Articles

Epidemiology of laboratory confirmed tuberculosis in Victoria, 1990 to 2004

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Abstract

In Australia, most cases of tuberculosis (TB) occur in migrants. To inform control strategies for this group, we investigated all laboratory confirmed tuberculosis cases diagnosed by the State TB reference laboratory in Victoria between 1990 and 2004. The laboratory data were matched to notification data to determine country of birth and a multivariate model was constructed to compare Australian and non-Australian-born patients. The proportion of non-Australian-born cases increased over the period of the study and a shift in cases from South East Asia to African countries was observed. Non-Australian-born cases were more likely to be young, female, have extrapulmonary disease and show first line TB drug resistance. The shift in country of birth of TB cases in Victoria reflects migration patterns and the corresponding epidemiology of TB in the country of origin of these migrants. Ongoing migration from countries with high TB incidence raises the question whether it is possible to eliminate TB from Australia and new control strategies should be considered. *Commun Dis Intell* 2008;32:237–241.

Keywords: tuberculosis, migrants, country of birth, incidence

Introduction

A third of the world's population is currently infected with tuberculosis (TB). An estimated 8 million new cases of TB disease and 2 million TB deaths occur every year.[1] Similar to other developed countries,[1] Australia has a low annual estimated incidence of TB, at 5–6 cases per 100,000 population.[2] Most TB cases in Australia now occur in people born in other countries, with the rate for non-Australian-born cases in 2005 being more than twenty times that of the non-Indigenous Australian-born national rate (20.6 cases per 100,000 population compared with 0.8 cases per 100,000 population respectively).[2] Control of TB in Australia is facilitated through entry screening of migrants using a chest x-ray and contact tracing people with active TB.[3]

The aim of this study was to investigate the population-based rate of laboratory confirmed TB in Victoria for the period 1990 to 2004. The characteristics of the non-Australian-born cases were also investigated to inform control strategies for this group.

Methods

Any person residing in Victoria between 1990 and 2004 with a laboratory confirmed diagnosis of TB was eligible for this study. Data were obtained from the Victorian Infectious Diseases Reference Laboratory (VIDRL), the state TB reference laboratory. Cases were matched against notification data of the Department of Human Services (DHS) to obtain further demographic details, including country of birth, using a purpose built Access database. Matches were made using combinations of name, date of birth, postcode and onset date fields. Of the 2,608 laboratory records included in the match (583 had this data already and were not included), 2,351 (90.1%) were matched to DHS notifications. The total number of TB notifications for the years 1990 to 2004 was also provided by DHS. The time between arrival in Australia and diagnosis of TB has been addressed in a separate study[4] and HIV status was unable to be analysed as it is not routinely collected by DHS. Given that TB is a notifiable disease in Victoria and analysing surveillance data is a core function of public health, ethics approval was not required.

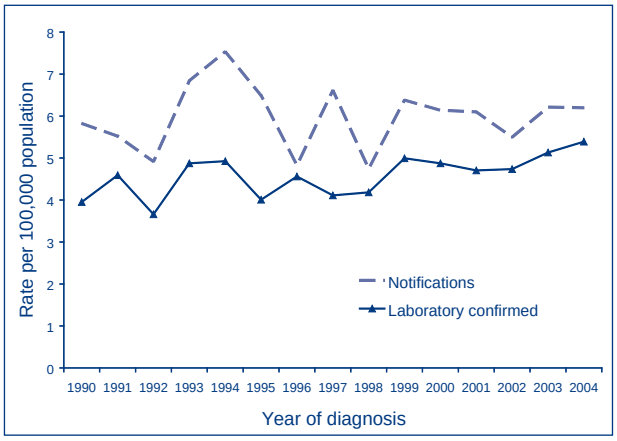
Region of birth categories, the Victorian population and population by country of birth were obtained from the Australian Bureau of Statistics.[5] As population by country of birth was available for census years only (1991, 1996 and 2001), data were analysed in three 4 year groups: 1990–1993, 1994–1998 and 1999–2003. Tests for trend were conducted using Poisson regression for notification and laboratory confirmed rates and linear regression for proportions. A categorical logistic regression model was constructed to compare Australian and non-Australian-born cases. Factors that were associated at the univariate level ($p<0.10$) were included in the model. Variables examined in the model were year of diagnosis, age-group, gender, clinical site (pulmonary or extra-pulmonary), drug resistance and country of birth. Country of birth information was incomplete in the DHS database for cases from 1996 and 1997 (43% unknown, compared to 9% for all other years, $p<0.001$). We therefore chose to

