Original Article

The greater metropolitan area of the Federal District: evaluation of tuberculosis cases occurring in ten outlying cities and reported in the Federal District, together with an analysis of tuberculosis incidence in the region*

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Abstract

Objective: To evaluate tuberculosis cases occurring in the greater metropolitan area of the *Distrito Federal* (MADF, encompassing the Federal District, i.e., the national capital of Brasília, located in the state of Goiás) but reported in Brasília itself and to analyze the influence that this has on the effectiveness of the tuberculosis control program, as well as on the collection of socioeconomic and demographic data related to tuberculosis incidence rates. **Methods:** Rates of tuberculosis incidence, cure, noncompliance, treatment failure, mortality, and referral, as well as socioeconomic and demographic data, were reviewed for patients from ten MADF cities. **Results:** From 2000 to 2004, 714 new cases of tuberculosis were reported in the cities studied, 436 (61%) of which were treated in Brasília and were therefore not included in the Goiás database. Among patients treated only in the MADF cities studied, the mean incidence of tuberculosis ranged from 4.40 to 10.02/100,000 inhabitants. When those treated in Brasília were included, the incidence significantly increased, ranging from 15.16 to 20.54/100,000 inhabitants ($p < 0.001$). The rate at which contacts of tuberculosis patients were investigated was low, and treatment outcomes were unsatisfactory in the MADF cities studied and in Brasília. Socioeconomic and demographic data were consistent with the tuberculosis incidence. **Conclusion:** The number of tuberculosis patients treated in the city in which they resided was lower than expected. Treatment in another city might impair tuberculosis control. The recalculated tuberculosis incidence is consistent with the socioeconomic and demographic profile of the region. A federal surveillance system could be efficiently optimized, improving the control of this disease.

Keywords: Tuberculosis/epidemiology; Epidemiologic studies; Government programs.

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Introduction

Tuberculosis (TB) remains a serious health problem in Brazil despite the systematic activities of specific programs sponsored by the National Ministry of Health (NMH).[1] Nationwide evaluation of the rates of cure for TB reveals unsatisfactory results in terms of the goals established, impairing the control of the disease, since it is not possible to break the chain of disease transmission. Although the nationwide trend toward a decrease in the incidence of TB in the past years seems incongruous with the lack of effective control of the disease, this situation could be the result of failure in the data collection system or, in some regions, of underdiagnosis.[1-4] The magnitude of the TB problem, albeit considerable, has been unsatisfactorily registered in the *Sistema de Informação de Agravos de Notificação relacionado à TB* (SINAN-TB, TB Case Registry Database). The objective of this database is to support planning, follow-up, and evaluation in TB control. At the request of the NMH, the SINAN-TB was evaluated by the International Research and Programs Branch,[5] which suggested that the possible underreporting of cases be taken into account in the planning policy that regulates the activities of the *Programa de Controle da Tuberculose* (PCT, Tuberculosis Control Program) since, in 2001, SINAN-TB registered 74,500 cases of TB, whereas the World Health Organization had estimated 110,500 cases for the same year.

The *Programa Nacional de Controle da Tuberculose* (PNCT, National Tuberculosis Control Program),[1] created in 2004 by the NMH, established some criteria for the prioritization of Brazilian cities regarding TB, based on the number of diagnosed cases in the past three years. The validity of these criteria depends on the data collection system and on the activities of the PCT which, as mentioned before, has some shortcomings. Considering the limitations of SINAN, we suggest a territory-based surveillance system, focusing on social processes and identifying risk situations that indicate the prioritization of these areas.[2]

The current situation of TB reporting in the greater metropolitan area of the *Distrito Federal* (MADF, the area encompassing the Federal District – national capital of Brasília – located in the state of Goiás) exemplifies the particular problems of TB surveillance, and of the PCT, mentioned above. The MADF comprises 19 cities and encompasses an area of 35,950,001 km^2, corresponding to 10.67% of the total area of the state of Goiás.[6,7] The *Secretaria de Saúde de Goiás* (SES-GO, Goiás State Department of Health), in partnership with the Damien Foundation, a Belgian nongovernmental organization, as of 2003, implemented the PCT in the MADF through systematized cyclic administration, consisting of the technical analysis of the program in each city, followed by the formulation of a plan of action for its implementation, supervision, and periodic reprogramming of activities, completing the cyclic administration. In the analyses of this situation,[8] we found that the incidence of TB was lower than would be expected for a region with a high incidence of socioeconomic and demographic factors that promote the spread of TB. In addition, we noted that innumerable patients with TB residing in the MADF sought medical assistance in the city of Brasília itself. As of 2002, data regarding these cases, which had previously been sent to the SES-GO through reporting forms, began to be sent through SINAN-TB reporting and investigation forms, which, for operational reasons, were not entered into the SINAN-Goiás (SINAN-GO), thereby directly interfering with the calculation of the TB incidence rate and of the dimension of the goals of the other indicators used in the PCT.

