

# Equity in health: tuberculosis in the Bolivian immigrant community of São Paulo, Brazil

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## Abstract

**OBJECTIVES** To analyse the profile of tuberculosis (TB) among Bolivian immigrants, investigate the impact that this population has on the trends of TB and assess equity in access to TB treatment, in the city of São Paulo, Brazil.

**METHODS** Descriptive study of the epidemiological profile of TB in four city districts with large Bolivian populations, comparing cases among Brazilians and Bolivians, during the 1998–2008 period was carried out. We used logistic regression to adjust the treatment outcome for potential confounders.

**RESULTS** We identified 2056 new TB cases: 65.7% in Brazilians, 32.1% in Bolivians and 2.2% among other nationalities. Although TB incidence remained stable (high) over the study period, the annual proportion of cases among Bolivians increased from 15.0% to 53.0%. In comparison with the Brazilians, the Bolivians were younger (median age, 24 *vs.* 40 years;  $P < 0.0001$ ) and presented a lower unemployment rate (3.1% *vs.* 11.6%;  $P < 0.0001$ ), a lower rate of HIV co-infection (1.5% *vs.* 28.5%;  $P < 0.001$ ), a higher proportion of individuals receiving supervised treatment (81.5% *vs.* 62.0%;  $P < 0.0001$ ) and a higher proportion of cures (71.6% *vs.* 63.2%;  $P < 0.0001$ ). After having been adjusted for potential confounder, cure after treatment was not associated with nationality.

**CONCLUSIONS** Bolivian immigrants influenced the incidence but not the trends of TB among Brazilians in the study area. We found no significant differences between Bolivians and Brazilians regarding healthcare access or treatment outcome. Guaranteed universal health care access for all, including undocumented individuals, contributes to health equity. Specific intervention strategies are warranted for immigrants with tuberculosis.

**keywords** tuberculosis, Latin-American immigrants, epidemiology, health equity, public policies

## Introduction

In recent decades, population movements have been a recurrent cause for concern among international organisations, because such movements have economic and social consequences, as well as having an impact on public health (Aagaard-Hansen *et al.* 2010). It has been estimated that 190 million people emigrate annually; of those, 40% move to neighbouring countries (Carballo & Nerukar 2001; Vázquez *et al.* 2011). This population is characterised as vulnerable from a socio-economic and health standpoint, because of poor living/working conditions, illegal immigrant status, language barriers and cultural barriers (Stronks *et al.* 2001). Therefore, migration has become a focus of socio-economic development plans and specific public policies to integrate immigrants into the host society (Vázquez *et al.* 2011).

Migration also constitutes a major public health challenge because it creates an unforeseen demand for health

care and because it changes the epidemiological profile of the host country (Carballo & Nerukar 2001). In recent decades, population movements from regions where tuberculosis (TB) is hyperendemic have been associated with resurgence of the disease in various countries (Gilbert *et al.* 2009).

Some Brazilian state capitals, especially the city of São Paulo, have received, since the 1990s, an increasing number of immigrants from countries in South America, Africa and Asia (Patarra 2005). However, no studies have consistently estimated the size and characteristics of immigrant communities. Most immigrants are undocumented and are therefore excluded from official statistics. Although imprecise, the available data indicate that the Bolivian community is the largest of all of the communities of immigrants who have recently arrived in the city of São Paulo (Patarra & Baeninger 2006).

The high TB incidence in Bolivia (WHO 2009) and the lack of published data regarding the impact that the

Bolivian immigration has on the epidemiological profile of the disease in the city of São Paulo warrant an exploratory study of the issue. The objectives of this study were to describe the profile of TB among Bolivian immigrants residing in four districts in the city of São Paulo, Brazil, and to determine the impact of the Bolivian community on TB trends in the study area, as well as to investigate possible disparities between Brazilians and Bolivian immigrants regarding access to health care and the quality of the treatment provided.

## Material and methods

### Study area and population

This study was conducted in the city of São Paulo, which is the largest urban area in Brazil, comprising 10 million inhabitants. In the 20th century, the growth of São Paulo was initially influenced by migration flows from Europe and Asia (Patarra 2005; Da Silva 2006) subsequent growth was driven by internal migration, primarily from the north-eastern region of the country (Patarra 2005).

