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INCIDENCE OF PULMONARY TUBERCULOSIS IN THE MAIN BRAZILIAN PORTS IN THE PERIOD 2019 TO 2023

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Abstract: Objective: Analyze the epidemiological distribution of tuberculosis in port regions in the period 2019-2023 in Brazilian territory. **Methodology**: This is a descriptive, observational study carried out based on data collected from DATASUS in 2024. **Results and discussion:** 7,148 cases of pulmonary tuberculosis were identified in the following port cities: São Luís, Angra dos Reis, Santos, Paranaguá and Tubarão, with the highest prevalence in the city of São Luís - MA. Among the epidemiological characteristics, we found a prevalence in males, between the ages of 30-49 years, of mixed and black ethnicity and with an education level of 5th to 8th grade of elementary school. This pattern is consistent with the profile of port workers, of which approximately 86.3% are men, of mixed or black ethnicity and manual workers. **Conclusion:** The results showed a slow and gradual increase in the number of tuberculosis cases in the port regions studied, with a significant increase being observed in 2022 in the Angra dos Reis region, making it necessary to be aware of a possible outbreak. It is necessary to maintain surveillance and adopt measures at the three levels of prevention according to the needs of each region in order to reduce the spread of this pathology.
Keywords: Emerging Communicable Diseases; Incidence; Pulmonary Tuberculosis

INTRODUCTION

Historically, ports have been epicenters of epidemics due to the intense traffic of people and goods since the days of shipping. In Brazil, the Port of Santos, between 1880 and 1900, was a classic example of this dynamic, facing several epidemics that profoundly marked daily life and generated fear in the population (CARMO; MATOS, 2022). This historical context highlights the vulnerability of ports as critical points in the spread of infectious diseases, a scenario that continues to be repeated with tuberculosis today.

The vulnerability of Brazilian ports to epidemics was not limited to the 19th century. In the early 20th century, bubonic plague also made its presence felt in the ports of Santos and Rio de Janeiro, again reflecting the impact of poor sanitary conditions and intense maritime traffic on the spread of disease, underlining the need for robust measures to control and prevent infectious diseases in port areas.

Pulmonary Tuberculosis (TB) is an infectious disease that primarily affects the lungs, although it can affect other organs and systems. The diagnosis is confirmed by the detection of *Mycobacterium tuberculosis* by sputum smear microscopy or culture. In Brazil, sputum smear microscopy is considered the standard method, allowing the identification of 60% to 80% of cases in adults (FREITAS GL DE, 2022).

Any individual with a confirmed diagnosis of the disease who has never used or used antituberculosis drugs for less than one month is considered a new case. It is important to note that pharmacological treatment must preferably be carried out under a Directly Observed Treatment (DOT) regime, in order to avoid incorrect, irregular use or even abandonment of the established treatment (GIACOMETTI MT, 2021)

According to the World Health Organization (W.H.O.), tuberculosis is considered a serious global public health problem due to its high morbidity and mortality rates. According to the Tuberculosis Epidemiological Bulletin, in 2023, 80,012 new cases of TB were reported in Brazil, corresponding to an incidence of 37.0 cases per 100,000 inhabitants. Affecting males, adults, and inhabitants of low-income countries to a greater extent, indicating a link between the occurrence of the disease and socioeconomic factors (PEREIRA, 2022).

The Ministry of Health (MS) has intensified the decentralization of actions for the diagnosis, control and treatment of the disease to Primary Care services because it is precisely at this level of care that all care for people with TB must be offered (TEIXEIRA LM, 2023). Therefore, the growing importance of formulating systematic strategies to computerize, prevent and identify diseases such as TB early, especially for port workers, since work in a port environment can contribute to the development of occupational and non-occupational pathologies (ALMEIDA et al., 2012).

OBJECTIVE

Analyze the number of new cases of pulmonary tuberculosis in the main ports of Brazil between 2019 and 2023.

METHOD

This is a descriptive, cross-sectional, ecological epidemiological study carried out using data extracted in July 2024 from the SUS Notifiable Diseases Information System (SINAN) on the website of the Unified Health System Information Technology Department (DATASUS) from 2019 to 2023. The variables evaluated were confirmed cases of pulmonary tuberculosis by: sex, age group, education level and type of admission.