The socioeconomic and demographic factors are directly related to the magnitude of the incidence of TB, a relationship that has been studied and mentioned in various scientific reports. Low family income, malnutrition, inadequate housing, high density communities, migration, difficult in accessing health care facilities, and unsatisfactory social assistance programs are frequently cited as risk factors for TB.[5,9-14] The inauguration of Brasília, in 1960, was followed by a rapid process of occupation of the MADF, due to the governmental incentives for laborers to migrate to the city. The resulting concentration of population had a negative influence on the social and urban infrastructure (education, health, sanitation, social assistance, public security, and housing).[6,7]

The objective of this study was to evaluate the reporting of TB cases involving residents of the MADF and its possible influence on the PCT, as well as to analyze the incidence of TB in the MADF cities studied, together with the possible impact that the

socioeconomic situation and demographic characteristics of the region have on this indicator.

Methods

This study analyzed data related to the 2000-2004 period in ten cities in the MADF: Águas Lindas, Cidade Ocidental, Cristalina, Formosa, Luziânia, Novo Gama, Padre Bernardo, Planaltina, Santo Antônio do Descoberto, and Valparaíso. Cities meeting the following criteria were included: being located in the MADF, according to the definition established by the Ministry of Social Integration for the Regional Development of the Federal District and Environs[7]; having a population of over 20,000 inhabitants; and being geographically closer to Brasília in relation to other cities in the MADF. The analyses were based on the collection of the following data for each city:

- Number of new cases of TB in residents of the other MADF cities studied who were treated in Brasília;
- Number of new cases of TB in residents treated in their own cities;
- Rate of contacts investigated in the cities studied and in Brasília;
- Indicators related to the treatment cohort (rates of cure, rate of confirmed cure of cases of active TB, rate of treatment noncompliance, treatment failure, death, and relocation), and
- Socioeconomic and demographic factors - municipal human development index (MHDI) regarding monthly income (MHDI-income), family income, geometric growth rate, demographic density, and migration flow (percentage of migrants from other states)

The concept of new case and of contact, as well as the characterization of case outcomes – cure rates, non-confirmed cure of cases of active TB, treatment noncompliance, relocation, treatment failure, case without information, and death – was based on the norms established by the NMH.[15] The goals for the related indicators were in accordance with those stipulated by the NMH,[1] that is, acceptable (5%) rate of treatment noncompliance, rate of cure ≥ 85%, and a maximum mortality rate of 5%.

The lists of the names of patients who were transferred, from Brasília as well as from the cities studied, were analyzed according to the type of input into the SINAN-GO and SINAN-DF; from the total of cases treated in each place, we deducted 26 cases of duplicity, 21 cases transferred to other cities in Goiás and 5 transferred to Brasília, which were entered as 'new cases' in the receiving facilities.

For the sake of accuracy, we decided to use only the socioeconomic indices for the year 2000, obtained through the most recent census and published that same year.

The sources for the data presented were as follows: for the number of cases treated - SINAN-GO, information obtained from the Brasília Department of Health through SINAN-DF and analyses of the PCT in the cities studied (SES-GO and Damien Foundation)[8]; for contacts investigated - monthly TB report (SES-GO) and monthly TB report (SES-DF); for demographic and socioeconomic data - Brazilian Institute of Geography and Statistics, Census 2000,[16] and *Superintendência de Estatística Pesquisa e Informação da Secretaria de Planejamento do Estado de Goiás* (SEPLAN-GO, Goiás State Secretary of Planning Superintendent of Statistics, Research, and Information).[17]

Absolute values, percentages, means (with standard deviations), indices, and rates were used in the description of the data. A year-to-year comparative analysis of the indices was carried out using the proportion test, whereas regression analysis was used in the comparison of the indices among cities. The type of outcome of the cases was analyzed by place of treatment using Fisher's exact test. Values of $p < 0.05$ were considered statistically significant.

