Characteristics of pulmonary tuberculosis in a hyperendemic area—the city of Santos, Brazil*

Características da tuberculose pulmonar em área hiperendêmica — município de Santos (SP)

Andrea Gobetti Vieira Coelho, Liliana Aparecida Zamarioli, Carmen Argüello Perandones, Ivonete Cuntiere, Eliseu Alves Waldman

Abstract

Objective: To characterize the profile of patients with pulmonary tuberculosis (PTB) in the city of Santos, Brazil, according to biological, environmental and institutional factors. **Methods:** Descriptive study, using the TB surveillance database, including patients with PTB, aged 15 years or older, residing in the city of Santos and whose treatment was initiated between 2000 and 2004. **Results:** We identified 2,176 cases, of which 481 presented a history of TB. Of those 481 patients, 29.3% were cured, and 70.7% abandoned treatment. In 61.6% of the cases, the diagnosis was confirmed by sputum smear microscopy, whereas it was confirmed based on clinical and radiological criteria in 33.8%; 69.0% were male; and 69.5% were between 20 and 49 years of age. There were 732 hospitalizations, and the mean length of hospital stay was 32 days (first hospitalization). The prevalence of alcoholism, diabetes and TB/HIV coinfection was, respectively, 11.7%, 8.2% and 16.2%. The prevalence of TB/HIV coinfection decreased from 20.7% to 12.9% during the study period. The treatment outcome was cure, abandonment, death from TB and death attributed to TB/HIV coinfection in 71.0%, 12.1%, 3.9% and 2.5%, respectively. The directly observed treatment, short-course (DOTS) was adopted in 63.4% of cases, and there were no significant differences between DOTS and the conventional treatment approach in terms of outcomes (p > 0.05). The mean annual incidence of PTB was 127.9/100,000 population (range: 72.8-272.92/100,000 population, varying by region). The mean annual mortality rate for PTB was 6.9/100,000 population. **Conclusions:** In areas hyperendemic for TB, DOTS should be prioritized for groups at greater risk of treatment abandonment or death, and the investigation of TB contacts should be intensified.

Keywords: Tuberculosis, pulmonary; Epidemiology, descriptive; Control.

Resumo

Objetivo: Caracterizar o perfil dos pacientes com tuberculose pulmonar (TBP) no município de Santos (SP) segundo fatores biológicos, ambientais e institucionais. **Métodos:** Estudo descritivo, com dados obtidos na vigilância da TB, abrangendo pacientes com TBP maiores de 15 anos de idade, residentes em Santos (SP) e com tratamento iniciado entre 2000 e 2004. **Resultados:** Foram identificados 2.176 casos, e 481 apresentavam história prévia de TB. Desses, 29,3% curaram-se no episódio anterior, e 70,7% abandonaram o tratamento. Em 61,6% e em 33,8% dos casos, o diagnóstico foi confirmado por baciloscopia e por critérios clínico-radiológicos, respectivamente; 69.0% eram homens, e 69,5% situavam-se entre 20 a 49 anos. Houve 732 hospitalizações, com tempo médio de permanência de 32 dias na primeira internação. A prevalência de alcoolismo, diabetes e coinfecção TB/HIV foi de, respectivamente, 11,7%, 8,2% e 16,2%, com declínio dessa última de 20,7% para 12,9% no período de estudo. O desfecho do tratamento para 71,0%, 12,1%, 3,2% e 3,3% foi, respectivamente, cura, abandono, óbito por TB e óbito por TB/HIV. O tratamento supervisionado de curta duração foi aplicado em 63,4% dos casos, e não houve diferenças nos desfechos entre os tipos de tratamento (p > 0,05). A incidência anual média de TBP foi de 127,9/100.000habitantes (variação: 72,8-272,92/100.000 conforme a região). A taxa anual média de mortalidade por TBP foi de 6,9/100.000 habitantes. **Conclusões:** Em áreas hiperendêmicas de TB, o tratamento supervisionado de curta duração deve ser priorizado para os grupos de risco para o abandono de tratamento ou óbito, e a busca de TB entre contatos deve ser intensificada.

Descritores: Tuberculose pulmonar; Epidemiologia descritiva; Controle.