The exact number of Bolivians currently living in the city of São Paulo is unknown, available estimates ranging from 70 000 to 200 000 (Cymbalista & Xavier 2007). Although Bolivian immigrants in São Paulo are distributed throughout 19 of the 91 city districts, they are principally concentrated in four districts (Da Silva 2006) – Belém, Brás, Bom Retiro and Pari – that constituted the study area. The numbers of Bolivians residing in each of the four districts have yet to be estimated.

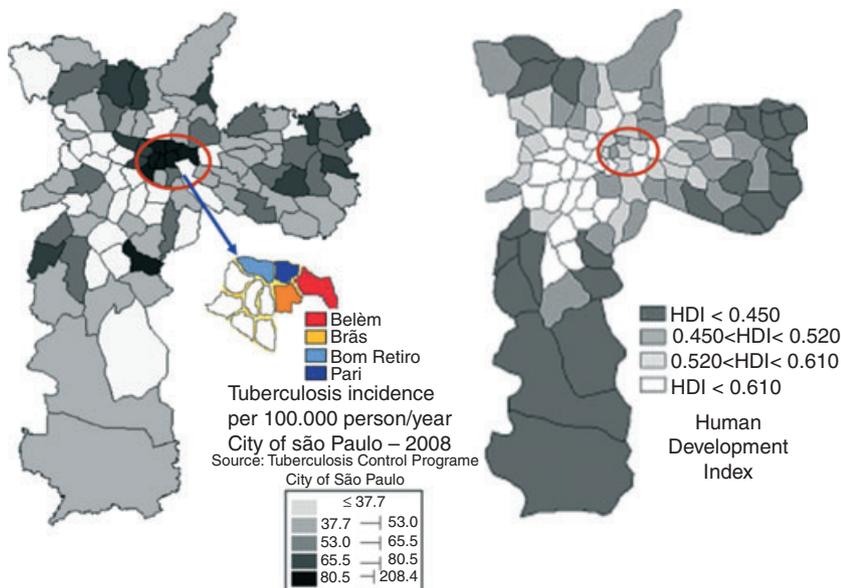
In the study area, the total population is 110 000 inhabitants; the number of inhabitants per district ranges from 16 000 to 37 000; lower-middle-class families predominate; and the Human Development Index ranges from 0.484 to 0.612, lower than the 0.841 reported for the city as a whole (São Paulo 2002).

Although TB incidence rates are high in the city of São Paulo, they dropped from 65/100 000 population in 1998 to 53/100 000 population in 2008. However, in the four districts under study, those rates have remained stable, at over 149/100 000 population, making them among the highest in the city (Figure 1).

The study period was from 1 January 1998 to 31 December 2008. The study sample comprised all new cases of TB among residents of the four districts under study. We included only TB cases reported to and confirmed by the TB surveillance in the city of São Paulo.

We defined TB cases as those in which the clinical profile was consistent with TB and the diagnosis had been confirmed by sputum smear microscopy or by isolation of *Mycobacterium tuberculosis* in sputum culture, or those in which the clinical profile was consistent with TB and the chest X-ray findings were suggestive of or the histopathological findings were consistent with the diagnosis.

The data source was the São Paulo City Tuberculosis Control Programme. The database files for the 1998–2008 period were saved as Epi Info, version 4.0, files and converted to files compatible with the Statistical Package for the Social Sciences, version 15.0 (SPSS Inc., Chicago,



**Figure 1** Map of the city of São Paulo. Administrative districts under study.

IL, USA). Duplicate entries were eliminated, and data consistency was analysed.

The variables of interest were as follows: socio-demographical variables (gender, age, nationality, occupation, level of education and number of household contacts); variables related to the diagnosis, clinical features and treatment of TB (time elapsed between symptom onset and treatment initiation, clinical presentation, type of treatment and outcome); and comorbidities (diabetes, HIV infection, alcoholism and mental illness).

The study design was approved by the Research Ethics Committees of the University of São Paulo School of Public Health.

