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ORIGINAL ARTICLE

Tuberculosis disease trends among African migrants from 2010 to 2014 in Aotearoa, New Zealand

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Abstract

Aim Minority migrant groups, such as African migrants in New Zealand, are often disproportionately affected by TB yet remain hidden or unaccounted for in government or public health statistics due to their small population sizes. The aim of this study was to address this gap and to expand the existing international literature by describing the epidemic characteristics and trends of TB for African migrants living in NZ.

Subject and methods A descriptive epidemiological analysis of all TB cases notified between 2010 and 2014 was undertaken using the R statistical tool version 3.3.1 and MS Excel 2016. TB incidence rates were computed and compared by three population groups; African, 'Other foreign', and NZ born.

Results From 2010 to 2014, the average annual incidence rate of TB was highest among the African migrants (25.37 per 100,000) compared to the other foreign-born (21.76 per 100,000), and NZ-born (1.96 per 100,000) populations. Africans notified as having TB were likely to be male, unemployed, within their first year of arrival, in their most productive ages (between 20 and 49 years), from the most deprived 20% of small areas in NZ, and likely to originate from South Africa, Somalia, or Ethiopia. While Africans with TB were more likely to delay in seeking treatment, they were the most likely to successfully complete.

Conclusion The study described key factors associated with TB and showed the different epidemiological characteristics between the three groups compared. The findings support the need for migrant-specific TB elimination action plans if TB elimination targets are to be achieved.

Keywords Migrant TB · African migrant · TB elimination · Low incidence

Introduction

Since 2015, The World Health Organisation's (WHO) strategy, "Towards TB elimination", aimed at eliminating TB by 2050 has reinvigorated global action against TB (Lönnroth et al. 2015). This global agenda has intensified the search for new and innovative mechanisms to rapidly reduce TB in many low-incidence countries, defined as countries reporting less than 100 TB cases per 1,000,000 population, where TB incidence has plateaued since the turn of the century (Lönnroth et al. 2015; Lonnroth et al. 2017; Pareek et al. 2016).

In New Zealand (NZ), one such low-incidence country, TB incidence rates have remained relatively low and stable over the last decade (Institute of Environmental Science and Research Ltd (ESR) 2018). For instance, previous estimates of TB burden have revealed that between 2000 and 2012 the annual rate of decline in incidence was 3.8% (Lönnroth et al. 2015). However, given the new targets for pre-elimination (defined as less than ten TB cases, all forms, per 1,000,000 population) by 2035 and subsequent elimination (defined as less than one TB case, all forms, per 1,000,000 population) by 2050, NZ is required to achieve an annual rate of decline of 11%, which is more than 3 times the decline observed between 2000 and 2012 (Lönnroth et al. 2015).

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Although national TB rates have remained low, about 6.7 per 100,000 population, ethnic disparities in incidence rate have persisted (Institute of Environmental Science and Research Ltd (ESR) 2018). As in other comparable countries, foreign-born persons living in NZ are disproportionately affected by TB (Aldridge et al. 2016; Fojo et al. 2017; Pareek et al. 2016). The foreign-born population constitute about a quarter (25.2%) of the population (Statistics New Zealand 2013), yet they report the highest proportion (77.6%) of all TB cases (Institute of Environmental Science and Research Ltd. (ESR) 2015). Achieving the elimination targets arguably would require more targeted interventions for most at risk groups, including migrants (Lonnroth et al. 2017).