Introduction

Brazil is one of the 21 developing countries that together account for approximately 80% of the new cases of tuberculosis (TB) that occur worldwide.[1] In Latin America, Peru and Brazil account for 50% of the TB cases.[2] In recent years, there has been a decrease in the incidence of TB in Brazil. However, in 2004, the incidence of TB was still high, i.e., approximately 44.6/100,000 population, and the mortality rate was approximately 2.1/100,000 population.[3]

In the state of São Paulo, the 2004 rates of TB-related morbidity and mortality were close to the national average (41.9 and 2.5/100,000 population, respectively).[3] In addition, 53% of the new TB cases were concentrated in 10 of the 647 cities in the state of São Paulo; those in the greater metropolitan area of Santos were the most affected by TB, the city of Santos proper presenting morbidity and mortality rates far higher than the national average and therefore being the city in which the situation raises the most concern.[4]

In order to develop public health interventions that focus specifically on hyperendemic areas, it is essential to analyze the indicators of the performance of the TB control program, particularly cure rates, treatment abandonment rates, mortality rates and retreatment rates, as well as the coverage of the directly observed therapy, short-course (DOTS) strategy. However, the TB surveillance database constitutes a privileged source of information for such analysis, since it comprises all reported cases of the disease.

Considering the magnitude of TB as a public health issue, the economic importance of the city of Santos and the few published studies addressing this issue,[5] we aimed to describe the behavior of pulmonary TB (PTB) in the city of Santos, based on data obtained from the TB surveillance database. The principal objectives of the present study were to estimate incidence rates, mortality rates, retreatment rates and hospitalization rates, as well as the principal treatment outcomes (treatment abandonment, cure and death).

Methods

This was a descriptive study, the area of interest of which included the city of Santos, located in a metropolitan area known as the Metropolitan Region of the Coastal Atlantic Forest, situated between the eastern edge of the Atlantic forest and the Atlantic coast. The city of Santos has a population of approximately 420,000 inhabitants and is the most populated city of the region, as well as being the city of greatest population density in the state of São Paulo, presenting, in the year 2000, an urbanization rate of 99.5% and a Human Development Index of 0.837.[6,7] The São Paulo State Social Vulnerability Index for the city of Santos shows satisfactory indicators, 76.5% of the population of the city being classified as presenting low to no vulnerability (Groups 1 and 2), as well as acceptable levels of wealth and education, although the indicators of longevity are less than satisfactory (Group 2).[6]

The study population comprised cases of PTB patients (≥ 15 years of age, residing and submitted to treatment in the city of Santos between January 1, 2000 and December 31, 2004) reported to the TB Surveillance System for subdivision IV of the Regional Health District of the state of São Paulo (RHD-IV, the Greater Metropolitan Area of Santos).

The inclusion criteria were as follows: being ≥ 15 years of age; residing in the city of Santos; presenting a clinical profile consistent with TB, the diagnosis being confirmed by sputum smear microscopy or by isolation of *M. tuberculosis* in culture; and chest X-ray findings suggestive of TB.

The following were excluded from the present study: cases in patients treated in the city of Santos but residing in other cities; cases presenting a clinical form of TB other than PTB; cases in patients whose diagnosis was changed; and cases in which there was no available information that could confirm the case in the data sources used to investigate such characteristics.

The following data sources were used: the TB surveillance database of the RHD-IV of the São Paulo State Health Department, the data being compiled from TB case registry database reporting forms; the Center for Epidemiological Surveillance of the São Paulo State Department of Health; and the Brazilian Institute of Geography and Statistics, which provided the demographic data used to estimate the rates of incidence and mortality.

In order to avoid loss of information due to late recording, the data used in the present study were updated through December 31, 2005.

The variables of interest included sociodemographic characteristics, current or previous TB, diagnosis-related aspects, treatment outcomes, comorbidities, facility characteristics, morbidity rate and mortality rate. The data regarding alcoholism and diabetes that were used in the present study were those registered on the reporting forms, i.e., no complementary tests or investigations were conducted.

The data analyzed were provided by the RHD-IV, in the format for Epi Info, version 6.4. After the analysis of consistency, the data were converted to the program Statistical Package for the Social Sciences, version 14 (SPSS Inc., Chicago, IL, USA), and the variables were regrouped and analyzed.

