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Prevalence of Tuberculosis and Factors Associated with Clinical Pulmonary Form in a North-Eastern Brazilian Municipality

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ABSTRACT

Objective: To determine the prevalence of tuberculosis and to verify the factors associated with pulmonary tuberculosis in Imperatriz-Ma, northeast region of Brazil.

Method: This is a cross-sectional study of all the cases of tuberculosis registered with the Notification of Injury Information System from January 2006 to December 2015. The prevalence rate/year of study and the mean prevalence for the period were determined and the Chi-square test was performed to evaluate the associations between the independent variables under investigation with the dependent variable "pulmonary tuberculosis".

Results: The mean prevalence rate was 33.1/100,000 inhabitants per year, with the highest 48.6/100,000 inhabitants detected in 2006 and the lowest 22.0/100,000 inhabitants in 2012. Most of the patients were 40 years old or less, male, race/brown, type of entry as a new case, with a clinical pulmonary form, suspected chest X-ray, among others. Predominant plots were evidenced in people with education level less than nine years, positive sputum smear microscopy and non-HIV serology. There was a statistically significant association ($p<0.05$) between gender, education level, type of entry and sputum smear microscopy.

Conclusion: This research has shown declining tuberculosis prevalence rates, although rates above the national average and factors associated with clinical pulmonary form are considered important epidemiological aspects to be considered in the management and organization of health services for the control and disease surveillance.

INTRODUCTION

Tuberculosis (TB) continues to be a world's leading infectious diseases. It is one of the top 10 causes of death in developing countries and it has infected more than two billion people, that is one-third of those infected and 10% of them will develop the disease during their lifetime[1]. According to the World Health Organization (WHO), 10.4 million people had TB in 2015 in the world, and more than one million died from the disease. These data show TB as a serious public health problem, and WHO recognizes it as the infectious disease with the highest mortality in the world, overcoming the Acquired Immunodeficiency Syndrome (AIDS) and Malaria together[1].

Also, WHO and the Pan American Health Organization (PAHO) revealed that nine million of the nearly 13 million TB cases in 2015 were new cases, but three million were not diagnosed, not treated or officially unregistered in any official care program of patients with TB and 1.5 million died[1,2]. This reality hinders to reach the global goals by the WHO, both to eliminate the disease by 2050 and to reduce the number of deaths by 85% by 2035[1,2].

Brazil and China were among the 22 countries that represent 80% of the world TB burden with the highest prevalence rates (about 39% in the last 17 years). However, Brazil still ranks 17th position in the number of cases and the 22nd position in the incidence rate with 34.97 cases/100,000 inhabitants and a mortality rate of 2.2 deaths/100,000 inhabitants[3]. Despite this reduction, the goal for the elimination of TB as a public health problem in Brazil is<10 cases per 100,000 inhabitants[3]. Despite this reduction, it is important to emphasize that the goal for the elimination of TB as a public health problem in Brazil is <10 cases per 100,000 inhabitants

Research on Pulmonary Tuberculosis (PTB) morbidity and mortality has been stimulated as an important tool for detecting health system failures[4], since the investigation of these objects (cases and deaths) allows to monitor the individual in different situations of the disease, and to provide additional analysis on patient surveillance and care[5]. It is worth highlighting that among several sources, the Brazilian Ministry of Health provides morbidity data through the Notifiable Diseases Information System (SINAN), which provides of socio-demographic, clinical variables and epidemiological contexts of events and/or diseases related to health. In this area, it is important to use data collected through notifications from the Health Information Systems (HIS), so they are not only historical records and do not fulfill the basic purpose of the surveillance, to provide technical guidance for health professionals, who have the responsibility to decide on the execution of disease control actions and aggravations[6].

Within the complexity of the TB situation and the need for specific strategies and interventions that prioritize resources to the most vulnerable groups, demonstrating the clinical-epidemiological profile and the prevalence of the disease, it is fundamental to know the epidemiological situation in the different places of the country considered as priority for TB control, such as in Imperatriz-MA[7]. Thus, the PTB reveals an important indicator of the quality of health services, enabling possibilities for reflections on health practices in the scenario and local under investigation, regional and country challenges to achieve a policy of control and social relevance. In this perspective, this study aims to determine the prevalence of TB and to verify factors associated with PTB in Imperatriz (MA) from January 2006 to December 2015.

