

# Original Article

## Tuberculosis in a medium-sized city in the Southeast of Brazil: morbidity and mortality rates (1985 - 2003)\*

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**Background:** Tuberculosis is a disease linked to poverty, unequal distribution of wealth, and urbanization, as well as the epidemics of acquired immunodeficiency syndrome epidemic and multidrug resistance.

**Objective:** To analyze indicators of tuberculosis morbidity and mortality in the city of São José do Rio Preto, Brazil from 1985 to 2003, compared with those in the state of São Paulo and in Brazil at large, and to determine the relationship between the risk of occurrence and socioeconomic level.

**Method:** The following official information systems were utilized: the Sistema de Informação de Mortalidade (SIM, Mortality database), the Notificação de Tuberculose (Epi-Tb, Tuberculosis Notification database), the Sistema de Informação de Agravos de Notificação (SINAN, Case-registry database), the Departamento de Informação e Informática do Sistema Único de Saúde (DATASUS, Information Department of the Brazilian Health Ministry) and the Instituto Brasileiro de Geografia e Estatística (IBGE, Brazilian Institute of Geography and Statistics database). New cases reported in 2003 in the urban area were georeferenced and analyzed. A map of the sectors, each classified as representing one of three socioeconomic classes, was drawn up, showing the respective tuberculosis incidence coefficients.

**Results:** Comparing Brazil as a whole to the state of São Paulo, total incidence coefficients and mortality rates were similar, as were gender-related values. In the city of São José do Rio Preto the rates were consistently lower. The proportion of cases presenting tuberculosis/human immunodeficiency virus coinfection varied from 29% to 37%. In 2002, 59% and 65% of tuberculosis-only and coinfecting tuberculosis patients, respectively, were under supervised treatment, with a cure rate of 81% and a treatment-abandonment rate of 1%. The risk of developing active tuberculosis was three times higher in the area presenting the lowest socioeconomic levels.

**Conclusion:** Identification of the areas with different levels of risks for tuberculosis enables the Municipal Health Department to deal with the peculiarities of each region and to prioritize those presenting higher incidences of the disease.

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**Key words:** Tuberculosis. Epidemiology. Socioeconomic class. Supervised Treatment. Infection. HIV.

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## INTRODUCTION

Analysis of the tuberculosis (TB) situation worldwide reveals that the disease is related to poverty, poor distribution of wealth and accelerated urbanization, therefore calling for urgent control measures. The acquired immunodeficiency syndrome epidemic and the emergence of multidrug-resistant TB foci have mobilized the world on the issue of TB and alerted health authorities to the need for revitalizing TB control through the use of energetic, efficacious and appropriate measures<sup>(1,2)</sup>.

The World Health Organization estimates that one-third of the global population is infected with *Mycobacterium tuberculosis*. The annual number of new TB cases is 8.7 million, 80% of which are concentrated in 22 countries with higher TB burdens. Among those 22, Brazil ranks fifteenth<sup>(3)</sup>. Approximately one-third of the 36.1 million people living with human immunodeficiency virus (HIV) at the end of the year 2000 were coinfecting with *Mycobacterium tuberculosis*<sup>(4)</sup>.

In view of this situation, it has been recommended over the last decade that the Directly Observed Treatment, Short-course treatment program for TB be expanded. The World Bank states that the Directly Observed Treatment, Short-course is "one of the most cost-effective health interventions available." This strategy has resulted in the cure of over 10 million patients since 1993, when the World Health Organization declared TB a world emergency<sup>(5)</sup>.

The number of TB cases in Brazil has been a cause for concern among regional and national health authorities. In 2002, 77,634 new cases were reported: 35,759 in the Southeast, 22,039 in the Northeast, 8,630 in the South, 7,061 in the North and 3,370 in the Midwest\*.

Nearly 50% of all TB cases in the state of São Paulo are reported in the city of São José do Rio Preto. It is considered a priority in the Tuberculosis Control Program due to the high number of TB patients presenting HIV seropositivity<sup>(6)</sup>.

In view of these facts, studies designed to increase understanding of the conditions of occurrence of this disease in the city as a whole, as well as in its various sectors, should be conducted. The objectives of this study were to analyze the indicators of TB-related morbidity and mortality in

São José do Rio Preto between 1985 and 2003, compare them with values obtained for the state of São Paulo and for Brazil as a whole, and evaluate the relationship between the risk of occurrence of the disease and socioeconomic level.