The descriptive analysis was performed through the comparison of means and proportions. For categorical variables, Pearson's chi-square test and Fischer's exact test were used, whereas the Kruskal-Wallis test was used for continuous variables.

For the calculation of the mean annual rate of incidence of PTB and the mean annual PTB mortality rate for the period of interest, we used, respectively, new cases and deaths as the nominators, and the population ≥ 15 years of age in the middle of the period was used as the denominator. Each rate was subsequently divided by five. The city of Santos was geographically divided into six sectors: Shoreline Area; Downtown/Port Area; City Center; Northwestern Zone; Hills Area; and Continental Area. The Downtown and Port sectors were analyzed as a single area because they present similar socioeconomic characteristics.

The present study was approved by the Research Ethics Committee of the Adolfo Lutz

Table 1 – Reported cases of pulmonary tuberculosis and treatment strategy according to sociodemographic variables. City of Santos, Brazil, 2000-2004.

Characteristic	Directly observed treatment, short-course		
	Subtotal[a]	No	Yes
	n = 2.145	n = 785	n = 1,360
Gender			
Female	665 (31.0)	254 (32.4)	411 (30.2)
Male	1,480 (69.0)	531 (67.4)	949 (69.8)
Age			
15-19 years	120 (5.6)	47 (6.0)	73 (5.4)
20-49 years	1,494 (69.7)	536 (68.3)	958 (70.4)
50-59 years	282 (13.1)	94 (12.0)	188 (13.8)
$\geq$ 60 years	249 (11.6)	108 (13.8)	141(10.4)
Years of schooling*			
None	77 (4.6)	22 (3.6)	55 (5.2)
1-3 years	201 (12.1)	53 (8.6)	148 (14.1)
4-7 years	636 (38.2)	216 (35.2)	420 (39.9)
8-11 years	569 (34.1)	217 (35.3)	352 (33.4)
$\geq$ 12 years	184 (11.0)	106 (17.3)	78 (7.4)
Total	1,667 (100.0)	614 (100.0)	1,053 (100.0)
Area of residence*			
Shoreline Area	522 (24.3)	266 (33.9)	256 (18.8)
Downtown/Port Area	501 (23.4)	139 (17.7)	362 (26.6)
City Center	304 (14.2)	119 (15.2)	185 (13.6)
Northwestern Zone	585 (27.3)	168 (21.4)	417 (30.7)
Hills Area	175 (8.2)	76 (9.7)	99 (7.3)
Continental Area	13 (0.6)	9 (1.1)	4 (0.3)
No fixed residence[b]	45 (2.1)	8 (1.0)	37 (2.7)

Results presented in n (%). No information regarding the years of schooling in 478 cases. aFor 2,145/2,176 patients, data regarding the type of treatment were available. bResiding in Santos without fixed residence. *p < 0.05.

Table 2 – Pulmonary tuberculosis and treatment strategy according to the history of tuberculosis and aspects regarding treatment and comorbidities. City of Santos, Brazil, 2000-2004.