The present study was submitted to the Ethics in Human and Animal Research Committee of the *Hospital das Clínicas* of the Federal University of Goiás (process no. 131/05, approved on 12/07/2005). This committee found no ethical impediment to the research.

Results

From 2000 to 2004, 714 new cases of TB involving residents of the ten MADF cities studied were reported. Of those 714 cases, 436 (61%) were reported and treated in Brasília, compared with 278 (39%) in the MADF cities studied (Figure 1). When only the cases treated in the MADF were considered, the mean 2000-2004 incidence of TB in the ten cities was found to range from 4.40 to 10.02/100,000 inhabitants. Calculating the inci-

dence rates by adding the cases treated in the cities studied to those treated in Brasília resulted in a statistically significant ($p < 0.001$) increase in the mean values of this indicator in all of the cities studied. Thus calculated, the rates ranged from 15.16 to 20.54/100,000 inhabitants (Table 1).

The incidence of TB in the state of Goiás ranged from 15.70 to 18.70/100,000 inhabitants in the period studied. The mean incidence of the cities studied, after adding the cases treated in Brasília, was similar to the statewide values, actually surpassing those rates in 2000 and 2002. In 2000 and 2002, respectively, the state of Goiás presented an incidence rate of 18.5 and 18.6/100,000 inhabitants, compared with 19.7 and 20.6/100,000 inhabitants in the MADF cities studied.

Among the cities studied, Luziânia presented the highest rates of identification of new cases when the cases treated in that city were added to those involving Luziânia residents treated in Brasília. The incidence rate of TB in Luziânia was similar to that found for Goiânia (the state capital) and Aparecida de Goiânia, two cities that are, according to the NMH criteria, considered priority cities for PCT activities (Figure 2). The difference between Luziânia and Goiânia in terms of the incidence rate, was not statistically significant ($p = 0.594$), nor was that between Luziânia and Aparecida de Goiânia ($p = 0.208$).

In some of the cities studied presenting null incidence values at the beginning of the period, the epidemiological profile changed radically when the Brasília data were added. In the year 2000, the city of Águas Lindas, which previously had a null incidence rate, presented an incidence rate of 16.1/100,000 inhabitants. The same occurred in Cristalina, Novo Gama, Padre Bernardo, and Santo Antonio do Descoberto.

The number of contacts investigated in Brasília, including the cases involving residents of Brasília and of Goiás, was 5665, which corresponds to 61% of the established goal of 4 contacts investigated per each of the 2305 patients treated in Brasília, that is, 9220 contacts. According to the data for

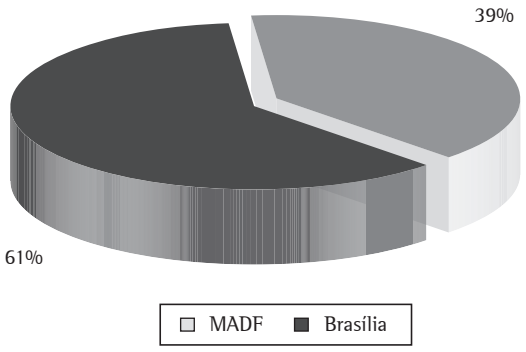

Figure 1 - New cases of TB in residents of the cities studied in the greater metropolitan area of the *Distrito Federal* (MADF, the area encompassing the Federal District) and in the Federal District itself (Brasília), distributed by place of treatment, 2000-2004.

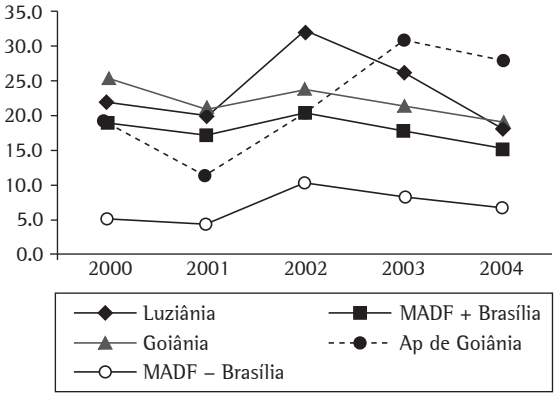

Figure 2 - Distribution of the TB incidence rate in the ten cities studied in the greater metropolitan area of the *Distrito Federal* (MADF, the area encompassing the Federal District) and in the Federal District itself (Brasília), by place of treatment, together with individual incidence rates for the cities of Luziânia, Goiânia, and Aparecida (Ap) de Goiânia, 2000-2004.