## METHODS

São José do Rio Preto is located in the northwest region of the state of São Paulo and, according to the (2004) report released by the Departamento de Informação e Informática do Sistema Único de Saúde (DATASUS, Information Department of the Brazilian Health Ministry), had a population of 382,173 people in 2003. The city is the headquarters for an administrative region comprising 101 municipalities.

Information from the Sistema de Informação de Mortalidade (SIM, Mortality database), the Notificação de Tuberculose (Epi-Tb, Tuberculosis Notification database) and the Sistema de Informação de Agravos de Notificação (SINAN, Case-registry database) was utilized. The population counts were obtained from the DATASUS. The data related to the 432 census sectors of the urban area of the city was provided by the Instituto Brasileiro de Geografia e Estatística (IBGE, Brazilian Institute of Geography and Statistics database).

The indicators of incidence and mortality were standardized by the population of the state of São Paulo, in 2002. When data regarding new cases or deaths by age bracket were available, the direct method of standardization was utilized, and when they were not, indirect standardization was utilized. The values for incidence and mortality in the city were smoothed through moving averages, because the original numbers presented great fluctuations due to the small number of cases and deaths considered.

The new cases reported in 2003 in the urban area of the city were georeferenced using tools provided in the MapInfo program and with the vector map (provided by city hall) showing street axes. These cases were grouped according to the 432 census sectors.

In order to carry out the analysis of main components, the following socioeconomic variables were selected based on the data provided by the IBGE: income and average years of schooling of the heads of households; the overall proportion of illiterate individuals and the proportion of illiterate women;

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the proportion of homes with five or more residents.

This analysis, carried out using the STATA software, produced several factors, from among which was chosen the one responsible for the highest proportion of total variability. This factor was used to divide the urban area into three groups of census sectors according to socioeconomic level, which made it possible to calculate the respective rates of TB incidence. A thematic map of the sectors grouped into three socioeconomic classes was generated, with the respective values of the rates of TB incidence.

## RESULTS

The standardized incidence ratios for the city, the state of São Paulo and Brazil during the 1985 to 2002 period were obtained through indirect standardization. The value of 100% corresponds to the rate of incidence for the state of São Paulo in 2002 (48 cases per 100,000 inhabitants). In 1985, the risk of developing active TB was higher in Brazil than in the state of São Paulo. Both later decreased, attaining similar values in 2003. The population of São José do Rio Preto has always a lower risk of developing active TB in relation to the state and national populations (Figure 1).

During the 2000 to 2003 period, the rates of TB incidence, directly standardized by the population of the state of São Paulo in 2002, ranged from 31 to 36 cases per 100,000 inhabitants. Among men,

these ranged from 45 to 47 and from 18 to 27 among women. During this period, the rates of TB incidence of in the 0 to 14 year age bracket ranged from 2 to 3 cases per 100,000 inhabitants. In the 15 to 49 age bracket, the values ranged from 33 to 44. In 2000, in the 50 and older age bracket, the rate of incidence of TB was 34 cases per 100,000 inhabitants. In the following years, the rate presented an increasing trend, reaching 66 cases per 100,000 inhabitants in 2003.

For the 1985 to 2002 period, the rates of total mortality and mortality calculated by gender for the three analyzed levels were standardized by the direct method. Similar rates can be observed for Brazil and the state of São Paulo, both regarding the total values as well as calculated by gender, whereas the values in the city were lower (Figures 2 and 3).

Regarding the rates of mortality for the 15 to 49 and 50 and older age brackets during the 1985 to 2001 period, similar values were observed for the state and the country, and lower values were observed for the city (Figure 3). The rates for the 0 to 14 age bracket for the city were always nil, and, for the state of São Paulo and Brazil, they ranged from 0.1 to 0.7 deaths per 100,000 inhabitants.