MATERIALS AND METHODS

Nature and Research Scenario

This is a cross-sectional study carried out in Imperatriz, northeastern Brazil. Since 2003, it remains on the list of eight municipalities in the state of Maranhro with a population of more than 100,000 inhabitants, in which surveillance and disease control actions should be prioritized[7,8].

Research Population, Selection Criteria, Sources of Information and Variables under Investigation

The study included all cases of TB (ICD10-A16.9) registered in SINAN from January 1, 2006, to December 31, 2015, of Imperatriz-MA. Data were obtained from the Health Surveillance Service (SVS) of the Imperatriz Regional Health Management Unit (UGRSI) in January 2018, saved in the Tabwin version 3.5 application and exported to Excel. Then, all the variables that could identify the individuals were excluded, keeping a confidential data. In the data exploratory phase, the variables for characterization of the individual cases were selected. The variables of interest in this study were individual notification data such as age, gender, race/skin color and education level, and complementary data of the case (type of entry, clinical form, chest X-ray, smear microscopy and sputum culture, HIV, AIDS, Directly Observed Treatment (DOT), closure situation and location of cases).

Analysis Plan

To obtain the TB prevalence rates by year of study, the sum of the TB (notified) cases in each year was divided by the standard population in the middle of the period[8], multiplied by 100,000, respectively. The mean TB prevalence rate for the analyzed period was also obtained, dividing the sum of the rates obtained each year by 10 (referring to the number of

years of study). The cases of TB were categorized from the median age, classified by age above or below this measure of central tendency and expressing the absolute and relative frequencies for the categorical variables. After the consistency analysis of the collected data, they were converted to IBM SPSS 22.0 program, where they were ported for the recategorization of variables and their analysis. The bivariate analysis was performed with a cross-over of the independent variables (sociodemographic, clinical and epidemiological variables) with the dependent variable "PTB" (yes, no), applying the chi-square test for the evaluations that followed the assumptions and Fisher's exact tests for 2-row and 2-column tables[9] and Fisher-Freeman-Halton[10] for tables with more than 2 rows and/or 2 columns. They are alternatives to the Chi-square test, when the conditions for its use are violated, as in the case of some of the analyses in this study.

Ethical Aspects

In accordance with the precepts of Resolution 466/2012 for this study, the project was previously submitted to the Research Ethics Committee involving human beings of the Federal University of Maranhro (UFMA) and approved under opinion 1,627,931 issued on July 7, 2016.

RESULTS

There were 800 cases of TB detected in patients in the municipality of Imperatriz-MA between 2006 and 2015. The highest prevalence rate was in 2006 (48.6/100,000 inhabitants) and there were a decrease of the prevalence rate of the disease by 2012, reaching 22.0/100,000 inhabitants. That same year, there was the lowest rate obtained during the analyzed period. The average prevalence rate for the period (2006 to 2015) was 33.1/100,000 inhabitants (**Figure 1**).

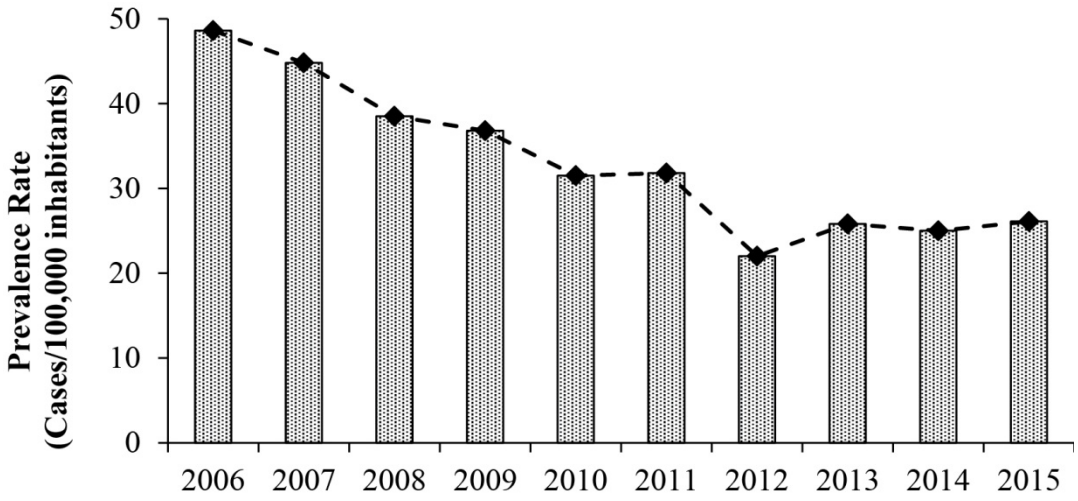

Figure 1: Prevalence of reported cases of tuberculosis, Imperatriz-MA (2006-2015).

