.55)	273 (6.72)	323 (7.06)
Negative	2192 (71.38)	2073 (68.92)	2397 (65.58)	2605 (64.16)	2683 (58.66)
In progress	11 (0.36)	8 (0.27)	13 (0.36)	20 (0.49)	59 (1.29)
Not performed	252 (8.21)	208 (6.91)	232 (6.35)	338 (8.33)	350 (7.65)
Ign/ Blank	365 (11.89)	485 (16.12)	737 (20.16)	824 (20.30)	1159 (25.34)
Status Closed x Year Diagnosis					
Cure	1896 (70.72)	1677 (68.20)	1892 (66.76)	1976 (64.96)	1084 (51.18)
Treatment dropout	331 (12.35)	365 (14.84)	409 (14.43)	431 (14.17)	322 (15.20)
Death from TB	134 (5.00)	107 (4.35)	145 (5.12)	176 (5.79)	162 (7.65)

Death from other causes	99 (3.69)	105 (4.27)	135 (4.76)	150 (4.93)	158 (7.46)
Transfer	132 (4.92)	123 (5.00)	163 (5.75)	195 (6.41)	282 (13.31)
TB-DR	41 (1.53)	41 (1.67)	46 (1.62)	53 (1.74)	45 (2.12)
Schema Change	14 (0.52)	21 (0.85)	21 (0.74)	18 (0.59)	11 (0.52)
Failure	5 (0.19)	1 (0.04)	3 (0.11)	3 (0.10)	1 (0.05)
Primary Treatment dropout	29 (1.08)	19 (0.77)	20 (0.71)	40 (1.31)	53 (2.50)

Regarding laboratory-confirmed diagnoses, all cases between 2019 and 2023 were without laboratory confirmation. In the analysis of the first sputum smear test, most results were ignored or blank, with about 50% of annual cases, while positive results stood out among those performed, especially in 2021 with 1,498 cases (25.68%). For sputum culture, most cases did not undergo the test.

Regarding the rapid TB test, rifampicin sensitivity detection was most prevalent in 761 cases (23.21%) in 2023. In HIV testing, most patients tested negative over the years, with a prevalence of 2,683 (58.66%) in 2023. In the closure situation, the cure rate was prevalent in 2019, with 1,896 cases (70.72%).

4 DISCUSSION

The present discussion aims to deepen the analysis of the study data, focusing on the sociodemographic, clinical, and laboratory distribution of patients. Understanding these variables is essential to outline the situation, thus building a robust and informative profile of TB cases in the state of Maranhão.

The analysis of sociodemographic characteristics based on variables such as age group, education level, race, and gender not only reveals who is most affected by the disease, but also suggests possible factors of vulnerability and access to health services (Macedo; Maciel; Ethel; Stru-chiner, 2021).

In relation to age group, a significant prevalence was observed among individuals aged 20 to 39 years, totaling 1,154 cases (38.22%). This age group consistently shows the highest prevalence in several studies, highlighting a worrying trend of TB infections in young adults, such as in Maranhão and Belém, with rates of 42.32% (Neto et al., 2023) and 33.5% (Mendes et al., 2021), respectively.

For Gonçalves et al. (2021), this upward trend in TB is synonymous with the need for better treatment strategies, as it is evident that many cases are new and require effective treatment to reduce transmission. On the other hand, although the focus on young adults is fundamental, it is essential to recognize that TB also affects older populations.

Factors such as low levels of education and the racial demographics of individuals predominantly self-declared as brown-skinned are common among populations most affected by clinical pulmonary TB (Santos et al., 2018). The study by Camêlo et al. (2016) reveals that lower

educational levels correlate with an increased incidence of TB, with individuals with less than nine years of schooling having higher rates of new TB cases and treatment dropout.

Although the disease affects both sexes, gender disparity is observed, with studies indicating that men account for a significant majority of cases (Neto et al., 2023; Ryuk et al., 2024). This gender disparity may be linked to behavioral and social factors, including access to healthcare and occupational exposure. On the other hand, although the data emphasize these trends, it is essential to consider that TB affects diverse populations, and interventions must be tailored to meet the specific needs of various demographic groups (Silva et al., 2022).

The gender disparity in tuberculosis (TB) is linked to behavioral and social factors, such as access to healthcare and occupational exposure. This complexity requires tailored and personalized interventions to meet the needs of diverse demographic groups. In this context, women often face barriers such as lack of education and financial resources, which delay their access to diagnosis and treatment of the disease (Nadakuditi, 2024).

Similarly, Muttamba et al. (2024) highlight that gender roles can hinder health-seeking behaviors, particularly among men who prioritize family provision over personal health. In this sense, the study by (Priya; Pandey, 2024) recommends the implementation of community-level interventions that consider specific gender needs.