Notwithstanding the benefits of migration to host countries, it is an important threat to the TB elimination agenda in low-incidence countries. The WHO has reinforced the importance of mitigating migrant TB by requiring countries to identify and address the special needs of migrants as one of the eight key intervention areas (WHO 2014). While the call is welcoming for public health action, it has revealed the paucity in existing published literature on the wider determinants of migrant TB. This is particularly pronounced for minority migrant groups who are often disproportionately affected by TB yet remain hidden or unaccounted for in government or public health statistics due to their small population sizes. For instance, persons born in sub-Saharan Africa (referred to as Africans in this study) are a relatively small group in NZ (less than 1% of the entire population) yet report disproportionately high rates of TB (19.4 per 100,000 population) compared to the NZ born (2.3 per 100,000 population) (Institute of Environmental Science and Research Ltd. (ESR) 2015). The African migrant population account for significant numbers of TB cases and national rates in some western countries (Abraham et al. 2013; Kempainen et al. 2001). However, to our knowledge there is currently no published study describing the epidemic trend of TB among Africans in New Zealand.

The aim of this study was to address this gap and to expand the existing international literature by describing the epidemic characteristics and trends of TB for African migrants living in NZ, and the factors that contribute to the relatively high rate of TB among this group in comparison to the host population and the "other foreign-born" group.

Method

In NZ, any clinician who diagnoses TB disease is required under the Tuberculosis Act 1948 to notify the local Medical Officer of Health. In addition, since 2007, laboratories are required to report TB cases to their Medical Officer of Health. The laboratory report provides details on drug susceptibility and species identification of notified cases. The TB case report form captures details of the case demography, clinical details, basis of diagnosis, risk factors, and case management, which are entered into EpiSurv, the national notifiable disease surveillance database, by staff at public health units (Institute of Environment Science and Research Ltd. (ESR) 2015).

A descriptive epidemiological analysis of all TB cases notified between 2010 and 2014 was undertaken using the R statistical tool version 3.3.1 and MS Excel 2016. Data were sourced from the national notifiable disease surveillance database, EpiSurv, through the Institute of Environment Science and Research (ESR). The analysis assessed the incidence of TB per 100,000 population at national level and by three population groups; African, 'Other foreign', and NZ born. The aggregate number of cases of TB disease was used as numerator data. The denominator was sourced from Statistics New Zealand, the official agency for government statistics (Statistics New Zealand 2013). The denominator data used to calculate the group specific TB rates was based on the proportion of people by country of birth from the usually resident 2013 census data applied to the corresponding official end of June mid-year population estimates for 2010 to 2014 (Statistics New Zealand, 2013). The mid-year population estimates offer a sufficient approximation of the national population (close to the mean population) in a year, with the national population changing at different times in a year because of births, deaths, and emigration/immigration. An analysis of the length of time from first arrival to New Zealand to notification of TB was undertaken (post arrival time) for all African and other foreign-born cases using the variable report date and arrival date on the notification form. To describe the distribution of TB by age groups and sex, the variables age group and sex were used respectively. The differences within-group categories including sex and New Zealand deprivation index (NZDep2013) were examined using a chi-square test at 95% confidence.

Incidence of TB by occupation was explored. All occupations recorded were extracted and classified using the Australian and New Zealand standard classification of occupations (ANZSCO) level two. The analysis focused on four main occupations from the ANSCO broad categorisation, which were identified from literature as the priority occupations. All other occupations were classified as other.

To describe the incidence of TB by deprivation, the New Zealand Deprivation Index 2013 (NZDep2013), a small area measure of relative deprivation estimated at meshblocks level (the smallest statistical population unit of at least 100 people) in NZ was used. The NZDep2013 estimates deprivation for the small areas (meshblocks) based on a combination of nine deprivation variables from the 2013 NZ census, and divides the country into tenths (deciles), with the scale of 1 representing the least deprived 10% and 10 representing the most deprived 10% of the small areas in NZ (Atkinson, Salmond and Crampton 2014). The NZDep2013 can also be

displayed in quintiles, as in this study, where quintile one represents the least deprived 20% and quintile five the most deprived 20%.

The study received ethical approval from the Auckland University of Technology (AUT) ethics committee (**reference 16/128**).