The results were shown in a decreasing order according to their response category. When the variable was not filled by the professional responsible for the notification was considered as "ignored". Most of the cases had people aged 40 years old or younger, male gender, brown race/skin color, type of entry as a new case, pulmonary clinical form, suspicious chest X-ray, sputum culture without Aids disease and aggravation, with healing closure and belonging to the urban area of the municipality. Predominant plots were evidenced in people with education level less than nine years, positive sputum smear microscopy and non-HIV serology. The categories of responses considered as "ignored" in the variables education and Aids aggravations were highlighted **(Table 1).**

Table 1: Sociodemographic and clinical-epidemiological characteristics of reported cases of tuberculosis, Imperatriz-MA (2006-2015).

Variables	N	%
Age		
≤ 40years old	416	52.0
>40 years old	384	48.0
Gender		

Male	504	63.0
Female	296	37.0
Race/skin color		
Brown	479	60.0
White	185	23.0
Black	97	12.0
Yellow	24	3.0
Ignored	09	1.2
Indigenous	06	0.8
Education		
<9 years of study	345	43.2
≥ 9 years of study	252	31.5
Illiterate	97	12.1
Ignored	85	10.6
Not applied	21	2.6
Type of entry		
New case	689	86.0
Recurrence	52	7.0
Transfer	51	6.0
Reentry after abandonment	08	1.0
Clinical form		
Pulmonary	720	90.0
Extrapulmonary	72	9.0
Pulmonary + Extrapulmonary	08	1.0
Chest X-ray		
Suspect	687	85.9
Not performed	88	11.0
Normal	13	1.6
Other Pathology	11	1.4
Ignored	01	0.1
Sputum smear microscopy		
Positive	307	38.4
Negative	274	34.3
Not performed	218	27.2
Not applied	01	0.1
Sputum Culture		

Not performed	730	91.2
Negative	46	5.8
Positive	16	2.0
In progress	08	1.0
HIV serology		
Not performed	384	48.0
Negative	295	36.9
Positive	68	8.5
In progress	53	6.6
AIDS aggravation		
No	507	63.4
Ignored	225	28.1
Yes	68	8.5
Directly Observed Treatment (DOT)		
Yes	516	64.5
No	277	34.6
Ignored	07	0.9
Closing situation		
Cure	692	86.5
Death by another cause	39	4.9
Abandonment	23	2.9
Transfer	23	2.9
Change of Diagnostics	11	1.4
Death due to TB	08	1.0
TB - Multiresistant	02	0.2
Ignored	02	0.2
Location of cases		
Urban area	785	98.2
Countryside	13	1.6
Ignored	02	0.2
TOTAL	800	100.0

The variables gender (p-value=0.03), education (p-value=0.01) type of entry (p-value=0.02) and sputum smear microscopy (p=0.01) had an association statistically significant with PTB **(Table 2)**.

Table 2: Sociodemographic and clinical-epidemiological variables associated with pulmonary tuberculosis, Imperatriz-MA (2006-2015). *Statistically significant values (p-value<0.05).

Variables	Pulmonary Tuberculosis		p-value
	Yes n (%)	No n (%)	
Age			
≤ 40 years old	363 (92.1)	31 (7.9)	
> 40 years old	357 (89.7)	41 (10.3)	
Gender			
Male	457 (90.8)	46 (9.2)	0.03*
Female	263 (91.0)	26 (9.0)	
Race/skin color			
Brown	433 (91.5)	40 (8.5)	0.54
White	163 (88.6)	21 (11.4)	
Black	86 (89.6)	10 (10.4)	
Yellow	24 (100.0)	00 (0.0)	
Ignored	08 (89.9)	01 (11.1)	
Indigenous	06 (100.0)	00 (0.0)	
Education			
< 9 years of study	310 (90.1)	34 (9.9)	0.01*
≥ 9 years of study	220 (88.7)	28 (11.3)	
Illiterate	90 (94.7)	05 (5.3)	
Ignored	80 (94.1)	05 (5.9)	
Not applied	20 (100.0)	00 (0.0)	
Type of entry			
New case	620 (90.9)	62 (9.1)	0.02*
Recurrence	52 (100.0)	00 (0.0)	
Transfer	41 (80.4)	10 (19.6)	
Reentry after abandonment	07 (100.0)	00 (0.0)	
Chest X-ray			
Suspect	636 (93.4)	45 (6.6)	0.11
Not performed	74 (85.1)	13 (14.9)	
Normal	06 (46.2)	07 (53.8)	
Other Pathology	03 (30.0)	07 (70.0)	
Ignored	01 (100.0)	00 (0.0)	