A descriptive analysis was performed to assess the number of new cases of pulmonary tuberculosis in the main Brazilian ports. The choice of port cities to be analyzed was made through research of the five Brazilian ports with the highest cargo transportation in 2024 according to the National Waterway Transportation Agency (ANTAQ), the agency responsible for the regulation, inspection and development of the Brazilian waterway transportation sector. The cities chosen in the present study and their respective resident population were: São Luís (1,037,775), Santos (418,608), Angra dos Reis (167,434) Paranaguá (145,829) and Tubarão (110,088).

The information collected was organized in a Microsoft Excel spreadsheet and absolute and relative frequencies were calculated for each variable studied. This study did not need to be submitted to the Ethics Committee, as it used information available in secondary databases and therefore did not involve direct research with people and/or animals, thus complying with Resolution of the National Health Council (CNS) No. 510, of April 7, 2016.

RESULTS AND DISCUSSION

Ports are essential to Brazil's economy, as they serve as the main gateways for national and international trade. Brazil has a diverse port network that facilitates the transportation of goods and economic growth in several areas due to its extensive coastline. There are 36 Public Ports organized in the country. This category includes ports whose administration is exercised by the Union, in the case of the Dock Companies, or delegated to municipalities, states or public consortiums. (BRAZIL, SECRETARY OF PORTS, 2020).

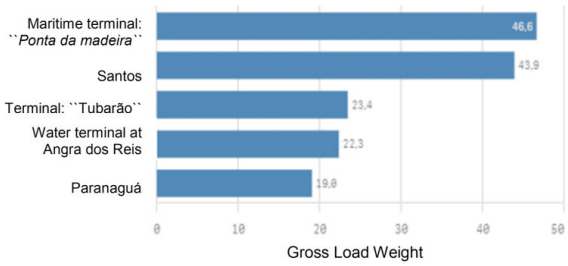

FIGURE 1: GRAPH OF PORTS WITH THE HIGHEST GROSS CARGO WEIGHT IN 2024 (IN MILLION X TONS IN JAN, FEB, MAR, APR)

SOURCE: National Waterway Transport Agency (ANTAQ) 2024

According to Moraes et. al. 2009, port development follows the evolution of shipbuilding, which leads to an increase in trade growth between nations, leading to the need to improve the means of transporting goods. Taking into consideration, the increase in the number of vessels, the size of the vessels also increases, with this constant movement of people and goods in these logistics centers, an environment is created that is conducive to the spread of infectious diseases and possibly tuberculosis.

During the period from 2019 to 2023, 7,148 cases of pulmonary tuberculosis were reported in the following port cities: São Luís, Angra dos Reis, Santos, Paranaguá and Tubarão. Comparatively, in the evaluation of the variables, the highest number of confirmed cases was observed, being in the male sex with 5,288 (73.98%) of the cases reported in the five cities, with approximately 3,616 (68.38%) cases in São Luís, Angra dos Reis (5.8%), Santos (18.53%), Paranaguá (5.35%) and Tubarão (1.92%).

According to Monié et al. (2006), on a global scale, production networks increasingly depend on maritime transport, which is responsible for the majority of flows of material goods between continents, and is also associated with other types of transport. This may possibly be a contributing factor to the greater number of occurrences of the disease in these respective municipalities classified as port cities.

Regarding sex, men have the highest number of cases, representing approximately 5,288 (73.98%) confirmed cases of pulmonary TB in the period studied, in contrast, women have 1,860 (26.02%) of the occurrences. This difference between the sexes can also be related to the gender disparity in port employment.

In a study carried out by ANTAQ, in partnership with WISTA Brazil (Women's International Shipping and Trading Association of Brazil), it was found that women occupy approximately 17.3% of the vacancies in the Brazilian port sector. (Richa, Morgana de Almeida et al. 2023). This data shows that port positions are still mostly occupied by men, who are therefore more susceptible to contracting infectious diseases, including pulmonary tuberculosis. TB affects economically active individuals, mainly men who are in the productive age group, abandoning treatment more easily than women, presenting considerable statistical differences (Moraes et. al. 2017)

According to Macêdo et al. (2021), the findings presented above can be explained by the fact that tuberculosis continues to be identified as a disease in which the process of transmissibility and infection is correlated with the living conditions of the human being, with the male sex of economically active age (15 to 54 years) and low economic and educational perspectives being identified as the main factors that favor its occurrence.