The findings in this study on TB in relation to clinical characteristics provide significant information on prevalence, indicating a predominance of pulmonary TB, mainly in the northern region of the state, and comorbidities such as AIDS, diabetes, alcoholism, mental illness, illicit drug use, and smoking were not strongly associated with TB diagnosis during this period.

In the present study, the highest prevalence of TB cases was pulmonary TB, and these findings indicate that this form is the most common, accounting for approximately 79% to 83% of cases in various regions of Brazil. The northern region of Maranhão had the highest incidence, suggesting a geographical concentration of cases that may require specific public health interventions (Moraes et al., 2018; Neto et al., 2023; Barbosa et al., 2014).

Unexpectedly, lower rates of comorbidities such as AIDS and diabetes were observed among TB patients, contrasting with previous studies that reported higher coinfection rates. This contrasts with other studies, such as that by Neto et al. (2011), in which co-infections, particularly with HIV, were more prevalent among TB patients (Sousa et al., 2022).

The first BAC sputum test showed a positive result in many cases. On the other hand, a considerable number of patients did not undergo sputum culture, which is essential for accurate diagnosis and treatment planning. Silva's study (2019) also identified a significant number of tuberculosis cases without laboratory confirmation.

Absence of HIV coinfection among most patients may contribute to more favorable TB treatment outcomes. On the other hand, the study observed that a significant number of patients achieved “cure” status, reflecting the effectiveness of treatment protocols in Maranhão (Ryuk et al., 2024).

In the present study, the high prevalence of cases without laboratory confirmation aligns with findings from Moraes et al. (2018), indicating that a substantial number of TB cases reported in Maranhão lacked laboratory confirmation, which complicates accurate epidemiological assessments. On the other hand, underreporting of cases, particularly those that result in death, suggests systemic problems (Martins et al., 2020).

The TB epidemiological profile in Maranhão aligns with national trends, particularly regarding the disproportionate impact on adult males, indicating the need for targeted public health interventions (Cunha et al., 2021).

The lack of laboratory confirmation can hinder the adoption of effective treatment and control measures, highlighting the need for more robust diagnostic protocols and training for health services. These actions include decentralizing laboratory diagnosis, implementing sputum culture in reference centers, ensuring the quality of tests, and efficiently organizing flows between health units and laboratories (Santos, 2007).

Sputum smear microscopy yielded positive results as a diagnostic tool (Correa et al., 2024). However, in many cases, sputum culture was not performed, which is essential for confirming TB and determining drug resistance (Moraes et al., 2018). Rapid TB testing was often not performed, indicating the need to improve access to rapid diagnostic methods.

Other significant results that should be mentioned are related to the presence of HIV-negative status among TB patients, which suggests a potential area for targeted interventions, as coinfection can complicate TB treatment (Jamal; Moherdaui, 2007). The cure rates indicate that a significant number of patients achieved “cure” status, reflecting the effectiveness of the treatment protocols in place (Silva et al., 2022).

5 CONCLUSION

The study of the epidemiological profile of TB patients in Maranhão highlights a worrying trend of persistently high TB prevalence. This situation has significant implications for public health, particularly in the context of disease management and control strategies.

Given the serious implications of high TB rates, public health authorities must strengthen the implementation of existing TB control strategies, particularly in areas with the highest concentration of cases located in urban areas and among specific demographic groups, which require targeted

interventions, particularly in education and awareness campaigns. Resource allocation should prioritize municipalities with the highest bacillary burden to optimize intervention outcomes.

REFERENCES

Barbosa, Débora Regina Marques; Almeida, Manoel Guedes De; Martins, Lidiane Mota. Características epidemiológicas, clínicas e espaciais de casos notificados de tuberculose em área hiperendêmica do nordeste do Brasil. ***Revista de Epidemiologia e Controle de Infecção***, 2014. DOI: 10.17058/RECI.V4I3.4205.

Brasil. Ministério da Saúde. Perspectivas brasileiras para o fim da tuberculose como problema de saúde pública. ***Boletim Epidemiológico***, v. 47, n. 13, p. 1-15, 2016.

Brasil. Ministério da Saúde. Programa Nacional de Controle da Tuberculose. 2021. Disponível em: https://portaldeboaspraticas.iff.fiocruz.br/biblioteca/programa-nacional-de-controle-da-tuberculose/. Acesso em: 28 jan. 2025.

Camêlo, Edwirde Luiz Silva; Aguiar, Dalila Camêlo; Monteiro, Tânia Maria Ribeiro; et al. Tuberculosis in Brazil: new cases, healing and treatment dropout in relation to level of education. ***International Archives of Medicine***, 2016. DOI: 10.3823/1939.

Correa, Mário Fernando Viana De Moraes; Frazão, Rita Da Graça Carvalhal; Coutinho, Nair Portela Silva; et al. Predictors of unsuccessful tuberculosis treatment outcomes in Brazil: an analysis of 259,484 patient records. ***BMC Infectious Diseases***, 2024. DOI: 10.1186/s12879-024-09417-7.