Sputum smear microscopy			
Positive	302 (99.3)	02 (0.7)	
Negative	245 (90.1)	27 (9.9)	0.01*
Not performed	172 (80.0)	43 (20.0)	
Not applied	1 (100.0)	00 (0.0)	
Sputum Culture			
Not performed	654 (90.5)	69 (9.5)	
Negative	43 (95.6)	02 (4.4)	0.25
Positive	15 (93.8)	01 (6.3)	
In progress	08 (100.0)	00 (0.0)	
HIV serology			
Not performed	353 (92.4)	29 (7.6)	
Negative	258 (89.0)	32 (11.0)	0.13
Positive	58 (86.6)	09 (13.4)	
In progress	51 (96.2)	02 (3.8)	
AIDS aggraviation			
No	452 (90.0)	50 (10.0)	
Ignored	210 (95.1)	13 (4.9)	0.14
Yes	58 (86.6)	09 (13.4)	
Directly Observed Treatment (DOT)			
Yes	475 (93.3)	34 (6.7)	
No	239 (86.6)	37 (13.4)	0.11
Ignored	06 (83.3)	01 (16.7)	
Closing situation			
Cure	626 (91.3)	60 (8.7)	
Death by another cause	33 (84.6)	06 (15.4)	
Abandonment	21 (95.5)	01 (4.5)	
Transfer	21 (91.3)	02 (8.7)	0.56
Change of Diagnostics	08 (80.0)	02 (20.0)	
Death due to TB	07 (87.5)	01 (12.5)	
TB – Multiresistant	03 (100.0)	00 (0.0)	
Ignored	02 (100.0)	00 (0.0)	
Location of cases			
Urban area	705 (90.7)	72 (9.3)	
Countryside	13 (100.0)	00 (0.0)	0.69

Ignored	02 (100.0)	00 (0.0)	

DISCUSSION

This study aimed to determine the prevalence of tuberculosis and to verify the factors associated with pulmonary tuberculosis in Imperatriz-Ma, Northeastern Brazil. The average prevalence rate found in Imperatriz during the study period (2006 to 2015) was 33.1/100,000 inhabitants, being below the prevalence rates found in the national scenario, detecting prevalence rates of 40.94/00,000 inhabitants[11] and 64.3/100,000 inhabitants[12]. Given the prevalence rates revealed each year in the scenario under investigation, specifically in 2006, the rate was 48.6/100,000 inhabitants, overlapping national data with a prevalence rate of 45.84/100,000 inhabitants[11]. However, these data in subsequent years had a representative decrease reaching 26.1/100,000 inhabitants in 2015. This evidenced situation highlighted the health services for the intensification of surveillance actions of the disease in the state of Maranhro and in the priority cities for the control of the disease[7], as in the case of the city of this study.

Grosch et al.[13] corroborate with this situation exposed because there was a decrease in TB cases from 2009 to 2014 in the State of Maranhro, ratifying the effectiveness of public policy actions that act against the disease and its control in a world-wide context, as in the national, state and municipal epidemiological panorama, in which the people who have had TB has been decreasing over the last years[3]. However, additional studies evaluating health services are necessary to confirm such findings in Imperatriz-Ma.

As to the association of the variables under investigation with the TPB, the variables age, gender, education level, new case, and sputum smear microscopy were statistically significant (p-value<0.05). In agreement with several studies[7,14-19] that indicate PTB as the predominant clinical form, this research found the PTB as the most reported cases (90.0%) and, as evidenced by the literature, it is highly lethal and represents the main transmissible form of the disease[20].