### Data analysis

We initially determined the profile of TB between 1998 and 2008 by estimating the annual incidence of the disease in the four districts as a whole, using the total number of new TB cases reported each year as the numerator and the estimated population for each year at mid-year (July 1) as the denominator. Because the total number of Bolivian immigrants residing in the study area was unknown, we evaluated the influence of Bolivian immigrants on the profile of TB in the study area by analysing the proportion of reported cases among Bolivians, Brazilians and individuals of other nationalities in the period of interest.

The number of Bolivian immigrants increased progressively over the study period, and that increase was accelerated in recent years. Therefore, we chose to compare Brazilians and Bolivians, in terms of the characteristics of TB, only for the 2006–2008 period. For categorical variables, we used Pearson's chi-square test and Fisher's exact test. For continuous variables, we used the Kruskal–Wallis test.

As a proxy measure of access to health care, we used the time elapsed between symptom onset and treatment

initiation. As a proxy measure of the quality of the treatment provided, we used the proportion of contacts examined, together with the cure rates.

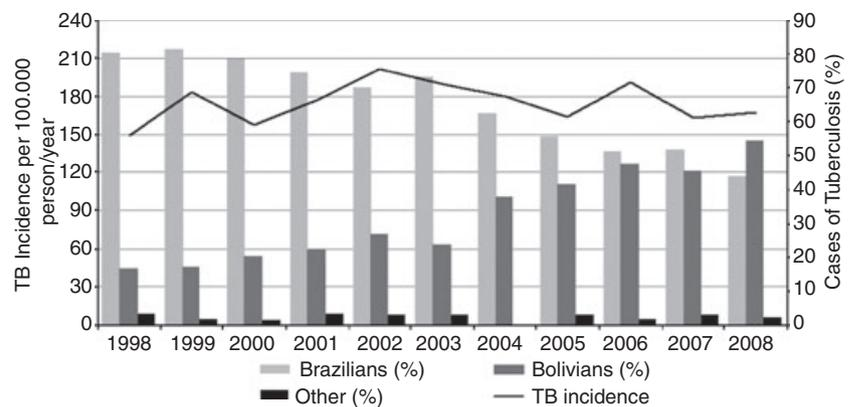
To investigate whether nationality was independently associated with cure, we used multiple logistic regression to adjust the odds ratio (OR) of the outcome of interest (cure) for potential confounders (gender, age, type of treatment (self-administered and supervised) and HIV co-infection).

### Results

Between 1998 and 2008, 2056 new TB cases were reported in the study area. Of those, 1351 (65.7%) occurred among Brazilians, 660 (32.1%) occurred among Bolivians, and 45 (2.2%) occurred among individuals of other nationalities. From 1998 to 2008, the annual proportion of TB cases among Bolivians increased from 15.0% to 53.0%. In addition, while the number of new TB cases among Brazilians decreased by 40.5%, the number of new TB cases among Bolivians increased by 260.0% (Figure 2). The mean annual TB incidence rates in the study area ranged from 149.1/100 000 population in 1998 to 167.2/100 000 population in 2008 (Figure 2).

Between 2006 and 2008, 557 new TB cases were reported in the study area. Of those, 272 (48.8%) occurred among Brazilians, 273 (49.0%) occurred among Bolivians, and 12 (2.2%) occurred among individuals of other nationalities.

Table 1 shows that the median age was higher among Brazilians than among Bolivians (40 *vs.* 24 years;  $P < 0.0001$ ). The proportion of men was also higher among Brazilians (73.5% *vs.* 61.9%;  $P < 0.0001$ ), as was the proportion of unemployed individuals (11.6% *vs.* 3.1%;  $P < 0.0001$ ). There are no differences among Brazilians and Bolivians in the level of education; the district of Belem had the higher proportion of TB among Bolivians. The TB patients with HIV co-infection were



**Figure 2** Annual incidence of tuberculosis, for all forms and cases of the disease, by nationality, in the districts of Belém, Bom Retiro, Brás and Pari, in the city of São Paulo, Brazil (1998–2008).