Between 1998 and 2002 in São José do Rio Preto, the proportion of cases of TB/HIV coinfection ranged from 29% to 37%. In 2002, the coverage of supervised treatment in the same year was 65% and

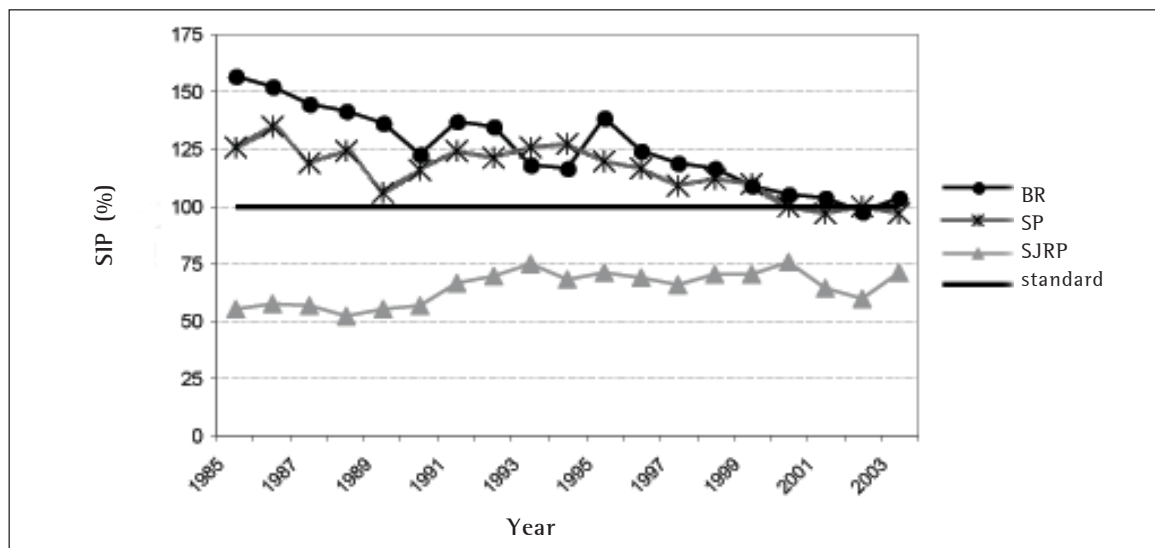


Figure 1. Standardized incidence ratios (SIPs), in percentages, for tuberculosis between 1985 and 2002 in São José do Rio Preto (SJRP), the state of São Paulo (SP) and Brazil (BR)

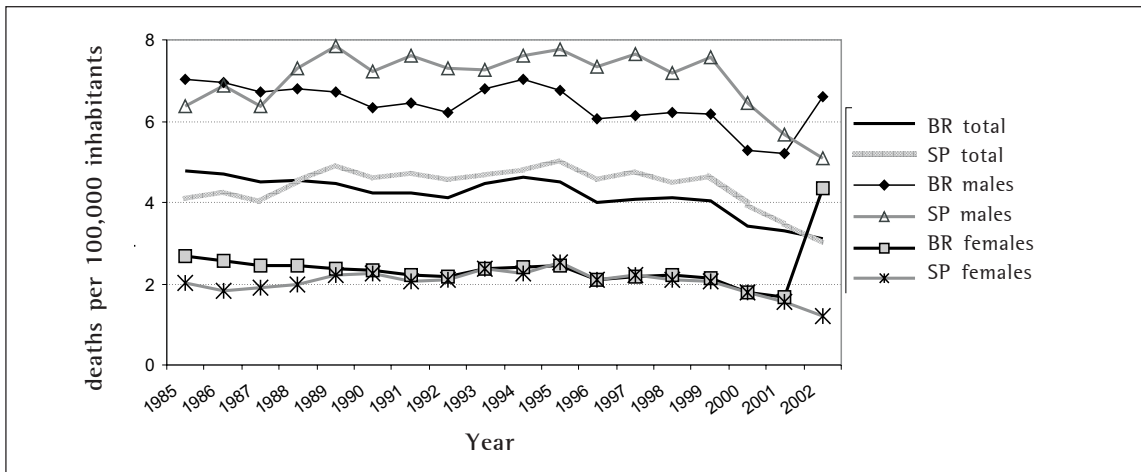


Figure 2. Standardized rates of mortality from tuberculosis (total mortality and mortality calculated by gender) between 1985 and 2002 in the state of São Paulo (SP) and in Brazil (BR)

59% respectively, among the coinfecting and the non-coinfecting. In 2002, the city presented a cure rate of 81% (Figure 4) and a 1% noncompliance rate.