Results

General trend and characteristics

Nationally, a total of 1479 cases of TB disease were reported (1423 new cases; 56 relapse or reactivation cases) from 2010 to 2014. Of the 1479 cases, 77.5% (1146 cases) were overseas born; of whom 7.5% (86 of 1146) were sub-Saharan African born and 92.5% (1060) born in other foreign countries other than in sub-Saharan Africa. There were significantly more cases of TB among males (53%) than females (χ^2 (1) = 5.36, $p = 0.02$). The highest age-specific average annual incidence rate in this period was in the 20–29 age group (12 per 100,000, 355 cases), followed by the 30–39 (10.4 per 100,000, 289) and the 60–69 (7.5 per 100,000, 160) age groups. The 20–29 age group reported the highest age-specific average annual incidence for both males and females (fig. 1).

African migrant TB characteristics

The average annual incidence rate over the period was highest among the African group (25.37 per 100,000) compared to the other foreign-born (21.76 per 100,000) and NZ-born (1.96 per 100,000) populations (fig. 2). During this period, the highest decline in TB incidence occurred among Africans (down 41.7% from 31.32 to 18.27 per 100,000) followed by other foreign-born (down 5.6% from 23.14 to 21.85 per 100,000). Among the NZ born, however, there was an increase (up 13.87% from 1.84 to 2.09 per 100,000). The average annual TB incidence among African males was slightly higher (27.11 per 100,000) than among African females (23.72 per 100,000), although not statistically significant over the period (χ^2 (16) = 20, $p = 0.22$). Of the African males diagnosed with TB, the highest proportion of cases was recorded among the 20–29 age group (24.4%, 11 cases), followed by 30–39 (22.2%, ten cases) and 40–49 (22.2%, ten cases) age groups. For females, the highest proportion of cases was reported among the 20–29 (26.8%, 11 cases) and 40–49 (26.8%, 11 cases) age groups. No case of TB was reported among the < 15 years age group within the period.

The African group (mean age, 39.4 years) were the youngest in comparison to the other foreign (mean age, 42.0 years) and NZ born (mean age, 42.4 years). Within this period, Africans with TB originated from 13 African countries: 42 cases (48.8%) migrated from East Africa, 40 (46.5%) from Southern Africa, three (3.5%) from West Africa, and one (1.2%) from Central Africa. The highest number of cases came from South Africa (28 cases; 32.6%), followed by Somalia (21; 24.4%), Ethiopia (12; 14.0%), and Zimbabwe (nine; 10.5%). Together, the top three countries (South Africa, Somalia, and Ethiopia) contributed 70.9% of all African TB cases.

Among Africans, there was a statistically significant difference in the proportion of TB cases reported from the least and most deprived neighbourhoods (χ^2 (4) = 11.41, $p = 0.02$). Approximately 53% of Africans with TB lived in the most deprived neighbourhoods (quintile 5 = 30.12%, quintile 4 = 22.9%) (fig. 3). Africans with TB were likely to be unemployed (20%), healthcare workers (14.1%), or students (10.6%) (Table 1).

Overall, 23.9% of all African cases were diagnosed within the first year after arrival and 55.3% within the first 5 years after arrival (fig. 4). African migrants continue to report TB cases 10 years on from arrival (26.9%). Among other foreign-born persons, notification of TB followed a similar trend; the highest proportion of notifications were within the first year after arrival (17.0%, 141 cases), lower than that for Africans, and more than half (57.6%) within the first five years after arrival. African TB