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Characteristic	Nationality		Total ( <i>n</i> = 545†) <i>n</i> (%)	<i>P</i> *
	Brazilian ( <i>n</i> = 272†) <i>n</i> (%)	Bolivian ( <i>n</i> = 273†) <i>n</i> (%)		
Gender				
Female	72 (26.5)	104 (38.1)	176 (32.2)	0.004
Male	200 (73.5)	169 (61.9)	369 (67.7)	
Age group				
<15 years	7 (2.6)	15 (5.5)	22 (4.1)	<0.0001
15–29 years	60 (22.1)	204 (75.0)	264 (48.6)	
30–39 years	62 (22.9)	41 (15.1)	103 (19.0)	
40–49 years	63 (23.2)	4 (1.5)	67 (12.3)	
≥50 years	79 (29.2)	4 (2.9)	87 (16.0)	
Median age (years)	40.0	24.0		<0.0001
Level of education				
0 years of schooling	4 (3.3)	5 (3.7)	9 (3.5)	0.412
1–4 years of schooling	19 (15.4)	22 (16.4)	41 (16.0)	
4–8 years of schooling	49 (39.8)	64 (47.8)	113 (44.0)	
9–12 years of schooling	41 (33.3)	30 (22.4)	71 (27.6)	
>12 years of schooling	10 (8.1)	13 (9.7)	23 (8.9)	
Employment status				
Employed	189 (78.1)	242 (94.5)	431 (86.5)	<0.0001
Unemployed	28 (11.6)	8 (3.1)	36 (7.2)	
Homemaker	15 (6.2)	5 (2.0)	20 (4.0)	
Retired	10 (4.1)	1 (0.4)	11 (2.2)	
District of residence				
Pari	36 (13.2)	26 (9.5)	62 (11.4)	0.01
Bom Retiro	69 (25.4)	68 (24.9)	137 (25.1)	
Brás	87 (32.0)	64 (23.4)	151 (27.7)	
Belém	80 (29.4)	115 (42.5)	195 (35.5)	
HIV/AIDS				
No	143 (71.5)	198 (98.5)	341 (85.0)	<0.001
Yes	57 (28.5)	3 (1.5)	60 (15.0)	
Diabetes				
No	260 (95.6)	269 (98.5)	529 (97.1)	0.04
Yes	12 (4.4)	4 (1.5)	16 (2.9)	
Alcoholism				
No	230 (84.6)	266 (97.4)	496 (91.0)	<0.0001
Yes	42 (15.4)	7 (2.6)	49 (9.0)	
Mental illness				
No	268 (98.5)	273 (100.0)	541 (99.3)	0.04
Yes	4 (1.5)	0 (0)	4 (0.7)	

\*Values of *P* represent comparisons between the two nationalities.

†In some cases, there were no data available for a given characteristic.

higher among Brazilians than among Bolivians (28.5% *vs.* 1.5%; *P* < 0.001), as were the prevalence of alcoholism (15.4% *vs.* 2.6%; *P* < 0.0001), the prevalence of diabetes (4.4% *vs.* 1.5%; *P* = 0.04) and the prevalence of mental illness (1.5% *vs.* 0.0%; *P* = 0.04).

The predominant clinical form was pulmonary TB, which was seen in 80–86% of the cases, and there was no significant difference between Brazilians and Bolivians in terms of this aspect (*P* > 0.05). As can be seen in Table 2,

there were no significant differences between Brazilians and Bolivians regarding the time elapsed between symptom onset and treatment initiation (*P* > 0.05); however, the proportion of patients who underwent supervised treatment was higher among Bolivians (81.5% *vs.* 62.0%; *P* < 0.0001). The proportions of patients diagnosed at primary healthcare facilities were 63.3% and 42.1% among the Bolivians and the Brazilians, respectively, whereas the proportions of patients treated at such

**Table 1** New cases of tuberculosis among Brazilians and Bolivians, by socio-demographical characteristic and comorbidities, in the districts of Belém, Bom Retiro, Brás and Pari, in the city of São Paulo, Brazil (2006–2008)