Characteristic	Directly observed treatment, short-course		
	Subtotal[a]	No	Yes
	n = 2,145	n= 785	n= 1,360
History of TB*			
No	1,548 (76.5)	599 (80.9)	949 (73.9)
Yes	476 (23.5)	141 (19.1)	335 (26.1)
Total	2,024 (100.0)	740 (100.0)	1,284 (100.0)
Previous outcome[b]			
Cure	141 (37.3)	44 (39.3)	97 (36.5)
Treatment abandonment	237 (62.7)	68 (60.7)	169 (63.5)
Total	378 (100.0)	122 (100.0)	266 (100.0)
Treatment*			
RHZ	1,661 (85.5)	636 (89.2)	1025 (83.3)
RHZE	250 (12.9)	70 (9.8)	180 (14.6)
SZEEt	32 (1.6)	7 (1.0)	25 (2.0)
Total	1,943 (100.0)	713 (100.0)	1,230 (100.0)
Outcome[c]			
Cure	1,525 (71.1)	579 (73.8)	946 (69.6)
Treatment abandonment	256 (11.9)	88 (11.2)	168 (12.4)
Death from TB	67 (3.1)	16 (2.0)	51 (3.8)
Death from TB/HIV	69 (3.2)	32 (4.1)	37 (2.7)
Death from other causes[d]	54 (2.5)	14 (1.8)	40 (2.9)
Treatment failure	1 (0.1)	0 (0.0)	1 (0.07)
Transfer	149 (6.9)	51 (6.5)	98 (7.2)
Ongoing treatment	24 (1.2)	5 (0.7)	19 (1.4)
Total	2,145 (100.0)	785 (100.0)	1,360 (100.0)
Alcoholism*			
No	1,659 (88.3)	647 (92.6)	1,012 (85.8)
Yes	219 (11.7)	52 (7.4)	167 (14.2)
Total	1,878 (100.0)	699 (100.0)	1,179 (100.0)
HIV infection			
No	1,700 (83.9)	610 (82.2)	1,090 (84.9)
Yes	295 (16.1)	124 (17.8)	171 (15.1)
Total	1,995 (100.0)	734 (100.0)	1,261 (100.0)
Diabetes			
No	1,723 (91.8)	639 (91.4)	1,084 (92.0)
Yes	154 (8.2)	60 (8.6)	94 (8.0)
Total	1,877 (100.0)	699 (100.0)	1,178 (100.0)
Mental disorder			
No	1,845 (98.2)	689 (98.6)	1,156 (98.0)
Yes	33 (1.8)	10 (1.4)	23 (2.0)
Total	1,878 (100.0)	699 (100.0)	1,179 (100.0)

TB: tuberculosis; RHZ: therapeutic regimen 1 (Rifampicin, Isoniazid, Pyrazinamide); RHZE: therapeutic regimen 1 combined with ethambutol (Rifampicin, Isoniazid, Ethambutol, Pyrazinamide); and SZEEt: therapeutic regimen 3 (Streptomycin, Pyrazinamide, Ethambutol, Ethionamide). Results expressed in n (%). The difference between the number of patients analyzed and the total for each variable corresponds to the lack of information for each variable. aFor 2,145/2,176 patients, data regarding the type of treatment were available. bOutcome of the previous treatment. cOutcome of the current treatment. dCause of death was not specified. *p < 0.05.

Institute, São Paulo State Health Department, São Paulo, Brazil (Registry no. 25, April, 2006).

Results

The database analyzed was previously selected by the TB surveillance team of the DSR-IV. The database consisted exclusively of confirmed cases of PTB in patients ≥ 15 years of age and residing in the city of Santos, which resulted in a total of 2,295 patients. Of these, 38 patients (1.7%) were excluded due to lack of information regarding the locale of treatment, and 81 others (3.5%) were excluded because, although they resided in Santos, they had been treated in neighboring cities. Therefore, 2,176 cases of PTB were included in the present study.

Upon completion of the data collection (December of 2005), the information regarding treatment outcome was available for approximately 99.0% of the patients; the remaining 1.0% were still under treatment.

The diagnoses had been confirmed based on the following: sputum smear microscopy (61.6% of the cases); clinical and radiological criteria (33.8% of the cases); sputum culture (2.1% of the cases); histopathological examination (2.1% of the cases); and smear microscopy of other material (0.4% of the cases). Pulmonary cavitation had been reported in 18% of the cases. In 51.8% (1,070/2,065) of the cases, the diagnosis

had been made at public health care facilities; in 38.2% (789/2,065) of the cases, the diagnosis had been made at emergency care facilities; in 9,2% (189/2,065) of the cases, the diagnosis had been made by private practice physicians; and the remaining cases had been diagnosed at other facilities. The time elapsed between the onset of the respiratory symptoms and the diagnosis was less than four weeks in 28.0% of the cases; it ranged from four to six weeks in 35.2% (465/1,320) of the cases; and it was more than six weeks in 36.8% (486/1,320) of the cases. The DOTS had been administered to 63.4% (1,360/2,145) of the patients included in the present study, and the DOTS strategy coverage increased from 51.9% in 2000 to 81.1% in 2004.