Regarding the age group, adults between 20 and 29 years old were the most affected by pulmonary TB in the cities evaluated, approximately 2,306 (32.26%) of the records, followed by the age groups 30 to 39 years old with 1,883 (26.34%), 40 to 49 with 1,671 (23.38%) and lastly 1,288 (18.02%) in the age group of 50 to 60 years old. Regarding the education level, 5th to incomplete 8th grade

Municipalities	São Luís	Angra dos Reis	Santos	Paranaguá	Tubarão	N	%
Gender							
Masculine	3.616	307	980	283	102	5.288	73,98%
Feminine	1.230	86	421	99	24	1.860	26,02%
Ethnicity							
Ign/White	16	22	155	4	0	197	2,76%
White	398	92	538	112	96	1.236	17,29%
Black	824	76	165	23	21	1.109	15,51%
Yellow	36	0	4	3	0	43	0,60%
Brown	3.565	202	538	240	9	4.554	63,71%
Indigenous	7	1	1	0	0	9	0,13%
Age range							
20 to 29 years old	1.655	114	421	88	28	2.306	32,26%
30 to 39 years old	1.274	105	396	79	29	1.883	26,34%
40 to 49 years old	1.091	97	326	116	41	1.671	23,38%
50 to 59 years old	826	77	258	99	28	1.288	18,02%
Education							
Ign/White	142	99	392	35	16	684	9,57%
Illiterate	133	8	5	10	2	158	2,21%
1st to 4th incomplete grade of EF	550	52	47	22	9	680	9,51%
4th grade complete EF	322	25	0	16	4	367	5,13%
5th to 8th incomplete grade of EF	1.249	88	315	116	42	1.810	25,32%
Complete primary education	453	27	0	82	12	574	8,03%
Incomplete high school	549	34	446	29	9	1.067	14,93%
Complete high school	1.178	36	0	58	22	1.294	18,10%
Incomplete higher education	117	11	141	5	3	277	3,88%
Complete higher education	153	13	55	9	7	237	3,32%

Table 1: Epidemiological Profile of Pulmonary Tuberculosis Cases in the 5 Largest Ports in Brazil, from 2019 to 2023.

Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

of EF 1,810 (25.32%) was the predominant in the number of cases in the present study.

The study data corroborate the study by Cecílio et al. (2012), which showed that the age groups 20 to 39 and 40 to 59 have been showing an increase in the number of cases since 2010. Possibly, the greater recurrence of the data can be attributed to the greater exposure of this population, as adults and young people are often present in places with large conglomerates of people.

Furthermore, in relation to race, there was a predominance of cases in the brown race in both cities, confirming 4,554 (63.71%) of the occurrences, with approximately 3,554 events reported in São Luís, 202 in Angra dos Reis, 538 in Santos, 240 in Paranaguá and 09 in Tubarão, followed by the white races 1,236 (17.29%), black 1,109 (15.51%) yellow 43 (0.60%) and 9 (0.13%) in the indigenous race, in addition to 197 cases that were ignored.

Thus, according to data from the 2022 census and according to the IBGE racial classification, 66.39% of Maranhão residents and 41.62% of the population of Rio de Janeiro self-declare as brown, limiting the number of people susceptible to a specific disease (IBGE, 2010). And corroborating this statistic, the

Ministry of Health (2024) brought in its epidemiological bulletin the information that in 2023 in Brazil, the proportion of new cases of TB is higher and with a tendency to increase in people who self-declare as black and brown. In contrast, it is known that black and brown people in Brazil are historically subject to lower education, lower income and more limited access to health services (Chiavegatto; Laurenti, 2013).

From 2019 to 2023, the types of notifications of pulmonary tuberculosis in the main port cities of Brazil were analyzed. The clinical-epidemiological data revealed a total of five main categories of notification: relapse, readmission after abandonment, unknown, and transfer. The distribution of cases in the cities of São Luís, Angra dos Reis, Santos, Paranaguá and Tubarão is presented in Figure 2.

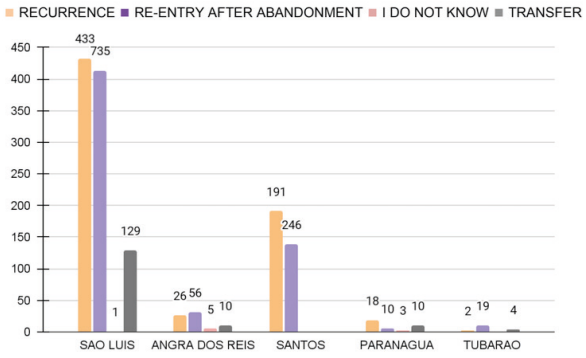

FIGURE 2: GRAPH OF TYPES OF REPORTING OF PULMONARY TUBERCULOSIS

Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

The city of São Luís had the highest number of notifications of re-entry after abandonment (735 cases), followed by recidivism (433 cases), unknown (129 cases) and transfer (1 case). Angra dos Reis had a predominance of cases of re-entry after abandonment (56 cases), followed by recidivism (26 cases), unknown (5 cases) and transfer (10 cases). It is important to highlight that among the port cities studied, only São Luís is a state capital and that the resident population is 1,037,775 people, according to the IBGE population estimate.