Analysis of the principal components with the utilized variables produced a Factor 1 with 87% of the total variability. Factor 1 characterized the socioeconomic level of the census sectors so that the higher the value the better the socioeconomic status of the resident population. The composition of Factor 1 was as follows: Factor 1 = 0.97 (average years of schooling of the heads of households) +0.94 (average years of schooling of the female heads of households) +0.85 (average income of the heads

of households) +0.85 (average income of the female heads of households) -0.89 (proportion of illiterate people) -0.89 (proportion of illiterate women) -0.56 (proportion of homes with five or more residents).

Three strata were established for Factor 1, the group of sectors with the highest values being denominated Class A (highest socioeconomic level). The group of sectors with the lowest values was denominated Class C (lowest socioeconomic level). The group of sectors with intermediate values for Factor 1 was denominated Class B (middle socioeconomic level). As a result of this analysis, the risk of developing active TB was found to be

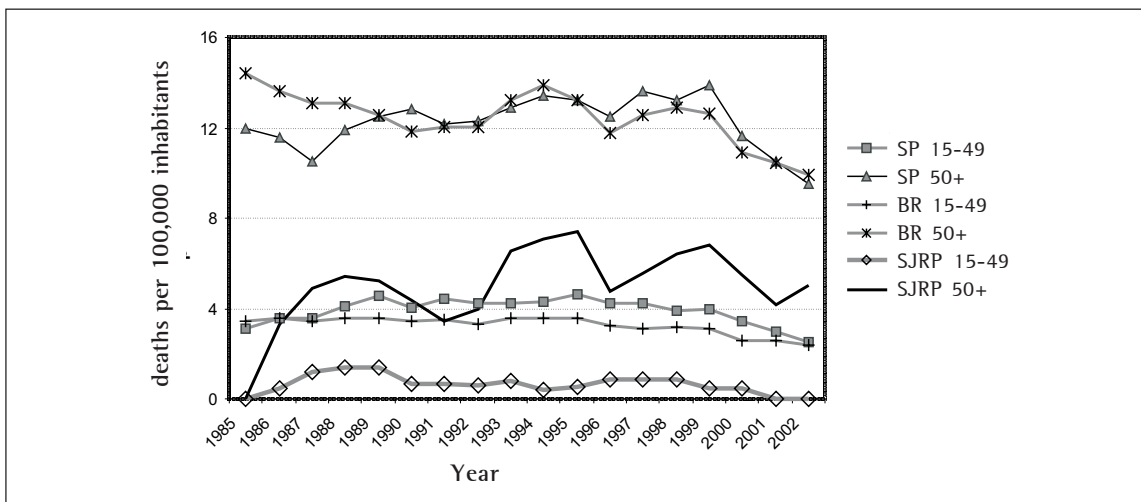


Figure 3. Rates of mortality from tuberculosis by age bracket between 1985 and 2001 in São José do Rio Preto (SJRP), the state of São Paulo (SP) and Brazil (BR)

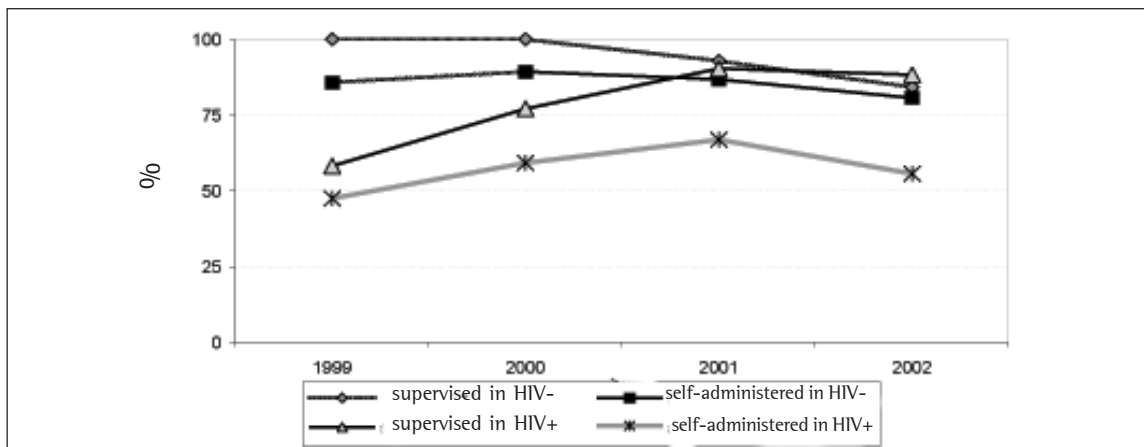


Figure 4. Percentage of HIV- and HIV+ patients cured through supervised and unsupervised treatment between 1999 and 2002 in São José do Rio Preto (SJRP)

approximately three times higher in the area with the lowest socioeconomic levels in relation to the area with the highest levels (Figure 5).