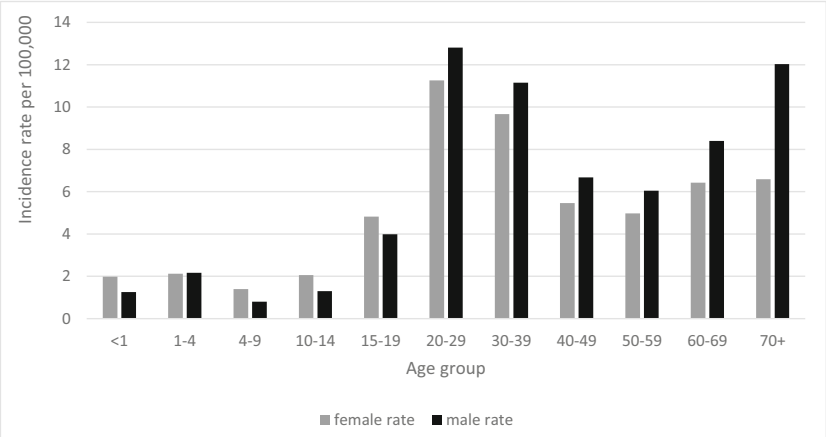

Fig. 1 Age and sex specific average annual Incidence per 100,000 population, 2010–2014

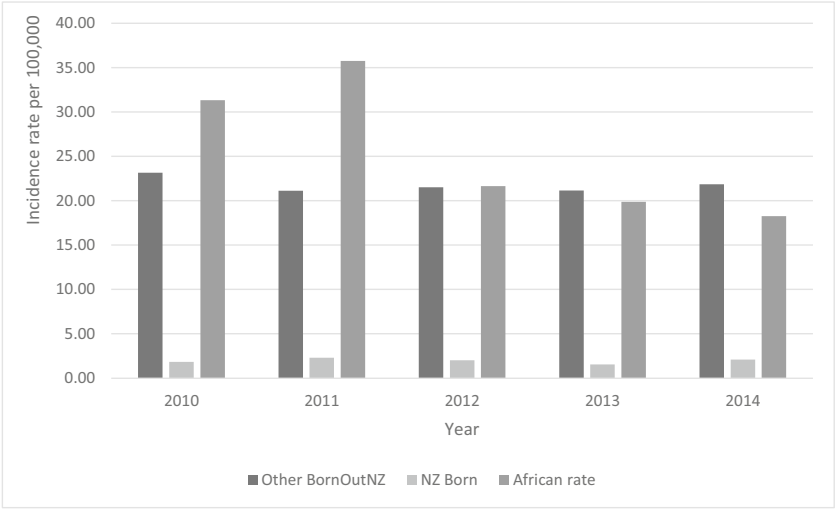

Fig. 2 Incidence rate by place of birth, 2010–2014

cases were mostly identified by a general practitioner (72.1%, 62 cases) or through immigrant screening (12.8%, 11 cases), similar to the other foreign-born group (fig. 4).

Data were fully complete for 53 out of 83 African cases who received treatment (63.9%). Analysis focused on pulmonary TB, as any delay in treatment is a public health threat. Among Africans with pulmonary TB (23 cases with complete data), the median time from onset of TB symptoms to treatment was about 3 months (2.7 months), and the mean was about 4 months (3.7 months). Approximately 56.5% of pulmonary TB cases who were African initiated treatment within the first 3 months of onset and 21.7% within the first month.

The proportion receiving treatment was quite similar for the three groups compared; NZ born 95.2%, other foreign born 96.7% and Africans 96.5%. NZ-born persons (33.8%, 112 cases) commonly received directly observed treatment (DOT) in the intensive phase of the treatment, more than other foreign born (32.4%, 343 cases) and Africans (25.6%, 22 cases). In all, 92.8% (77 cases) of Africans receiving treatment for TB successfully completed their treatment, the highest of the three groups compared; the figures for NZ born were 86.3% and for other foreign born were 84.6%. Over half of all cases reported from 2010 to 2014 were hospitalized (57.97%). The proportion of hospitalizations for TB was lowest for Africans (47.7%) compared to NZ-born cases (64.5%) and other foreign-born cases (56.7%).

BCG vaccine provides protection against severe TB disease, especially among children. Approximately 97.8% of all cases had BCG vaccination status recorded. In all, 41.4% reported having been vaccinated against TB sometime in their life prior to the onset of the disease. Other foreign–born persons (47.5%, 495 cases) more frequently reported they were vaccinated against TB than Africans (44.6%, 37 cases) and NZ born (20.6%, 66 cases).