There was a predominance of males (69.1%) and of individuals in the 20-49 age bracket (69.5%). The overall median age was 40 years (35 years for females and 41 years for males). The data regarding the level of education showed that 55.2% (932/1,688) had had up to seven years of schooling, whereas 44.8% (756/1,688) had had eight or more years. As can be seen in Table 1, 50.7% (1,104/2,176) of the cases occurred in the poorer areas of the city (the Northwestern Zone and Downtown/Port area), whereas 0.8% (17/2,176) occurred in an area characterized as rural (the Continental Area).
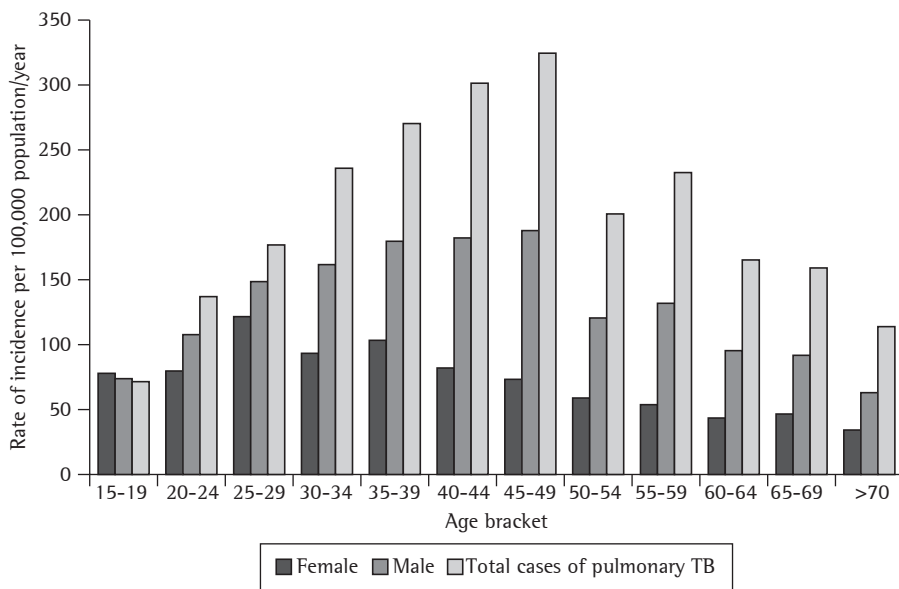

Figure 1 – Mean annual rate of incidence of pulmonary tuberculosis (TB) among the population ≥ 15 years of age, by age bracket and gender. City of Santos, Brazil. 2000-2004.

The proportion of patients with a history of TB was 23.5% (481/2,048). For 342/481 (71.1%), we obtained information regarding the time elapsed between the previous and current treatment. Therefore, the previous episode had occurred up to two years before in 43.6% (149/342) of the patients, between two and five years before in 22.2% (76/342) and more than five years before in the remaining 34.2% (117/342). Regarding the type of discharge from the previous treatment, 67.0% (240/381) abandoned treatment, whereas 37.0% (141/381) were cured. The latter were classified as cases of recurrence (Table 2).

Regarding comorbidities, 11.7% (222/1,901) had a history of alcoholism, 8.3% (158/1,900) had diabetes and 1.7% (33/1,901) had mental disorders. There was information regarding laboratory tests for HIV infection for 2,049/2,176 patients (94.2%), revealing a mean prevalence of TB/HIV coinfection of 16.2% (332/2,049) in the study period, a prevalence that decreased from 20.7% to 12.9% between 2000 and 2004 (Table 1).

Reinforced regimens (rifampicin-isoniazid-ethambutol-pyrazinamide or streptomycin-pyrazinamide-ethambutol-ethionamide) were used in 14.5% (284/1,958) of the cases (Table 2); the therapeutic regimen was changed during treatment in 3.7% (76/2,079) of the cases.

Of the patients for whom information regarding hospitalization was available, 34.2% (616/1,801) had been hospitalized at least once during treatment. The proportion of hospitalized patients that presented a previous episode of TB was 38.2% (152/398), whereas the proportion of patients who were treatment-naïve was 30.7% (396/1,291; p = 0,005). Of the 616 hospitalized patients, 104 were hospitalized twice, and 12 were hospitalized three times, totaling 732 hospitalizations. The mean length of the hospital stay was 32, 68 and 106 days, respectively, for the first, second and third hospital stays.