Table 1 - Incidence of TB in the cities studied during the 2000-2004 period, distributed by place of treatment.

Year	Resident population	Cases registered		Incidence (per 100,000)		t	p[a]
		MADF – B	MADF + B	MADF – B	MADF + B		
2000	712,047	37	140	5.20	19.66	464.074	< 0.001
2001	750,521	33	132	4.40	17.59	7.708	< 0.001
2002	788,613	79	162	10.02	20.54	344.202	< 0.001
2003	818,423	69	146	8.43	17.84	354.421	< 0.001
2004	883,742	60	134	6.79	15.16	5.313	< 0.001

MADF: cities studied in the greater metropolitan area of the Federal District of Brasília; – B: excluding Brasília; + B: including Brasília; [a]Difference in proportions test considering the incidence in the MADF and in the MADF + B.

Brasília, 80% of the individuals investigated were contacts of patients residing in Brasília. A total of 1133 contacts were not investigated, which includes the residents in the cities studied. However, the rate at which contacts were investigated in these cities was 20% of the established goal. Therefore, it is estimated that 954 contacts were not investigated.

Table 2 shows the data related to the treatment cohort of the cases treated in Brasília and in the cities studied. In Brasília, the outcome was cure in 68.2% of the cases in the cities studied (calculated on the total of cases including other types of outcome: treatment noncompliance, relocation, death, and no information). Of those, 12% were classified as confirmed cure of cases of active TB. Cure was achieved in 71.5% of the cases treated in the MADF, 23.8% of which were confirmed cure of cases of active TB. The rate of cure was significantly higher in Brasília ($p = 0.004$), in contrast to what is observed in relation to the confirmed cure of cases of active TB. In Brasília, as well as in the cities studied, cure rates were below the 85% recommended by the NMH. Even including the percentage of confirmed cure of cases of active TB, we found a mean cure rate of 69.9% for the region as a whole (Brasília and the cities studied). In the period studied, we observed rates of treatment noncompliance higher than the 5% considered acceptable by the NMH: 7.9% in Brasília and 10.4% in the cities studied. This difference was not statistically significant ($p = 0.053$).

The transfer rate of the cases treated in Brasília was 15%, whereas that of those treated in the cities studied was 8.7%, constituting a statistically significant difference ($p = 0.004$). Of the 66 cases involving residents of those cities who sought treatment in Brasília and were classified in SINAN-DF as transferred cases (Table 2), 35 (53.2%) were, according to SINAN-GO, not reported among the cases of the cities where they resided. There was no statistically significant difference ($p = 0.183$) between Brasília and the MADF cities studied in terms of the percentage of cases for which there was no information available (2.5 and 2.7%, respectively). There were no cases of treatment failure among the patients who completed the Regimen 1 treatment. Regarding the mortality rate, there was no significant difference between Brasília and the cities studied, with values of 6.4 and 6.7% ($p = 0.118$), respectively.

The 739 cases included in the treatment cohort exceed the 714 cases of the historic series (2000 to 2004) by 25 cases, since the cohort included the cases that initiated treatment in 1999.

Generally speaking, the socioeconomic indices for the year 2000 in the cities studied were unfavorable when compared to the statewide index for the same year (Table 3). The mean MDHI-income was 0.655 in the MADF cities studied, compared with 0.717 statewide. This index was lower than the statewide index in 60% of the cities, and this difference was statistically significant ($p < 0.05$). Family income was up to 3 times the minimum wages in 57.36% of the families residing in these cities, compared with 49% statewide index for the same year. There was a statistically significant difference when the percentage for each city was compared to the statewide percentage ($p < 0.001$).

In the 2000 census, the demographic data for the cities studied (Table 3) showed a geometric rate of population growth of 6.14%, compared with 2.46% statewide. There was a statistically significant difference in terms of annual population growth, which was greater in all of the cities studied than in the state as a whole ($p < 0.001$). In the cities studied,

Table 2 - Treatment cohort of cases, percentages by place of treatment, in the period from 2000 to 2004.