**Table 2** New cases of tuberculosis among Brazilians and Bolivians, by characteristic related to diagnosis/treatment, in the districts of Belém, Bom Retiro, Brás and Pari, in the city of São Paulo, Brazil (2006–2008)

Characteristic	Nationality		Total ( <i>n</i> = 545†)	<i>P</i> *
	Brazilian ( <i>n</i> = 272†)	Bolivian ( <i>n</i> = 273†)		
Time from symptom onset to treatment initiation				
≤4 weeks	72 (54.5)	100 (62.9)	172 (59.1)	>0.05
5–8 weeks	32 (24.2)	23 (14.5)	55 (18.9)	
9–12 weeks	15 (11.4)	21 (13.2)	36 (12.4)	
>12 weeks	13 (9.8)	15 (9.4)	28 (9.6)	
Type of treatment				
Supervised	103 (62.0)	185 (81.5)	288 (73.3)	<0.0001
Self-administered	63 (38.0)	42 (18.5)	105 (26.7)	
Treatment outcome‡				
Cure	153 (63.2)	174 (71.6)	327 (67.4)	<0.0001
Abandonment	50 (20.7)	39 (16.0)	89 (18.4)	
Transfer	1 (0.4)	23 (9.5)	24 (4.9)	
Death from tuberculosis	12 (5.0)	3 (1.2)	15 (3.1)	
Death from HIV	26 (10.7)	4 (1.6)	30 (6.2)	
Place of diagnosis				
Primary healthcare clinic	110 (42.1)	162 (63.3)	272 (52.6)	<0.0001
Emergency room	79 (30.3)	54 (21.1)	133 (25.7)	
Hospital	57 (21.8)	30 (11.7)	87 (16.8)	
Other	15 (5.8)	10 (3.9)	25 (4.8)	
Place of treatment				
Primary healthcare clinic	118 (43.5)	196 (72.1)	314 (72.1)	<0.0001
Outpatient clinic	96 (35.4)	58 (21.3)	154 (28.4)	
Hospital	57 (21.0)	18 (6.6)	75 (13.8)	
Mean number of contacts per TB case				
	1.8	4.4		<0.0001
Household contacts				
	437 (27.0)	1182 (73.0)	1619 (100%)	
Household contacts examined				
Yes	282 (64.5)	719 (60.8)	1001 (61.8)	>0.05
No	155 (35.5)	463 (39.2)	618 (38.2)	

\*Values of *P* represent comparisons between the two nationalities.

†In some cases, there were no data available for a given variable.

‡There were no cases registered for treatment failure.

facilities were 72.1% and 43.5%, respectively ( $P < 0.0001$  for both). Comparing Bolivians and Brazilians, we found that the former showed higher proportion of cure rates (71.6% *vs.* 63.2%;  $P < 0.0001$ ). In addition, the rates of all unfavourable outcomes were lower among the Bolivians than among the Brazilians: treatment abandonment (16.0% *vs.* 20.7%;  $P < 0.0001$ ), deaths from TB (1.2% *vs.* 5.0%;  $P < 0.001$ ) and deaths from other causes (1.6% *vs.* 10.7%;  $P < 0.001$ ). There were no documented cases of treatment failure.

As shown in Table 2, the mean number of contacts per patient was higher among Bolivians than among Brazilians (4.4 *vs.* 1.8;  $P < 0.0001$ ). The total number of contacts was 1182 among the Bolivian patients – 719 (60.8%) of those 1182 had been examined – compared with 437 among the Brazilian patients – 282 (64.5%) of those 437 had been examined. The difference between Bolivians and

Brazilians regarding the proportion of contacts examined was not significant ( $P > 0.05$ ). Among the contacts examined, new cases of TB were identified in 2 (0.7%) of the 282 Brazilians and 13 (1.8%) of the 719 Bolivians.

Bivariate analysis (Table 3), using Brazilians as the category of reference, revealed a positive association between cure and being Bolivian (crude OR = 2.2; 95% CI: 1.4–3.3). However, that association did not remain statistically significant when we adjusted simultaneously for gender, age, type of treatment and HIV co-infection (adjusted OR = 1.0; 95% CI: 0.4–2.5).