The information regarding the number of contacts was available for 55.3% (1,203/2,176) of the cases, totaling 4,514 contacts. Of these 4,514 contacts, 1,302 (28.8%) had been effectively examined, and 71 new cases had been identified among them, i.e., 54.5 new cases per 1,000 effectively examined contacts. Among to the cases in which the DOTS strategy had been employed, the contacts had been examined in 30.7% (238/774), whereas the proportion of cases in which contacts had not been examined was 38.2% (159/416) (p < 0.05).

Regarding treatment outcome, 70.6% (1,536/2,176) of the patients were cured, 12% (262/2,176) abandoned treatment, 3.2% (69/2,176) died from TB and 3.3% (72/2,176) died from TB/HIV coinfection. For 2.8% (61/2,176) of the patients, the cause of death was not specified (Table 2). However, such outcomes varied according to the history of patients. Among those who did not present a previous episode of PTB, 77.4% were cured, 8.9% abandoned treatment and 2.9% died from TB. Among those who presented at least one previous episode of PTB, 59.1% were cured, 21.8% abandoned treatment and 4.8% died from TB.

The mean annual incidence of TB among those ≥ 15 years of age in the city of Santos in the period of interest was 127.9/100,000 population, decreasing from 158.1 to 121.1/100,000 population between 2000 and 2004. The risks were higher for adult males in their economically productive years. Figure 1 shows that, for the sample as a whole, the highest mean annual incidence rate was observed among those in
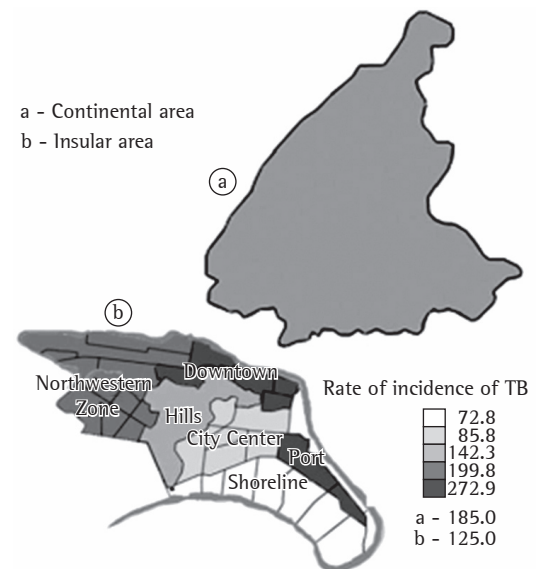

a - Continental area
b - Insular area

Rate of incidence of TB

☐	72.8
☐	85.8
☐	142.3
■	199.8
■	272.9

a - 185.0
b - 125.0

Figure 2 – Mean annual rate of incidence of pulmonary tuberculosis (TB) among the population ≥ 15 years of age, by geographic area and region of residence, per 100,000 population/year. City of Santos, Brazil. 2000-2004.

the 45-49 age bracket (184.7/100,000 population); for females, the highest rate was observed among those in the 25-29 age bracket (119.7/100,000 population), and for males, the highest rate was observed among those in the 45-49 age bracket (321.6/100,000 population).

The mean annual incidence rates by region of residence showed an unequal distribution, ranging from 72.8 to 272.9/100,000 population in the Shoreline Area and in the Downtown/Port Area, respectively. The mean annual incidence rate in the Continental Area, which has rural characteristics, was 185.0/100,000 population, compared with 125.0/100,000 population in the insular area (consisting of the remaining five sectors), which is urban (Figure 2). The mean and median of the annual number of PTB cases in the Continental Area were 3.4 and 3.0, respectively.