exclude these 2 years from the analysis; although the trend of the proportion of overseas-born cases was the same as we report in the results (p=0.001) when these 2 years were included. The Victorian totals include Indigenous residents as indigenous status has only been collected accurately since 2001 with only 4 Indigenous cases notified since then. Data were analysed using Stata Version 8.0.[6]

Results

There were 3,191 laboratory confirmed cases of tuberculosis between 1990 and 2004 in Victoria, representing 77% of notifications during this period. The rate of laboratory confirmed TB significantly increased over the study period from a low of 3.7 cases per 100,000 population in 1992 to a high of 5.4 cases per 100,000 population in 2004 (p<0.001). In comparison, notification rates, which included cases that were not laboratory confirmed, had a median annual rate of 6.2 per 100,000 and were relatively stable over the period (p=0.72) (Figure 1).

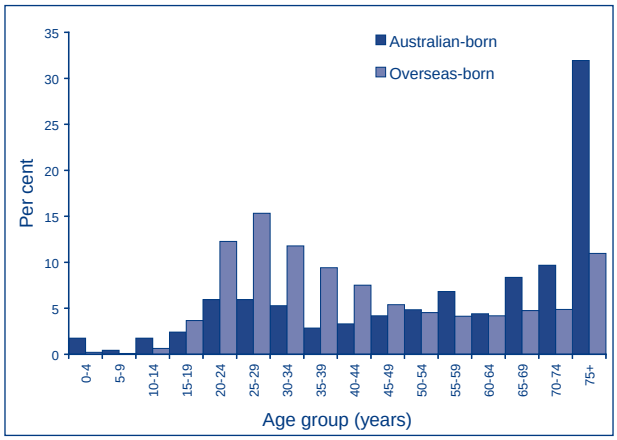
Figure 1. Annual notification rates and incidence of laboratory-confirmed tuberculosis, Victoria, 1990 to 2004



Half (51.9%) of the cases were male and the age specific rate of laboratory confirmed TB showed a bimodal distribution, with peaks at ages 20 to 34 and again at 55 years. There were 70 cases aged less than 15 years and the incidence in this group increased from a low of 0.1 case per 100,000 population in 1990 to a high of 1.1 case per 100,000 population in 1999 (p<0.001), corresponding to between 1 and 10 cases per year.

Of the 2,769 (87%) cases where country of birth information was available 2,315 (84%) were non-Australian-born. In the non-Australian-born group, the proportion of males and females was approximately equal, whereas males comprised 63% of the Australian-born group (p<0.001). For Australian-born patients the proportion of cases increased with increasing age, with the 75 years or over age group comprising 32% of all new cases. The highest proportion of non-Australian-born cases was in the 20–39 years age group (Figure 2).

Figure 2. Percentage of laboratory confirmed tuberculosis, Victoria, 1990 to 2004 by age group and country of birth



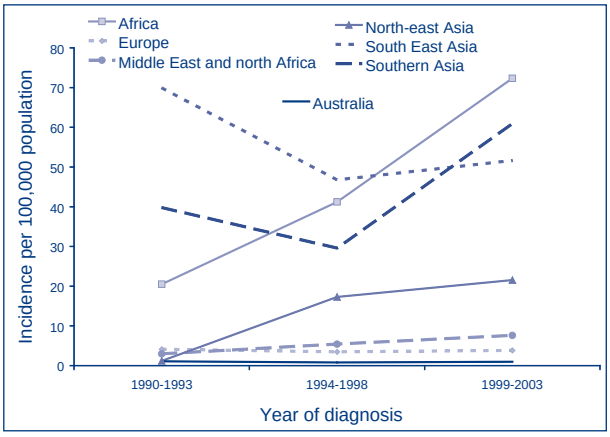
Laboratory confirmed tuberculosis rates by country of birth

The proportion of non-Australian-born cases increased over the study period from a low of 66% in 1994 to a high of 82% in 2004 (p=0.002). Of those with country of birth information 34% were born in South East Asia, 15% in Australia, 14% in Southern Asia, 11% in Europe and 8% in Africa.