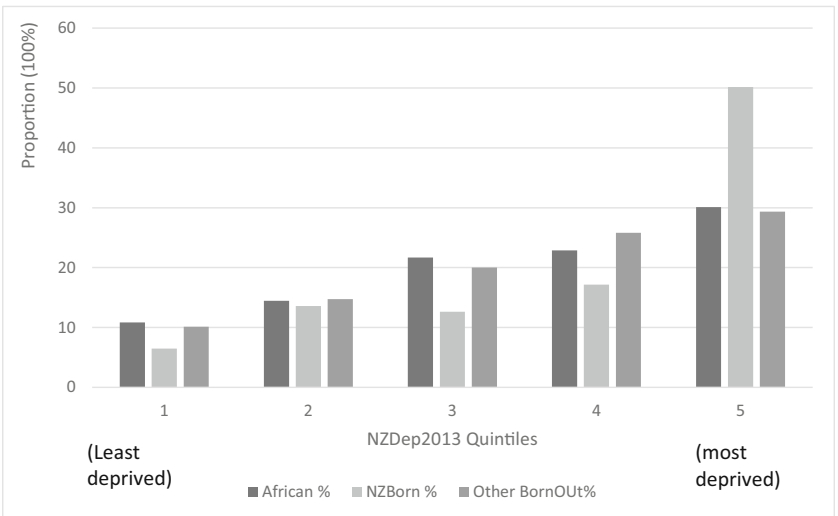

Fig. 3 Proportions of African, NZ-born and other foreign-born TB cases by New Zealand Deprivation Index (NZDep2013), 2010–2014

Table 1 Occupation groups of reported TB cases by place of birth, 2010–2014

Occupation classification	African		NZ born		Other foreign born	
	Cases (*n*)	Proportion (%)	Cases (*n*)	Proportion (%)	Cases (*n*)	Proportion (%)
Healthcare workers	12	14.1	7	2.1	53	5.1
Student	9	10.6	32	9.8	140	13.4
Retired	5	5.9	56	17.1	144	13.8
Unemployed	17	20.0	37	11.3	70	6.7
Other occupations	42	49.4	195	59.6	634	60.9
Total	85	100.0	327	100.0	1041	100.0

Discussion

This is the first study to describe the epidemiology of TB among persons born in sub-Saharan Africa living in NZ. Over the study period (2010–2014), the national TB rate declined, albeit statistically insignificantly. Due to the potentially long and variable time between when a person gets exposed to TB bacilli and when they actually develop TB disease, it can be difficult to make justifiable conclusions from fluctuations in the annual TB disease notifications. For example, the decline from 2012 (6.6 per 100,000) to 2013 (6.2 per 100,000) and the rise in 2014 (6.7 per 100,000 population) can be difficult to explain. Hence, trends in TB disease notifications are better explained over a period. The findings showed that there were significantly more males diagnosed with TB than were females, that persons aged 20–29 years recorded the highest age-specific cumulative incidence rate, and that TB was commonly notified among persons living in the most deprived small areas of NZ.

The incidence rates of TB among Africans declined, albeit statistically insignificantly, from 2010 to 2014, but remained disproportionately high, about 12 times more than the rate among persons born in NZ. Previous studies have attributed the disproportionately high rates of TB among Africans to the reactivation of previously acquired TB infection from their home countries (Abraham et al., 2013). Exposure to TB, most likely from an African source in the host country, might also explain why the rates are high (Borgdorff et al. 2000; Garzelli et al. 2010). For instance, in the current study the analysis showed that seven African TB cases (8.1%) had made contacts with confirmed TB cases in NZ. While this might not be enough evidence to conclude that transmission of TB had occurred, it may suggest that the risk of exposure within the African community from an African source could occur. This assertion is supported by a previous molecular epidemiological study in NZ (Yen et al. 2013).