The mean annual mortality rates for TB, for TB/HIV coinfection and for cases in which there was no available information regarding the probable cause of death among those $\geq$ 15 years of age in the city of Santos were, respectively, 4.1, 4.2 and 4.3/100,000 population. The risk of death among those with TB/HIV coinfection was higher in the 30-49 age bracket, whereas the risk of death from TB exclusively was higher among all patients $\geq$ 40 years of age (Figure 3).
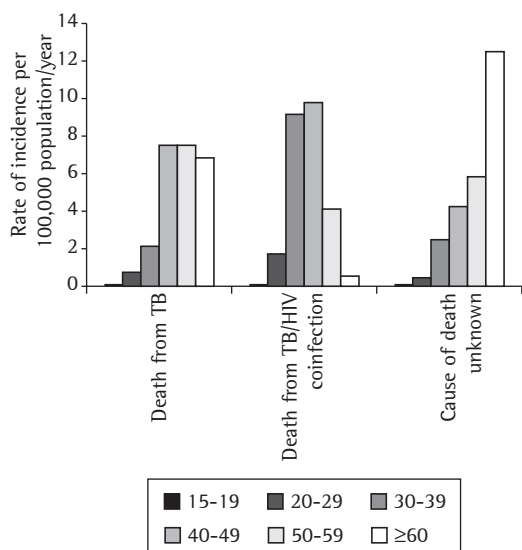
Tables 1 and 2 present the characteristics of the reported cases according to the treatment strategy adopted. By comparing the characteristics of the patients treated under the DOTS strategy with those of the patients submitted to the conventional treatment approach, we observed that those treated under the DOTS strategy had had fewer years of schooling ($p < 0.001$). In addition, the proportion of patients with a history of alcoholism was higher ($p < 0.0001$) among patients treated under the DOTS strategy. However, no significant differences were observed regarding other comorbidities (diabetes, TB/HIV coinfection and mental disorder; $p > 0.05$; Table 1).

We also observed a greater coverage of the DOTS strategy in the poorer areas of the city ($p < 0.001$), among patients with a history of TB ($p < 0.001$) and among patients treated with the reinforced regimen ($p = 0.002$). However, no differences in outcomes (cure, treatment abandonment or death) were observed when patients treated under the DOTS strategy were compared with those who were not ($p > 0.05$; Table 2). The analysis of the year-to-year outcomes exclusively for patients treated under the DOTS strategy revealed no change in the outcomes as the coverage of the DOTS strategy increased.

Discussion

Despite the decrease observed in recent years, the morbidity and mortality rates for PTB in the city of Santos reveal the severity of the situation. The mean incidence and mortality rates are far higher than those reported for the state of São Paulo and for Brazil as a whole,[3] as well as being ten times higher than those reported for Cuba.[8]

The high incidence observed among individuals aged 15-19 years and individuals in their economically productive years reveals the hyperendemic character of TB; this is in contrast with other communities, which have controlled TB, in which the elderly are the group most affected by the disease.[9,10] Another surprising aspect is the fact that the small rural population of the city presented an incidence that was 48% greater than that found in the urban population. Such data should be interpreted carefully, since the rural area has few inhabitants, and the estimated incidence therefore represents a small number

Figure 3 – Mean annual rate of mortality for pulmonary tuberculosis (TB) among the population $\geq$ 15 years of age, by age bracket. City of Santos, Brazil. 2000-2004.

of cases, even if such cases recurred with small variations in the period.

The heterogeneous form of distribution of PTB over the different areas of the city, affecting particularly the poorer, is consistent with the concept that there is a social component of the epidemiology of the disease.[11,12]

The considerable proportion of cases of retreatment due to treatment abandonment is worrisome because it contributes to the maintenance of a high risk of infection, since such patients were infectious. Such conditions are extremely favorable to the transmission of TB among contacts and to the increase in mortality rates, since it is known that retreatment is associated with multidrug-resistant TB[13] and with greater severity of the disease.[14,15]

The fact that one third of the patients with a history of TB becomes ill again within five years after the previous episode suggests an environment favorable to exogenous reinfection.[16]

Some of the characteristics observed in the cases under study have been reported to be associated with retreatment; among such characteristics is the significant proportion of young patients,[17] of patients with TB/HIV coinfection and of patients presenting greater disease severity, as evidenced by the number of hospitalizations during treatment.[18,19]