In Santos, the data showed a predominance of cases of re-entry after abandonment (246 cases), followed by relapse (191 cases); there is no data computed in DATASUS classified as unknown and transfer in this region. Paranaguá presented a relatively balanced number of notifications, with 18 cases of relapse, 10 cases of re-entry after abandonment, 3 cases of unknown and 10 cases of transfer. Tubarão presented 19 cases of re-entry after abandonment, 4 cases of transfer and 2 cases of relapse and no cases of unknown.

For Macedo (2018), urbanization favors the spread of tuberculosis cases, taking into consideration, the contamination of these environments, poor ventilation and a larger agglomeration of people than in rural areas.

The results indicate that recurrence is the most frequent notification category in São Luís and Santos, suggesting the need for health policies that address continuity and adherence to tuberculosis treatment in these locations. The high number of recurrence cases may be an indication of failures in monitoring and complete cure of patients, which results in new infections.

According to Perriëns et. al. 2013, several factors have been identified as being associated with the occurrence of TB recurrence, such as, for example, duration of treatment, bactericidal/bacteriostatic activity of the drugs, method of administration (daily or intermittent) and irregularity of their use. According to Durans et. al. 2013, patients who are readmitted due to abandonment are unable to interrupt the epidemiological chain of TB and continue to transmit the bacillus, infecting other people, and may even develop more potent and resistant forms of the infection.

In contrast, Angra dos Reis had a high number of cases classified as "unknown", which may reflect inconsistencies or gaps in notification data. This highlights the importance of improving the collection and recording of clinical information to ensure the accuracy of epidemiological data. Paranaguá and Tubarão showed lower numbers of notifications in all categories, which may reflect a lower incidence of tuberculosis or better effectiveness in controlling and treating the disease.

In Paranaguá, according to the Ministry of Labor (BRAZIL. Ministry of Labor), there are more than 4,100 people registered as port workers on the employment record. This represents 11.3% of the city's workforce. According to ANTAQ, 43,205 workers are registered in the country as port workers in 2021. The constant mobility of these workers often prevents them from seeking health services, since this population is constantly on the move and at risk of contracting various airborne diseases, such as pulmonary TB.

These findings emphasize the importance of adapting tuberculosis control strategies to the specific needs of each location, taking into consideration the epidemiological particularities of each port region. The implementation of public policies such as "Health in Ports" carried out in some locations in Brazil such as Santos, Niterói, Maceió and São Luís is a practice that can be widely adopted in other port cities in order to minimize the occurrence of the disease under study.

The action moved some mobile units to the port regions with the aim of promoting vaccination, toxicology reference service, guidance for the prevention of dengue and zoonoses, dental evaluation, blood glucose and blood pressure tests, syphilis and HIV testing, among other services (National Transport Confederation).

The possibility of carrying out the Rapid Molecular Test (TRM - TP) on a large scale in public policies aimed at this public must be considered, as the result is available within 1 hour and a half after the exam, and will also facilitate more accurate diagnosis and notification of the population at risk, as well as encouraging this initiative to cover even more ports to stimulate health promotion.

Between 2019 and 2023, the five cities examined – São Luís, Angra dos Reis, Santos, Paranaguá and Tubarão had significantly different rates of new cases of pulmonary tuberculosis. The rate of pulmonary tuberculosis per 100,000 inhabitants in each city was distributed from 2019 to 2022, as shown in Figure 2.