## DISCUSSION

Whereas the global data show a tendency toward stabilization of TB incidence rates, these rates have presented a decreasing trend in Brazil<sup>(7,8)</sup>. Such analyses should take into consideration the fact that the estimated magnitude of TB is based on numbers of cases reported, which are subject to the problems inherent to each region. These data should be interpreted with caution because the quality of the data depends on the systems used to identify and report cases in each country. The number of cases worldwide is underreported by approximately half in comparison to that estimated by the World Health Organization<sup>(9)</sup>.

The fact that the risk of developing active TB is lower in São José do Rio Preto is coherent with other health indicators in the city: proportional mortality ratio of 79.2% and infant mortality rate of 11.8 deaths of 1-year-olds per 1,000 born alive<sup>(10)</sup>. However, this can also be explained by the underreporting resulting from the limitation of the current health care structure, in which diagnostic and treatment services are typically centralized in a single secondary-care facility.

In this study, the identification of a higher risk of developing active TB for the male sex is in accordance with the findings of other studies<sup>(11,12)</sup>. The reasons for the higher risk among males still remain unclear and may be related both to biological factors and to underreporting among

females<sup>(13)</sup>. The biological factors which explain the differences found may be related to lifestyle, favoring a higher incidence of the disease in the male gender, and to the possibility that women are more resistant and take better care of their health than do men<sup>(14)</sup>.

The lower rates of TB mortality, total mortality and mortality calculated by gender found in the city, in relation to the other levels studied, may be attributed both to lower incidences presented as well as to underreporting of cases and deaths. At all three levels, men presented a two or three times higher risk of dying from TB than did women, probably due to the lower rates of incidence among the women living in the city. This also suggests similar lethality rates.

The city also presented lower rates of mortality by age bracket. At the three levels analyzed, mortality rates for the 50 and older age bracket were always higher, indicating greater vulnerability to the disease among the elderly. A higher risk of death from TB among the elderly confirms the results of other studies<sup>(15,16)</sup>. This fact has been attributed to both demographic factors related to the ageing of the population as much as to the influence of control programs and of HIV infection<sup>(16)</sup>.

With the ageing of the population, many individuals who were initially infected in the first decades of the twentieth century may become susceptible again in their old age. Because they present atypical clinical profiles, such individuals are not easily diagnosed, which increases mortality among the elderly. However, as the transmission of TB decreases, there is a decrease in the risk of