Although the highest proportion of non-Australian-born cases was born in South East Asia, their laboratory confirmed TB rate declined between 1990–1993 and 1994–1998, after which it remained relatively constant (Figure 3). Laboratory confirmed rates for cases from all other regions increased, the most marked being in African migrants. Australian and European-born cases had low and stable rates over the 3 periods (1.0 case per 100,000 population and 4.0 cases per 100,000 population, respectively).

Laboratory confirmed TB rates in Victoria for migrants from the most high-risk countries were consistently over 30 per 100,000 (Table). In 1999–2003, migrants from Somalia, Ethiopia, India and Indonesia had the highest average annual rates, whereas in 1990–1993 the highest rates were observed for migrants from Vietnam, India, Cambodia and the Philippines. Combined with data illustrated in Figure 3, these data suggest there has been a shift in Victoria in recent years of cases of TB from South East Asia to African countries. An increase was also observed for cases from Southern Asia, especially from India.

Figure 3. Incidence of laboratory confirmed tuberculosis, Victoria, 1990–1993, 1994–1998 and 1999–2003, by region of birth



Resistance to tuberculosis drugs

Isolates from 331 (11%) laboratory confirmed cases were resistant to at least one of the first line TB drugs (isoniazid, rifampin, ethambutol and pyrazinimide), and 69% of these were from non-Australian-born cases. Although the trend over the entire study period was not significant (p=0.55), there was a significant increase between 2000 and 2004 from 3.4 to 5.8 per million (p=0.04) corresponding to 16 and 29 cases respectively. Of the 331 cases with drug resistance, 202 (61%) were resistant to isoniazid only, 62 (19%) were resistant to pyrazinimide only, 17 (5%) were resistant to isoniazid and pyrazinimide, 5 to rifampin only, 5 to isoniazid and ethambutol and 1 to ethambutol only.

Multi-drug resistance (MDR), defined as resistance to at least isoniazid and rifampicin, was uncommon, occurring in 39 cases (1.2%). All MDR cases with country of birth specified (73%) were non-Australian-born – 16 (41%) from South East Asia, 4 (10%) from both North-east and Southern Asia and a further 3 and 5 cases from Africa and Europe respectively. Again there was an increase in the rate of multi-drug resistance between 2000 and 2004 (p=0.005); corresponding to an increase from 1 to 7 cases.

Table. Number and rate of laboratory-confirmed tuberculosis, Victoria, 1990–1993, 1994–1998 and 1999–2003,* by country of birth and comparison to home countries incidence

Country	1990–1993		1994–1998		1999–2003		Incidence in home country‡
	Number per year	Rate†	Number per year	Rate†	Number per year	Rate†	
Australian-born§	35	1 (0.7–1.4)	26	1 (0.5–1.1)	32	1 (0.6–1.3)	6
Non-Australian-born	133	13 (11–15)	127	15 (13–18)	186	22 (19–24)	6
Africa							
Somalia	–	–	8	544 (157–931)	12	519 (226–813)	412
Ethiopia	–	–	2	163 (0–379)	7	335 (79–591)	356
Southern Asia							
India	11	56 (23–90)	10	39(15–65)	30	98 (63–133)	168
South East Asia							
Indonesia	3	38 (0–82)	6	48 (9–87)	9	80 (27–133)	285
Cambodia	4	52 (0–106)	3	41 (0–85)	6	62 (11–114)	508
Vietnam	40	89 (62–117)	36	65 (44–87)	34	60 (40–80)	178
Philippines	8	48 (15–82)	10	51 (20–82)	13	56 (25–87)	296
Northern Asia							
Hong Kong	1	4 (0–14)	3	19 (0–41)	5	34 (5–62)	92
China	10	47 (17–78)	9	31 (11–52)	12	32 (14–50)	102

* Countries were included in this table if they had more than 5 cases per year in the latest period (1999–2003) and rates were presented where the population denominator was higher than 1,000.