## Discussion

The study area is located in the oldest sector of the city of São Paulo. Although there is ample access to public transportation, schools and health care in those districts,

Characteristic	Cure after treatment		OR crude (95% CI)	OR adjusted (95% CI)
	No ( <i>n</i> = 134*) <i>n</i> (%)	Yes ( <i>n</i> = 327*) <i>n</i> (%)		
Gender				
Female	36 (26.9)	117 (35.8)	1	1
Male	98 (73.1)	210 (64.2)	0.7 (0.4–1.0)	0.4 (0.2–1.1)
Age group				
<15 years	2 (1.5)	15 (4.6)	1	1
15–29 years	54 (40.3)	161 (49.5)	0.4 (0.1–1.7)	1.7 (0.2–16.1)
30–39 years	20 (14.9)	68 (20.9)	0.4 (0.1–1.9)	1.2 (0.1–12.5)
40–49 years	24 (17.9)	34 (10.5)	0.2 (0.1–0.8)	0.8 (0.1–9.6)
≥50 years	34 (25.4)	47 (14.5)	0.2 (0.1–0.8)	1.2 (0.1–13.4)
HIV/AIDS				
Yes	30 (38.0)	23 (8.8)	1	1
No	49 (62.0)	238 (91.2)	6.3 (3.4–11.8)	5.3 (2.0–14.2)
Type of treatment				
Self-administered	28 (41.8)	64 (23.7)	1	1
Supervised	39 (58.2)	206 (76.3)	2.3 (1.3–4.0)	1.5 (0.6–3.2)
Nationality				
Brazilian	88 (65.7)	153 (46.8)	1	1
Bolivian	46 (34.3)	174 (53.2)	2.2 (1.4–3.3)	1.0 (0.4–2.5)

\*In some cases, there were no data available for a given variable.

living conditions have deteriorated in recent decades, which have led to a worsening of the social, economic and health indicators (Ferreira *et al.* 2006). It should be highlighted that even when the number of Bolivian immigrants in those districts was low, the TB incidence was higher there than in the city as a whole.

Two of the findings of the present study are relevant to public health. One is that Bolivian immigrants have influenced the incidence of TB, as evidenced by the rapid increase (in absolute and relative values) of TB among Bolivians immigrants, without affecting the trends of TB or its characteristics in the districts under study, as evidenced by the consistent decrease in the number of TB cases among Brazilians. Nevertheless, considering the mean number of contacts per patient and the proportion of cases identified among contacts were far higher among Bolivians than among Brazilians, together with the fact that the number of Bolivian immigrants is increasing, shows that in the city of São Paulo, we perceive a potential risk of the resurgence of TB, whose occurrence in other countries has been attributed to immigration (Gilbert *et al.* 2009).

Our results show that migration from countries where the TB incidence is high can have a major impact on host cities, even cities such as São Paulo, where the TB incidence is already far higher than is that reported for large cities in developed countries (Iñigo *et al.* 2007; Gilbert *et al.* 2009). One aspect that merits attention is the possibility of a change in the pattern of TB transmission as a result of such

migration flows, a phenomenon reported in studies conducted in developed countries receiving immigrants from hyperendemic areas (Iñigo *et al.* 2007). Investigations conducted in those countries showed that immigrants rarely become infected after having arrived in the host country, which is evidence that infection occurs before their arrival, that is, in their country of origin (Dahle *et al.* 2001). Although the risk of developing a disease is higher during the first years following emigration, it can remain high for longer when the country of origin is highly endemic (Lillebaek *et al.* 2002; Vos *et al.* 2004). However, studies conducted in developed countries, using epidemiological data and DNA genotyping, suggest that immigration from hyperendemic areas has no significant influence on the pattern of TB transmission within the host country population. Nevertheless, that could be attributed to limited contact between the two populations and to the good performance of immigrant-screening programmes targeting TB (Dahle *et al.* 2007; Barniol *et al.* 2009). Those issues are relevant to the development of new control strategies and require further investigation in the context of a large Brazilian city, where the risk of TB infection is far higher than is that reported for developed countries.