Other aspects that merit attention are the high proportion of patients that were hospitalized at least once during treatment and the mean length of hospital stay per hospitalization. This illustrates the social cost of TB and the impact of such cases on the budget of the TB control program, since it is estimated that the cost of hospital treatment is 14 times higher than that of outpatient treatment.[20] It has been demonstrated that 65% of the TB control program budget is expended for hospitalizations, and that the families of patients allocate 33% of their income to expenses related to the maintenance of the patients during hospital treatment.[20]

The high proportion of hospitalizations can be partly explained by the low adherence to treatment, which increases the risk of developing severe forms of the disease,[14,15] or by the high prevalence of patients with TB/HIV coinfection,[18] as well as by the fact that TB is a hyperendemic disease in the community studied, creating conditions for a more marked

and prolonged exposure to *M. tuberculosis*.[16] However, due to its importance to the TB control program, this issue deserves further investigation, since it warrants specific interventions.

The search for cases among those of patients with respiratory symptoms in public health care facilities and the investigation of contacts are important aspects of the TB control strategy, to which the success of certain programs has been attributed.[21] However, we observed that only half of the cases were identified in public health care facilities; in one third of such cases, the diagnosis was established more than six weeks after the onset of respiratory symptoms, and the proportion of contacts investigated was low.

Treatment outcomes indicate the obstacles faced by the program; however, such outcomes are similar to those observed, on average, in Brazil as a whole,[22] suggesting that the more severe conditions of TB in Santos are not related exclusively to the performance of the program in the city.

Biological factors such as the high number of people living with HIV/AIDS in the city of Santos might also be contributing to the hyperendemic level of TB there.[23]

However, environmental and institutional factors, especially the conditions favorable to the increase in the occurrence of multidrug-resistant TB and to the transmission of TB, seem to have a greater influence than do other factors.[24] Nevertheless, the fact that the city of Santos has a wide range of public health care facilities, together with the fact that access to the diagnosis and treatment of TB is universal and free, creates the conditions necessary for a decrease in the morbidity and mortality rates for TB in the city of Santos.

Certain favorable results should be highlighted. One is the decrease in the prevalence of TB/HIV coinfection in the study period, a finding that is consistent with those of other studies.[25,26] We also observed a significant increase in the coverage of the DOTS strategy during the study period, an increase that was higher than that observed for Brazil as a whole.[2] However, no significant differences in treatment outcomes were observed between patients treated under the DOTS strategy and those who were not.

The interpretation of the results of the present study should take into consideration not

only the intrinsic limitations of the surveillance but also underreporting, the lack of complete information and the difficulties that arise from working with multiple data sources, as well as the fact that only cases of PTB were analyzed. The data regarding alcoholism and diabetes should be interpreted with caution, since they were not verified by means of laboratory tests or a validated questionnaire. However, despite such limitations, the high proportion of cases for which there was information regarding treatment outcomes (99.0%) ensures the quality of the data collected in the present study. The consistency and usefulness of the results obtained are also undeniable.

The high prevalence of patients infected with *M. tuberculosis* in the city of Santos is an obstacle to the rapid decrease of TB cases. In addition, the high proportion of patients with a history of TB contributes to the aggravation of the problem of multidrug-resistant TB. In hyperendemic areas, it is important that the DOTS strategy be prioritized for groups at greater risk of treatment abandonment or death in order to reduce the number of cases of treatment abandonment, as well as the number of deaths. In addition, it is important to intensify the screening for TB among patients with respiratory symptoms, as well as among individuals who have had contact with TB patients.

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About the authors

Andrea Gobetti Vieira Coelho
Assistant in Technological and Scientific Research. Adolfo Lutz Institute-Santos, Santos, Brazil.

Liliana Aparecida Zamarioli
Scientific Researcher. Adolfo Lutz Institute-Santos, Santos, Brazil.

Carmen Argüello Perandones
Director. Epidemiological Surveillance, Regional Health Care Division of the Greater Metropolitan Area of Santos, São Paulo State Department of Health, Santos, Brazil.

Ivonete Cuntiere
Nurse. Tuberculosis Control Plan of Santos, Epidemiological Surveillance, Santos City Hall, Santos, Brazil.

Eliseu Alves Waldman
Professor. Department of Epidemiology of the University of São Paulo School of Public Health, São Paulo, Brazil.