Africans diagnosed with TB were younger compared to other foreign and NZ born, and were more commonly diagnosed within the first year after arrival than other foreign born were. This finding corroborates studies from other places (Abraham et al., 2013; Farah et al., 2005; Kempainen et al., 2001). Previous studies have suggested that most Africans diagnosed within the first year of arrival were likely to be refugees (Kempainen et al. 2001; Varkey et al. 2007). This study is unable to affirm this finding, as data on immigration status were unavailable. However, about seven Africans were diagnosed within the first 100 days post arrival. These people were more likely to be quota refugees and would have been identified through the immigration screening at the Mangere Refugee Resettlement Centre (MRRC). Screening at the MRRC is compulsory and is a very

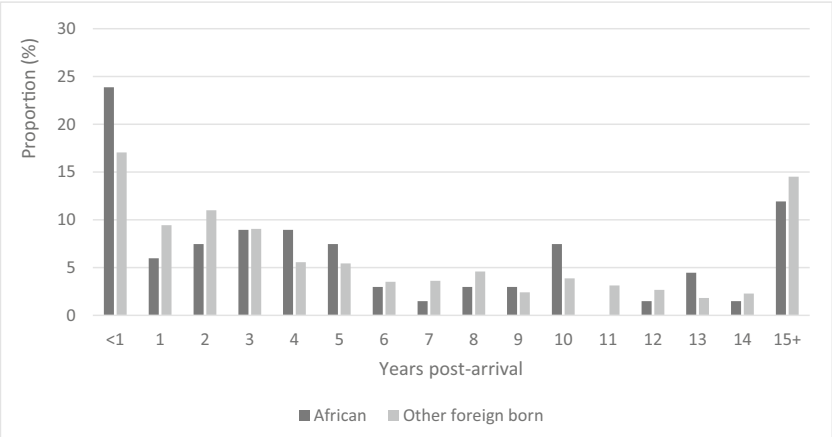

Fig. 4 Proportion of African and other foreign-born TB cases by post-arrival time, 2010–2014

formalised part of the arrival processes. Refugees are likely to be diagnosed with TB within the first few months of arrival because of three main reasons: stressful conditions of their travel, the conditions of their transit (refugee camps), and the resettlement process (Dhavan et al., 2017). Refugees endure harsh conditions from forced migration, as they flee wars, violence, persecution or natural disasters, with some traveling in dangerous and overcrowded conditions (Dhavan et al., 2017). The situation worsens in the refugee camps (transit points for those who reach developed countries) where many refugees live through the stress from displacement, malnutrition, poor housing and overcrowded conditions, further predisposing them to TB infections (Dhavan et al. 2017; Kempainen et al. 2001). Upon arrival in their new country, the stressful conditions of the resettlement process and the poor living conditions, such as poor housing and malnutrition, particularly within the first few months of arrival, further increase their risk of progression to TB disease or acquisition of new infection (Lonnroth et al. 2017).

There were marked differences in the number of cases reported from the different sub-Saharan African countries: 70.9% of all African cases originated from three countries — South Africa, Somalia, and Ethiopia. The observed pattern is likely to be due to the interplay of two factors: the high burden of TB in these countries, and the relatively high emigration from these countries to NZ. The countries reporting the highest number of TB cases have larger population sizes in NZ compared to those that reported zero or few cases. Data from Statistics New Zealand (2013) on the usual resident population by birthplace shows that the highest proportion of sub-Saharan Africans living in NZ were born in South Africa. Persons born in Somalia and Ethiopia also constitute a large proportion of the sub-Saharan population and have long established communities, following their arrival in New Zealand in the early 1990s. In the case of the other sub-Saharan countries who reported a zero or fewer cases, the trend may reflect their population size in New Zealand. It might not necessarily be the case that the TB burden was low in such countries, as most sub-Saharan African countries are rated as high-burden TB, TB/HIV and MDR-TB countries (WHO 2015).