Another noteworthy finding of the present study is the equity in access to health care and in the quality of the treatment provided. This equity was evidenced by the lack of differences between Brazilians and Bolivians regarding the time elapsed between symptom onset and treatment

**Table 3** Association between cure after tuberculosis treatment and nationality after adjusted by sex, age, co-infections TB/HIV and type of treatment. Districts of Belém, Bom Retiro, Brás and Pari, in the city of São Paulo, Brazil (2006–2008)

initiation, as well as the proportions of patients who received home visits, patients who were cured and patients whose outcome was unfavourable (treatment abandonment or death). The most striking finding was that the proportion of patients submitted to supervised treatment was higher among the Bolivians than among the Brazilians.

These results suggest that, even in the absence of public health policies targeting immigrants, the guarantee of universal access to free health care – one of the cornerstones of the Brazilian public health system – promotes equity in health (Menicucci 2009; Guanais 2010). It is possible that the changes made by the Brazilian National Tuberculosis Control Programme in the last decade, which strengthened the role of municipal primary health care (Hijjar *et al.* 2007), have increased the effectiveness of the programme in vulnerable populations.

The fact that Bolivian immigration in São Paulo typically results from labour migration (Patarra & Baeninger 2006; Cymbalista & Xavier 2007) largely explains the differences between Bolivian and Brazilian patients regarding their socio-demographical profile. In our study, we found that the Bolivians were far younger than the Brazilians, the proportion of women being higher and unemployment rates being lower among the Bolivians, although the level of education was comparable between the two populations. In general, similar characteristics were observed among immigrants with TB in Madrid, Spain and most of whom were from South or Central America (Iñigo *et al.* 2007).

Unlike TB among Bolivians, TB among Brazilians has the characteristics of TB in areas of moderate endemicity. The disease primarily affects individuals at a more advanced age (Chaimowicz 2001), which can partially explain the higher prevalence of comorbidities, especially diabetes, among Brazilians in the present study. In contrast, the low prevalence of HIV co-infection among the Bolivians with TB in the present study was probably due to the incidence of AIDS in Bolivia, which is among the lowest in the Americas (USAID Bolivia 2008).

Our results should be interpreted in view of the fact that they reflect the situation only in the four districts under study and not in the city of São Paulo as a whole. In addition, the quite real possibility that there are undocumented Bolivians in São Paulo who are subject to abusive working conditions should be taken into consideration. The situation in which those immigrants live might prevent them from seeking medical assistance, which would represent a bias in the present study. In 2009, the Brazilian government signed an amnesty bill affecting workers from countries that are members of the Southern Common Market, as well as of those from Chile and Bolivia,

allowing illegal immigrants to seek legalisation (Brasil 2010).

The limitations of passive surveillance itself – especially under-reporting – and the lack of data regarding immigrant populations should also be taken into consideration because it prevents us from estimating the risk of TB among Bolivian immigrants.

Despite the aforementioned limitations, the results of the present study are consistent with those in the literature (Gilbert *et al.* 2009) and are therefore useful for the formulation of public policies, as well as for the planning of interventions. Our results indicate the need for demographic censuses, and national surveys should include specific questions regarding immigration. Furthermore, intersectoral public policies are required to facilitate the integration of immigrants into Brazilian society. The results of the present study underscore the need for evaluating the advantages and disadvantages of screening programmes for immigrants from countries where TB is hyperendemic, to identify and treat individuals with latent TB infection.

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#### References

- Aagaard-Hansen J, Nombela N & Alvar J (2010) Population movement: a key factor in the epidemiology of neglected tropical diseases. *Tropical Medicine and International Health* **15**, 1281–1288.
- Barniol J, Niemann S, Louis VR *et al.* (2009) Transmission dynamics of pulmonary tuberculosis between autochthonous and immigrant sub-populations. *BMC Infectious Diseases* **9**, 197.
- Brasil (2010) *Ministério do Trabalho e Emprego. Autorização de trabalho a profissionais estrangeiros no Brasil. Legislação Base.* Ministério do Trabalho e Emprego, Brasília, 10.
- Carballo M & Nerukar A (2001) Migration, refugees, and health risks. *Emerging Infectious Disease* **7** (3 Suppl.), 556–560.
- Chaimowicz F (2001) Age transition of tuberculosis incidence and mortality in Brazil. *Revista de Saúde Pública* **35**, 81–88.
- Cymbalista R & Xavier IR (2007) A comunidade boliviana em São Paulo: definindo padrões de territorialidade. *Cadernos Metrópole* **2**, 119–133.
- Da Silva AS (2006) Bolivianos em São Paulo: entre o sonho e a realidade. *Estudos Avançados* **20**, 157–170.