Type of outcome	Brasília		MADF		p[a]
	n	%	n	%	
Cure	248	56.2	142	47.7	0.004
Confirmed cure of cases of active TB	53	12.0	71	23.8	< 0.001
Treatment noncompliance	35	7.9	31	10.4	0.053
Death	28	6.3	20	6.7	0.118
Relocation	66	15.0	26	8.7	0.004
Treatment Failure	0	0.0	0	0.0	1.000
No information	11	2.5	8	2.7	1.183
Total	441	100.0	298	100.0	-

MADF: cities studied in the greater metropolitan area of the Federal District of Brasília; [a]Fisher's exact test.

Table 3 - Distribution of the socioeconomic and demographic profile of the cities, in 2000.

City	Population	MHDI income	No. of families with an income of up to 3× the minimum wage (%)	Annual growth rate (%)	Migrants in the past 10 years (%)
Águas Lindas de Goiás	105,746	0.610	63.40	14.50	75.00
p[a]		< 0.001	< 0.001	< 0.001	< 0.001
Cidade Ocidental	40,377	0.700	45.00	5.06	42.00
p[a]		0.342	< 0.001	< 0.001	< 0.001
Cristalina	34,116	0.674	64.00	4.82	17.60
p[a]		0.167	< 0.001	< 0.001	< 0.001
Formosa	78,651	0.681	56.00	3.44	11.00
p[a]		0.112	< 0.001	< 0.001	< 0.001
Luziânia	141,082	0.665	59.00	7.23	32.00
p[a]		0.009	< 0.001	< 0.001	< 0.001
Nova Gama	74,380	0.646	59.00	5.32	42.00
p[a]		0.008	< 0.001	< 0.001	< 0.001
Padre Bernardo	21,514	0.623	66.00	6.25	19.00
p[a]		0.040	< 0.001	< 0.001	< 0.001
Planaltina	69,428	0.619	61.30	5.92	34.00
p[a]		0.001	< 0.001	< 0.001	< 0.001
Sto. Antonio do Desc.	51,897	0.600	62.0	2.95	75.0
p[a]		< 0.001	< 0.001	< 0.001	< 0.001
Valparaiso	94,856	0.716	43.50	5.91	47.50
p[a]		0.486	< 0.001	< 0.001	< 0.001
Mean of the cities	71,205	0.655	57.36	6.81	41.99
p[a]		0.485	< 0.001	< 0.001	< 0.001
Goiás (state as a whole)	5,003,228	0.717	49.00	2.46	12.00

MHDI: municipal human development index; [a]Values of p according to the difference in proportions test values between the cities studied and the state of Goiás as a whole.

the mean rate of migration from other states was 35.2% over the past 10 years, compared with 12% statewide, this rates being higher in all of the cities studied, except for the city of Formosa. The overall difference between the MADF cities studied and the state as a whole was statistically significant ($p < 0.001$).

The mean demographic density in the cities studied was 275 inhabitants/km^2, which was 18 times higher than the 15.67 inhabitants/km^2 calculated for the state as a whole. The demographic density in the city of Valparaíso was 1578.01 inhabitants/km^2 in 2000, which is greater than the 1478.05 inhabitants/km^2 calculated for Goiânia.

Discussion

Many residents of the MADF cities work in Brasília, and these cities are therefore characterized as 'bedroom communities'. One of the consequences of this situation is the fact that the number of individuals with TB who seek treatment in Brasília is greater than that reported for the MADF cities studied, affecting the PCT in the state of Goiás as a whole as well as in Brasília.

The situation described above has indirectly affected the quality of the SINAN-GO data. As the SINAN is a 'closed' data collection system undergoing a process of consolidation, the data regarding the patients treated in Brasília cannot yet be accessed in Goiás. However, the cases regarding the notification and investigation forms sent by the SINAN-DF had not been registered at the SINAN-GO up to 2004, since the health units in Brasília were not registered in this database, which is necessary for the registration of the cases of TB. Therefore, the calculation of indicators and goals of the PCT was impaired. In the MADF cities studied, the TB incidence rate was underestimated, as shown by the statistically signifi-

cant alteration of the incidence profile when the cases reported in Brasília were included. This fact affected the calculation of this rate for the state of Goiás as a whole, as well as the planning of the activities of control and surveillance, which depend on the data collection system. In an evaluation of the SINAN-TB by the International Research and Programs Branch of the United States Centers for Disease Control and Prevention,[5] it was concluded that the usefulness of the system was reduced, due to the lack of information regarding the follow-up of the patients, as well as to the lack of feedback at the local and regional level. The limitations of the SINAN-TB have been remarked upon in various studies conducted in Brazil.[2,18,19] However, the importance of this database is undeniable, and the pertinent adaptations carried out by the NMH could solve problems and outstanding issues, making it more efficient.