† Average annual rate per 100,000 population for the period. Population data sourced from the Australian Bureau of Statistics 2004.[5]

‡ Incidence for 2003 per 100,000 population. Sourced from the World Health Organization Global TB database[7] and Hong Kong Department of Health web site8 and based on notification data.

§ Includes Indigenous Australians.

Clinical site of tuberculosis

Over the 15 years reviewed, just over half of the diagnoses (55%) were pulmonary disease. Non-Australian-born cases had a significantly lower proportion of pulmonary disease than did the Australian-born for each year of this study (p=0.003) and for the whole period (52% compared with 76%). Over a quarter (27%) of non-Australian-born cases were diagnosed with TB in the lymphatic system, compared with 5% of Australian-born cases.

Comparison of non-Australian-born with Australian-born cases

In multivariate analysis non-Australian-born cases were more likely to be diagnosed in the later 2 diagnosis periods (OR=1.5, 95% CI 1.1–1.9 for 1995–1999 and OR=1.6, 95% CI 1.2–2.0 for 2000–2004). They were also more likely to be female (OR=1.4, 95% CI 1.1–1.8), aged 20–34 years (OR=3.1, 95% CI 1.9–5.1) or 35–49 years (OR=2.8, 95% CI 1.8–3.0), diagnosed with extrapulmonary disease (OR=2.3, 95% CI 1.1–1.9) and resistant to at least 1 of the 4 first line drugs (OR=3.1, 95% CI 1.7–5.7).

Discussion

TB in Victoria is a disease predominantly affecting migrants with a bimodal age distribution. Non-Australian-born females were likely to be diagnosed at a younger age, while Australian-born men were most likely to be diagnosed after the age of 70 years. Over time, the proportion of pulmonary disease has decreased, reflecting the increased prevalence of non-pulmonary disease in people born overseas. Drug resistance, including multi-drug resistance, was not common, and was mainly observed for non-Australian-born cases with all multi-drug resistance cases being non-Australian-born. The characteristics of non-Australian-born cases were similar to those from previous studies in Victoria[9] and New South Wales[10] and the notification rate by country of birth was similar to that reported nationally.[2,11] Other low incidence countries, such as the United Kingdom,[12] the United States of America,[13] and countries from Western Europe[14] also have TB incidence that reflects their migration patterns.

Laboratory confirmed TB by both region and country of birth changed during the period of this study with increasing rates from African countries and Southern Asia. This reflects Australia's immigration patterns as there have been increases in the number of arrivals from Africa, and to a lesser extent Southern Asia, in the latter part of the 20th Century,[15] and a decrease overall in arrivals from Asia.[16] The increase in rates for immigrants from African countries reflects the global picture of TB, as Africa is the only continent where TB rates are increasing.[1] It has been shown in Australia that the incidence of TB in the country of birth is the single most important group-level predictor of the rate of TB among migrants in Australia.[17] However, despite these changes in rates, South East Asia continued to contribute the highest number of cases for each period.

The rate of drug resistant isolates in this study was low, but the increase observed in the latter part of the study period may be cause for concern. Most cases with drug resistant isolates were from countries that have a high incidence of resistant strains of TB and also have a poor history of TB control.[18] All multi-drug resistance cases with country of birth information available were non-Australian-born. Improving TB control in high incidence countries may help to reduce the threat of drug resistance in Australia.

That the incidence of laboratory-confirmed TB increased over the study period while the notification rates were relatively stable reflects an improvement in specimen referral to the reference laboratory, and less reliance on diagnoses made on clinical and radiological findings only. Data on HIV status and treatment were not routinely available from clinical notes included with specimens received in the laboratory and could not be included in this review.

The results of this review raise the question of whether it is possible to eliminate TB from a low incidence country with ongoing immigration from high prevalence countries. The current TB control strategy in Australia of entry screening before arrival may not be adequate. Using chest x-ray as a screening tool will not help detect extra-pulmonary disease, which was more common in non-Australian-born cases in Victoria, and will miss many migrants who arrive with latent pulmonary infection. Other strategies, such as testing for latent TB on arrival or extending follow-up for a longer period post arrival, may be more effective in reducing the number of cases of TB in the non-Australian-born population, but will be more costly. Another control strategy, as recommended by the European framework for TB control, is to improve TB control in high incidence countries,[14] which could also be adopted by Australia to complement our own efforts.

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