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- Dahle UR, Sandven P, Heldal E & Caugant DA (2001) Molecular epidemiology of *Mycobacterium tuberculosis* in Norway. *Journal of Clinical Microbiology* **39**, 1802–1807.
- Dahle UR, Eldholm V, Winje BA, Mannsaker T & Heldal E (2007) Impact of immigration on the molecular epidemiology of *Mycobacterium tuberculosis* in a low-incidence country. *American Journal of Respiratory Critical Care Medicine* **176**, 930–935.
- Ferreira MP, Dini NP & Ferreira SP (2006) Espaços e dimensões da pobreza nos municípios do Estado de São Paulo: Índice Paulista de Vulnerabilidade Social – IPVS. *São Paulo em Perspectiva* **20**, 5–17.
- Gilbert RL, Antoine D, French CE, Abudakar I, Watson JM & Jones JA (2009) The impact of immigration on tuberculosis rates in the United Kingdom compared with other European countries. *International Journal of Tuberculosis and Lung Disease* **13**, 645–651.
- Guanais FC (2010) Progress in a land of extremes. *British Medical Journal* **341**, 1198–1201.
- Hijjar MA, Gerhardt G, Teixeira GM & Procópio MJ (2007) Retrospecto do controle da tuberculose no Brasil. *Revista de Saúde Pública* **41** (Suppl. 1), 50–58.
- Iñigo J, Viedma DG, Arce A *et al.* (2007) Analysis of changes in recent tuberculosis transmission patterns after a sharp increase in immigration. *Journal of Clinical Microbiology* **45**, 63–69.
- Lillebaek T, Andersen AB, Dirksen A, Smith E, Skovgaard LT & Kok-Jensen A (2002) Persistent high incidence of tuberculosis in immigrants in a low-incidence country. *Emerging Infectious Disease* **8**, 679–684.
- Menicucci TMG (2009) O Sistema Único de Saúde, 20 anos: balanços e perspectivas. *Cadernos de saúde pública* **25**, 1620–1625.
- Patarra NL (2005) Migrações internacionais de e para o Brasil contemporâneo: volumes, fluxos, significados e políticas. *São Paulo em Perspectiva* **19**, 23–33.
- Patarra NL & Baeninger R (2006) Mobilidade espacial da população no MERCOSUL: metrópoles e fronteiras. *Revista Brasileira de Ciências Sociais* **21** (Suppl. 60), 84–181.
- São Paulo (2002) Secretaria de Desenvolvimento, Trabalho e Solidariedade do Município de São Paulo. Desigualdade em São Paulo: IDH. Prefeitura do Município de São Paulo, São Paulo, 1–12.
- Stronks K, Ravelli A & Reijneveld AS (2001) Immigrants in the Netherlands: equal access for equal needs? *Journal of Epidemiology and Community Health* **55**, 701–707.
- USAID (2008) HIV-AIDS health profile – Bolívia. <http://bolivia.usaid.gov/> [Accessed 15 December 2009].
- Vázquez ML, Terraza-Núñez R, Vargas I & Rodrigues D (2011) Health policies for migrant population in three European countries: England; Italy and Spain. *Health Policy* **101**, 70–78.
- Vos AM, Meima A, Verver S *et al.* (2004) High incidence of pulmonary tuberculosis persists a decade after immigration, the Netherlands. *Emerging Infectious Disease* **10**, 736–739.
- WHO Report (2009) *Global tuberculosis control: epidemiology, strategy, financing*. WHO, Geneva.

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