The findings from the study suggest that Africans are more commonly diagnosed with extra-pulmonary TB compared to the NZ and other foreign-born populations, which corroborates other previous studies (Abraham et al. 2013, Kempainen et al. 2001). Extra-pulmonary TB, except laryngeal TB, is considered less important to public health, as it is rarely infectious. However, extra-pulmonary TB, like any other disease, can lead to severe suffering and can be difficult to diagnose (Crofton et al. 1999). This finding has important implications for clinical practice, as health professionals who deliver healthcare services to Africans may need to suspect extra-pulmonary TB especially in instances where they present with symptoms and signs that are unexplained but likely to be due to extra-pulmonary TB.

Another important finding was that 20% of all Africans diagnosed with TB were unemployed; about 30% of these people lived in the most deprived 20% of the small areas in NZ, and were most commonly (23.9%) diagnosed with TB within the first year of arrival. This supports the hypothesis that, although most Africans might be exposed to TB before their arrival, the conditions of their transitioning into their new environments within their first few years of entry may influence the reactivation of latent TB (Abraham et al. 2013; Lönnroth et al. 2009).

Africans over the period did not record any case of MDR-TB. All 16 cases reported over the period were other foreign born. A similar finding has been shown in the US, where MDR-TB has been shown to be less reported among Africans compared to other foreign born (Abraham et al., 2013). That notwithstanding, an increasing trend in the incidence of MDR-TB in the African region could mean cases might be reported by persons of African origin in the years ahead (WHO 2016). However, with the findings suggesting a high treatment completion rate (92.7%) among Africans, it may be reasonable to suggest that the trend of no MDR-TB cases might be sustained, or that if there were to be any cases, they would be very few.

Early initiation of treatment for pulmonary TB is important for public health, to prevent the chances of transmitting TB to other susceptible individuals. The median time from onset to treatment among Africans was about 3 months (2.7 months), which was higher than other foreign (2.1 months) and NZ born (1.8 months). Previous studies in NZ have attributed delays in seeking treatment to personal and health system factors (Calder et al. 2000). Lack of awareness of the symptoms of TB, fear on the part of persons to find out about the disease, and the idea that the symptoms may go away were some of the reasons why people delayed in seeking treatment (Calder, Gao, & Simmons, 2000). Among Africans, another important factor contributing to the delays might be the stigma associated with TB.

Limitations

The limitations of the study are those associated with the EpiSurv TB data. Despite existing mechanisms to improve sensitivity and completeness of TB data (Das et al. 2006), this study is limited by incomplete data entry. For instance, among cases of sub-Saharan African origin, data on treatment and the year of arrival were incomplete for 30 cases (36.1%) and 19 cases (22.1%) respectively.

Another limitation is the use of place of birth from the census as the denominator in the analysis. This assumes that persons born in sub-Saharan Africa may self-identify as such and the capture of TB cases at the hospital level may accurately record this in EpiSurv. This variable was chosen over ethnicity, given the inherent limitations with the capture of

ethnicity data. It was observed that some African countries such as South Africa and Zimbabwe were coded as European, hence leading to serious undercounts of persons who may self-identify as belonging to the African ethnicity.

Conclusion

This study has provided the background understanding of the African migrant TB epidemiology by establishing key factors associated with TB. Africans notified as having TB were more likely to be male, unemployed, within their first year of arrival, in their most productive ages (between 20 and 49 years), from the most deprived 20% of small areas in NZ, and more likely to originate from South Africa, Somalia, or Ethiopia. While Africans with TB were more likely to delay in seeking treatment, they were the most likely to successfully complete. The differences in epidemiological characteristics warrant improved data collection and analysis by specific migrant groups, and the development of targeted TB elimination strategies and action plans.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee [Auckland University of Technology (AUT) Ethics Committee, reference 16/128] and with the 1964 Helsinki Decalaration and its later amendments or comparable ethical standards.

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