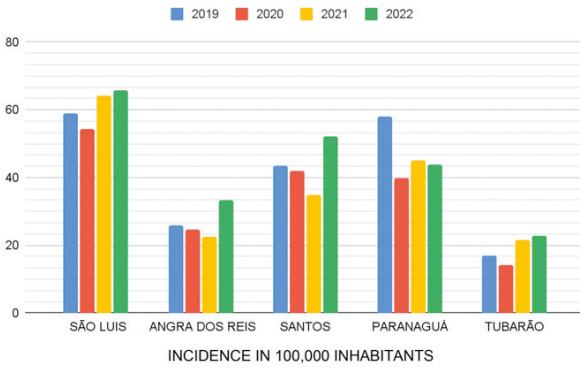

FIGURE 3 – GRAPH OF INCIDENCE OF PULMONARY TB AMONG BRAZILIAN PORTS IN THE LAST 5 YEARS

Source: Ministry of Health - SUS Hospital Information System (SIH/SUS)

Among the cities examined, São Luís had the highest incidence of pulmonary tuberculosis and it has increased over the years. In 2019, the incidence was 58.90 cases per 100,000 inhabitants. In 2020, 54.56 cases per 100,000 inhabitants, it rose in 2021 to 64.07 and reached its peak with 65.81 cases per 100,000 inhabitants in 2022.

Angra dos Reis had a lower incidence compared to São Luís. In 2019, the incidence was 26.01 cases per 100,000 inhabitants,

with a slight decrease in 2020 (24.63) and 2021 (22.36), and an increase to 33.45 per 100,000 inhabitants in 2022. Santos had an intermediate incidence of pulmonary tuberculosis. In 2019, the incidence was 43.39 cases per 100,000 inhabitants, 2020 was 41.97, 2021 was 35.02 and 2022 had a significant increase with 52.32 per 100,000 inhabitants.

Paranaguá had a variable but high incidence, with a peak in 2019 of 58.09 cases per 100,000 inhabitants. In 2020 and 2021, the incidence decreased to 39.7 and 45.11 cases per 100,000 inhabitants respectively, and had a slight decrease in 2022 presenting 43.89 per 100,000 inhabitants.

Tubarão had the lowest incidence of all the cities analyzed. In 2019, the incidence was 17.03 cases per 100,000 inhabitants, with a slight decrease in 2020 (14.09), followed by a gradual increase, reaching 21.47 per 100,000 inhabitants in 2021 and 22.71 per 100,000 inhabitants in 2022.

The analysis of pulmonary tuberculosis incidence data in the main port cities of Brazil reveals distinct patterns that suggest differences in social, economic and public health conditions between these locations. São Luís, with the highest incidence, highlights the urgent need for specific interventions to control tuberculosis transmission. The upward trend suggests that current control efforts may not be sufficient or that there are local risk factors that are not being adequately addressed, such as the presence of vulnerable individuals: low-income people, migrants and people co-infected with tuberculosis and HIV, relating to poverty, social exclusion and misery, inequality, social, economic, demographic and cultural barriers; education; problems inherent to medication (Aragão et al., 2020), in addition to being the most populous city under study. In contrast, Angra dos Reis showed a significant increase in 2022 after a stable trend, which may indicate localized outbreaks or changes in living conditions or health services.

Santos and Paranaguá, with intermediate incidences, show fluctuations that may be related to variations in tuberculosis control programs, population mobility or other epidemiological influences. Tubarão, with the lowest incidence, may be benefiting from improved living conditions, access to health services or more effective control programs. However, the increasing trend, albeit slow, suggests the need to maintain surveillance and reinforce preventive measures. These results underscore the importance of a decentralized approach tailored to the specific needs of each location for tuberculosis control. Targeted interventions, increased surveillance and continued education and prevention efforts are essential to reduce the incidence of pulmonary tuberculosis in Brazilian ports.

CONCLUSION

The results of this study demonstrate that during the period from 2019 to 2023 there was an increase in the number of reported cases of pulmonary tuberculosis in the five port areas analyzed. This can be justified by the high flow of people in these regions associated with the long periods exposed to vessels and crowded environments, making the population living in port areas more susceptible to acquiring this disease, since in this study a greater number of notifications of new cases were observed. Regarding the port areas analyzed, São Luís was the city with the highest number of reported cases. However, it is worth highlighting that there is a need to expand studies conducted with the port population to assess whether the additional individual factors of each city directly influence the incidence of pulmonary TB in the port population. In addition, there is a predominance of confirmed cases in males, in the age group of 20-29 years, in the brown race and in people with education up

to the incomplete eighth grade of elementary school, corroborating the literature. The analysis of these results makes it possible to understand the characteristics of patients and indirectly assess the quality of public policies for tuberculosis control in port areas. These figures suggest the need for interventions to control the disease. Therefore, it is necessary to adopt interdisciplinary strategies that address the socioeconomic determinants that influence the disease, aiming to design appropriate and efficient interventions for the rapid detection and treatment of new cases.

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