Cunha, Viana Paulo Victor De Sousa; Redner, Paulo; Ramos, Jesus Pais. Fatores associados ao abandono e ao óbito de casos de tuberculose drogarresistente (TBDR) atendidos em um centro de referência no Rio de Janeiro, Brasil. ***Cadernos de Saúde Pública***, v. 34, 2018.

Gonçalves, Neemias Costa Duarte; Santos, Denise Alves; Ramos, Sabrina de Cristo; et al. Epidemiological profile of tuberculosis cases in Belém-Pará, between the years 2018-2022. ***Revista Cereus***, 2023. DOI: 10.18605/2175-7275/cereus.v16n2p212-220.

Inocêncio, Ariel Silene Faria. Evolução da resistência em Tuberculose. 2021. Dissertação de Mestrado. **Universidade de Lisboa (Portugal).**

Jamal, Leda Fátima; Moherdaui, Fábio. Tuberculose e infecção pelo HIV no Brasil: magnitude do problema e estratégias para o controle. ***Revista de Saúde Pública***, v. 41, p. 104-110, 2007.

Macedo, Laylla Ribeiro; Maciel, Ethel Leonor Noia; Struchiner, Claudio Jose. Populações vulneráveis e o desfecho dos casos de tuberculose no Brasil. ***Ciência & Saúde Coletiva***, v. 26, p. 4749-4759, 2021.

Martins, Muniz Nathalia Carolline Lima; Guilherme, Junnya Gabrielly Anacleto; Freitas, Rosa Caroline Mata Verçosa. Caracterização epidemiológica da tuberculose em Alagoas. ***Revista JRG de Estudos Acadêmicos***, v. 7, n. 14, p. e141176-e141176, 2020.

Mendes, Lucas Joshuah Teixeira. Georreferenciamento na Saúde Coletiva: uma proposta acessível para a Atenção Primária. 2021.

Moraes, Mário Fernando Viana De; Frazão, Rita da Graça Carvalhal; Coutinho, Nair Portela Silva; et al. Perfil epidemiológico de casos de tuberculose em um município prioritário no estado do Maranhão. 2018.

Muttamba, Winters; Omongot, S.; Najjingo, Irene; et al. Using intersectional gender analysis to identify challenges in tuberculosis care at four health care facilities in Uganda. ***Infectious Diseases of Poverty***, 2024. DOI: 10.1186/s40249-023-01171-3.

Nadakuditi, Swapna. Gender based disparities in healthcare in developing nations – a comprehensive review. *Journal of Health Statistics Reports*, 2024. DOI: 10.47363/jhsr/2024(3)120.

Neto, Neemias Costa Duarte; Santos, Denise Alves; Ramos, Sabrina de Cristo; et al. Epidemiological profile of tuberculosis cases in Belém-Pará, between the years 2018-2022. ***Revista Cereus***, 2023. DOI: 10.18605/2175-7275/cereus.v16n2p212-220.

Oms – Organização Mundial da Saúde. Global Tuberculosis Report. Geneva: WHO, 2021.

Priya, Vishnu; Pandey, S. Navigating gender disparities on the management of chronic disease: a narrative review. ***International Journal for Multidisciplinary Research***, 2024. DOI: 10.36948/ijfmr.2024.v06i04.25710.

Ryuk, Do Kyung; Pelissari, Daniele Maria; Alves, Kleydson; et al. Predictors of unsuccessful tuberculosis treatment outcomes in Brazil: an analysis of 259,484 patient records. ***BMC Infectious Diseases***, 2024. DOI: 10.1186/s12879-024-09417-7.

Santos, Joseney. Resposta brasileira ao controle da tuberculose. ***Revista de Saúde Pública***, v. 41, p. 89-93, 2007.

Santos, Janine Nascimento Dos; Bispo Júnior, José Patrício; et al. Fatores associados à cura no tratamento da tuberculose no estado do Rio de Janeiro, 2011-2014. ***Epidemiologia e Serviços de Saúde***, v. 27, p. e2017464, 2018.

Silva, Natally dos Santos; et al. Análise comparativa da técnica de baciloscopia no diagnóstico da tuberculose pulmonar frente ao GeneXpert em amostras de pacientes da cidade de Recife, Pernambuco. ***RBAC (Online)***, p. 65-69, 2019.

Silva, Alexandra Rodrigues dos Santos; et al. Percepções de pessoas com tuberculose/HIV em relação à adesão ao tratamento. ***Acta Paulista de Enfermagem***, v. 35, p. eAPE03661, 2022.

Sousa, George Jó Bezerra; et al. Prevalência e fatores associados ao abandono do tratamento da tuberculose. ***Revista da Escola de Enfermagem da USP***, v. 55, p. e03767, 2022.