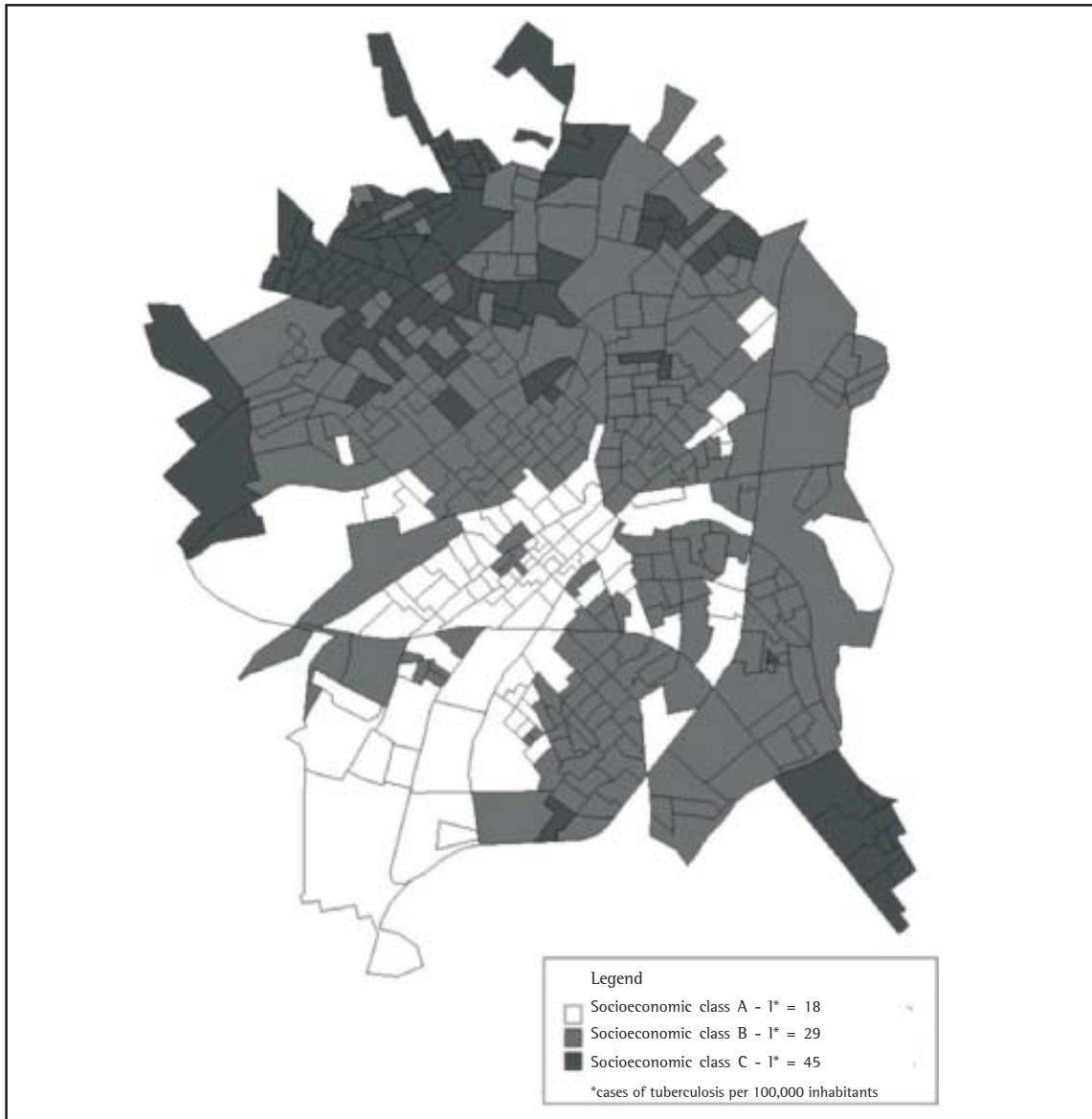


Figure 5. Map of São José do Rio Preto by socioeconomic area and by tuberculosis incidence (I) in 2003

infection and not in the risk of re-activation of previous lesions, which also contributes to the increased predominance in the upper age brackets<sup>(16)</sup>.

The high proportions of HIV/TB coinfection found in the city corroborate its classification as a priority by the Tuberculosis Control Program, which receives incentives from the state and federal governments. In Brazil as a whole, the proportion of cases presenting coinfection was approximately 8% in 2003<sup>(17)</sup>.

As of 1997, the various levels of government began to consider supervised treatment, one of the components of the Directly Observed Treatment, Short-course strategy, as an important instrument for increasing cure rates and decreasing noncompliance in TB cases. In 1998, the city implemented supervised treatment, initially with greater coverage among TB patients coinfecting with HIV. In 2001 and 2002, a near 65% coverage was obtained among these patients. Coverage

among the non-coinfecting, which was less than 20% until 2002, reached 59% in 2002, approximating that of the coinfecting<sup>(10)</sup>.

The 80% cure rate and 1% noncompliance rate achieved in 2002 brought the city closer to the goals established by the Tuberculosis Control Program. These proportions may be related to the treatment strategy adopted. In 2002, the proportions of cured and noncompliant patients in Brazil were 70% and 12%, respectively.

In the city, the population of the area with the lowest socioeconomic level presented a higher risk of developing active TB. This finding is in accordance with those of other studies showing that TB has a direct relationship with the low levels of socioeconomic development (poor living conditions, overcrowding, inadequate basic sanitation/housing, hunger and poverty). It is clear that TB is a disease that is not confined by biological barriers. More than a mere deviation or biological dysfunction, TB is a social problem<sup>(18)</sup>.

The identification of areas presenting different TB risks makes it possible for the municipal health system to treat the city as a compound of distinct realities and prioritize the regions presenting higher incidences of the disease. This prioritization should take into account the planning of treatment strategies oriented toward the identification of cases and types of treatment, as well as the establishment of strategies articulated with other sectors of the city, having the ultimate goal of achieving an improvement in the living conditions of the population.

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