The particular situation of TB cases involving residents of the MADF being treated in cities other than the city of residence makes it more difficult to manage these cases and their contacts. We observed that, in Brasília, 61% of the contacts of the patients treated, most of whom were residents of the city, were investigated. Therefore, there might have been underdiagnosis of cases of TB among the contacts of the cases of the MADF cities studied, which could have contributed to feed the transmission chain of the disease in the region.

In a study conducted in a city in São Paulo,[20] 263 contacts were registered in the evaluation of the charts of 112 cases of TB. Of those, only 63.1% were evaluated, 36.9% either not being treated or not being registered as having been treated. In a similar study,[21] 181 children and adolescents who were contacts of TB cases were studied. Of those, 41.3% were found to be infected with *Mycobacterium tuberculosis*, and 13.6% were cases of pulmonary TB, 28% of which were asymptomatic. Many other authors have highlighted the need to encourage surveillance of contacts as part of the PCT.[20-22] Since immunity to TB is mediated by cells (macrophages and CD4 T lymphocytes) and not by antibodies, which provide permanent immunity, the existence of an unidentified TB index case will make cure difficult and will favor recurrence among those who are under treatment or were discharged after confirmed cure.[23]

The rate of cure and the rate of treatment noncompliance of the cases involving residents of the cities studied who were treated in Brasília were unfavorable, considering the rates recommended by the NMH and, in part, these results could be related to the fact that the patients with TB were treated in a city other than that in which they resided. In one study,[24] the unfavorable situation of TB indicators in Brasília correlated with the constant population migration to the region. The authors suggest studies that discriminate between the two population groups, residents and nonresidents. When we analyze the percentage of cure of the cases treated in the MADF cities studied, we also observe values below those recommended by the NMH. The opposite situation might have occurred in those residing in the MADF who were treated in the Goiás state health care system and work in Brasília. In both situations, there could have been difficulties in accessing health care facilities and, consequently, an increased rate of treatment noncompliance. It is well known that treatment compliance is essential to therapeutic success and thus to the control of the disease. Other authors[25] evaluated the causes of treatment noncompliance of patients with TB and suggested that the lack of financial resources for food and transportation are contributing factors to treatment noncompliance.

In the treatment cohorts of the cases treated in Brasília and in the cities studied, we observed that the mortality rate during treatment was greater than the 5% maximum predicted by the NMH,[1] suggesting that there was late diagnosis of TB. This situation could have resulted from lack of access to treatment and the rarity of early diagnosis. A study on the deaths of patients with TB in Rio de Janeiro[18] reported a median of 60 days (range, 7-730 days) between the onset of symptoms of the disease and the diagnosis.

There have been no reports of cases of treatment failure, possibly because some of these cases could be included among transferred patients or among those who were noncompliant with treatment. There was a statistically significant difference between the cases involving residents of the cities studied who were treated in Brasília and those involving residents of those cities who were treated in the MADF in terms of the rate of transfer. This could be related, in part, to the fact that the treatment was received in a city other than the city of residence. However, most of these cases were not mentioned in the lists of patients treated in their

cities of residence. Therefore, the patients probably sought treatment at other health care facilities, and thereby, again, encountered difficulties in accessing treatment.

We should take into account the fact that the low number of contacts investigated and unfavorable treatment results in terms of the goals established in the patients treated in the cities studied indicate low effectiveness of the PCT in these cities. The advantages of being treated in the city of residence would be greater if the PCT provided the necessary effectiveness in those cities. However, it must be borne in mind that, in order to achieve treatment effectiveness, patients with TB should be treated in the facility that provides the best treatment conditions, is most convenient to them, and offers the best overall health care. The transfer of case information between health units, within the same state or in different states, would improve the control of contacts and of the epidemiologic surveillance in general, even if, due to labor market demands, the patient were treated out of the city or state of residence.

Various studies have associated TB with low socioeconomic indicators. In one study,[26] it was reported that poor individuals are at a greater risk of infection with TB and of developing the active form of the disease, and that such individuals depend on the quality of TB control programs and on the infrastructure of public health care facilities for treatment. An individual with TB can lose approximately 3 to 4 months of salary,[27] trapped in a vicious cycle of poverty.