Regarding the sociodemographic profile, the prevalence of the disease was found in people younger than 40 years old, as reported by Fusco[19] as an economically and socially active age. Most of the PTB were male and predominated in individuals with education of less than nine years of education, corroborating with data observed in the literature[21-24]. It is also worth noting that factors such as increased exposure to risk related to work environments, alcoholism, smoking, and delay in the search for health services, although not investigated in this series are pointed out as determinants of the higher prevalence of TB in men[25]. Low level of education and lack of understanding can influence individuals in obtaining information about the disease, as well as access to information in general and, why not, the access to quality of life, therefore, social injustice. These records reflect a whole set of precarious social conditions, which increase vulnerability to PTB and responsible for the higher incidence of the disease, besides contributing to non-adherence to treatment and to the increase of the abandonment rate, as well as to the occurrence of death[26].

Data from this study revealed 86.0% of new cases, 86.5% with cure, 2.9% with treatment abandonment, without testing 48% of individuals for TB/HIV co-infection. A goal defined by the National Program for Tuberculosis Control (PNCT) to diagnose 100% of Respiratory Symptoms (RS) was not achieved, since they had an abandonment rate of less than 5% and cure greater than 85% of the cases recommended by WHO[1,7], they are consistent with the control actions of the disease and considered positive points for the decrease of prevalence rates in the scenario investigated.

Regarding the bacilloscopy, it was observed that the PTB occurred in individuals who presented a positive bacilloscopy result, differently from the cases diagnosed with the extrapulmonary clinical form in which the bacilloscopy was not performed. Also, 72.7% of those affected by TB underwent such an examination, a percentage that overlaps the national value in 2009, where 64.0% of the cases were tested[1]. According to Ferrer et al.,[17] although smear microscopy is defined as a goal by the WHO, Brazil has pointed out difficulties in the implantation and use of this test for the detection of TB cases since 1993, which is not the case in the scenario under investigation. It is important to emphasize the prioritization of sputum smear microscopy and rapid molecular testing for the diagnosis, control, and monitoring of the disease, as well as the improvement of the registries and SIS in the US for an improved diagnosis of the disease[27]. Since correctly performed in all its phases, smear microscopy allows detecting 60.0% to 80.0% of cases of PTB, being essential from the epidemiological point of view, since the bacilliferous cases are responsible for maintaining the chain of transmission[7].

The deficiencies pointed out in this study for the non-compliance of goals agreed by the Ministry of Health for the control of the disease, especially for the non-performance of laboratory tests such as bacilloscopy and sputum culture and anti-HIV solorogy, also suggest difficulties in Primary Health Care (PHC) in management, in the provision of diagnostic resources or case management, and in the referral system to other health services. Several authors[19,21,23] report the relevance of strengthening and restructuring actions for TB control in primary health care since these actions favor the search for RS, control, and monitoring of the disease. The study also pointed out the great demand for the

implementation of decentralized TB care actions announced by the Ministry of Health (MS), highlighting the essentiality of the systematic involvement of all levels of care, particularly the primary sector, corroborating to achieve the goals recommended by WHO, the fight against TB is a set of decentralized and inter-sectorial actions that help in the quality of care provided to the sick individual.

LIMITATIONS

It should be mentioned that as a source of information for the study of notifications in a given region, SINAN has its weaknesses. One of them is the country's own underreporting[16] which is one of the consequences of the inequity of access to health services. The weaknesses in the filling of the records considered "ignored", mainly in the variables education and AIDS, among others were considered as relevant information to health management and planning. In this perspective, improving the quality of the records in the filling the fields and updating the data from the Health Information Systems are very important for the reliability of the epidemiological analysis[26]. Thus, the need for training of the professionals responsible for completing the research/notification forms or feeding the system emerges, reiterating one of the goals established for the control and surveillance of the disease regarding the need to maintain reliable records and updated.

CONCLUSIONS

The mean prevalence rate was 33.1/100,000 inhabitants per year, with the highest 48.6/100,000 inhabitants detected in 2006 and the lowest 22.0/100,000 inhabitants in 2012, showing rates below and above those obtained in the Brazilian scenario. Statistically significant association ($p<0.05$) was observed between sociodemographic variables (gender and education level) and clinical-epidemiological variables (type of entry and sputum smear microscopy) with PTB. Inconsistent data related to the variables investigated constituted limiting factors of this study since many records with ignored data were found.

It is important to mention that the challenges to control TB in Brazil persist, and the prospects for ending the disease as a public health problem will be only materialized if more efforts are launched by the three SUS management spheres, as well as the establishment of partnerships outside this sector. The study undoubtedly brings important contributions to the advancement of knowledge in this area by highlighting that PTB cases are socially determined events, which reinforces the importance of social protection by universal health systems for the elimination of TB and no more unjust or avoidable deaths.

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