Studies on the risk of developing TB mention socioeconomic and demographic factors such as size of the household, number of rooms in the household,[12,14] and close living quarters.[9,13,14] In Pelotas, Brazil,[28] the risk of developing TB is 3.1-times greater in residents living in close quarters, becoming 5.4-times greater when such residents also have an income less than or equal to the minimum wage.

The present study revealed statistically significant differences between the cities studied and the state as a whole, using the 2000 census as a reference, in terms of the socioeconomic and demographic profiles. These differences, in general, indicate levels of poverty and of overcrowding greater than those seen statewide. Between 1991 and 2003, the accumulated annual rate of population growth was greater in the MADF cities studied than in the state as a whole. This trend has continued. The estimate for the year 2003 showed that there are cities in the region with extremely high indices of demographic density: Valparaíso de Goiás, 1779.54 inhabitants/km^2 (higher than that of the capital, Goiânia, which has 1549.86 inhabitants/km^2); Águas Lindas, 690.78 inhabitants/km^2; and Novo Gama, 436.02 inhabitants/km^2. These highly populated areas continue to be magnets for migrants.[6,7] The migratory movement to the cities studied is marked in comparison with that of the state as a whole. Most migrants residing in the cities studied came from states in the northeastern region,[29] where the incidence of TB is among the highest in Brazil.[1] In a study conducted in the state of New Jersey (USA),[9] Hispanic residents were found to be at an increased risk of TB, which correlates with, among other factors, contact with immigrants. One group of authors studied immigrants in the province of Ontario (Canada) and found a high incidence of TB in the country of origin to be a risk factor for TB.[30] By analogy, we can suggest that, in the cities studied in Goiás, migration is one of the factors that explain the relatively high incidence of TB. Other studies are needed in order to confirm or rule out this possibility. According to SEPLAN-GO,[6] the MADF still presents socioeconomic problems and constant migratory movements. Overcrowding continues to increase, as evidenced by the fact that the indices of demographic density and population growth remain high.[17]

Considering the studies mentioned, the socioeconomic and demographic data of the cities studied are consistent with even higher incidence rates than those found in this evaluation, which could affect the use of the prioritization criteria of the cities for the activities of the PCT, since they are close to the mean incidence of the cities that are priorities for the PNCT. However, considering the prioritization criteria recommended by the NMH in 2004,[1] none of the MADF cities studied were considered a priority. Criteria are based on data that depend on the data collection system that, however, led to an unrealistic incidence rate. Among the MADF cities studied, considering the incidence of TB and the factors that facilitated the occurrence of the disease, the cities which should be a priority for the PCT are Valparaíso, Luziânia, Águas Lindas, and Novo Gama.

In order to assess the impact that the MADF cities have on the TB situation in the state of Goiás, it is necessary to weigh the risk factors for TB that are inherent to the region. This assessment also depends on the greater efficiency of the surveillance system and of the registration of cases in the SINAN-TB, as well as on the exchange of information among the states and Brasília, so that all cases, especially those involving residents of one region who are treated in another, can be duly registered. Given the immensity of the Brazilian territory, it is possible that other situations like that seen in the MADF exist along state borders, as well as in the greater metropolitan areas of other large cities.

Some aspects mentioned in this study, such as the need for a territory-based surveillance system, are in accordance with the ideas of other authors.[2,13] On group of authors stated that the health surveillance system should be built within defined bases of at-risk populations, as well as in areas or situations of high risk. We propose the use of socioeconomic and demographic factors in the mapping of high-risk areas in order to integrate those factors into the health-related information.

The results of this study allows us to conclude that the number of cases of TB among residents of the cities studied, treated in their own cities, was below what was expected and that the treatment of these cases in cities other than the city of residence can reduce the efficiency of TB control in the MADF as a whole, as well as in Brasília itself.

In addition, we can conclude that the incidence of TB was underestimated in the cities studied. This recalculated indicator, including the cases treated in Brasília, is more consistent with the socioeconomic and demographic profile of the region, which facilitates the occurrence of the disease.

Based on the results of the present study, we can suggest that the implementation of activities and measures to ensure the efficiency of the PCT in the region should proceed in a systematic and continuous manner. It addition, it can be inferred that the SINAN-TB and the Epidemiological TB Surveillance System, which facilitate the planning of activities designed to control of the disease, need to be reviewed and constantly updated. Using data from data collection systems that take socioeconomic and demographic factors into account could serve to optimize the efficiency of a territory-based TB surveillance system, which would have a positive effect of the control of the disease.

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