

## The changing face of tuberculosis control in a rural district of New Zealand

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### SUMMARY

**SETTING:** Waikato Health District (WHD), New Zealand.

**OBJECTIVE:** To describe the changing epidemiology of TB in the WHD and the factors responsible for this.

**DESIGN:** Descriptive epidemiological study of all notified TB cases from the WHD from 1 January 1992 to 31 December 2001. Major outcome measures were delay of diagnosis and treatment outcome.

**RESULTS:** There were 244 cases included. Over the 10-year period, TB incidence has remained stable in the WHD. There has been a significant reduction of TB in the Maori population (from 30.3 to 12.5/100 000,  $P = 0.03$ ). This has been matched by a rise in the overseas-born population (from 4.6 to 21.2/100 000,  $P = 0.04$ ).

Tuberculosis became a predominantly urban disease during the study period. Delay in diagnosis ( $>4$  weeks) occurred in 85% of cases, with significantly more delays in older age groups. Use of directly observed therapy (OR 3.65, 95%CI 1.24–10.76), and being a migrant (OR 3.52, 95%CI 1.74–7.09), were significantly associated with improved treatment outcome.

**CONCLUSION:** A significant change in the epidemiology of TB has occurred over the last decade. Tuberculosis control strategies need to be developed to effectively diagnose and treat patients from diverse cultural backgrounds.

**KEY WORDS:** indigenous; New Zealand; tuberculosis; epidemiology; immigrant

NEW ZEALAND has one of the lowest rates of tuberculosis (TB) in the world.<sup>1</sup> Despite this, TB remains a concern in certain sub-sections of the population, in particular in indigenous Maori, Pacific Islanders and overseas-born people,<sup>2,3</sup> with continuing challenges for TB control programmes.<sup>4–8</sup> Previous TB studies in New Zealand have concentrated on the urban Auckland<sup>2,4</sup> and Wellington regions.<sup>8</sup> There has been little research on the epidemiology of TB and in particular how ethnicity and other factors affect the control programme in rural regions of New Zealand.

The Waikato Health District (WHD) has a diversity of ethnic groups, which have historically comprised populations of European origin, indigenous Maori and Pacific Islanders. In recent decades, there has been increased immigration of people from Asia, Africa and the Pacific, including a steady influx of refugees.<sup>8–10</sup> In other industrialised countries with low TB incidence rates, the human immunodeficiency virus/acquired immune-deficiency syndrome (HIV/AIDS) epidemic, increased immigration from developing countries, and less effective control programmes have led to an increased incidence of TB.<sup>8,11</sup>

This paper examines the pattern of TB notifications in the WHD of New Zealand for the period 1992–2001, and in particular the effects of the changing socio-economic, cultural and geographic characteristics of notified TB cases and the response of the health services to these changes during this period.

### METHODS

#### *Study population*

The Waikato Health District (WHD), one of New Zealand's 21 health districts, with an area of 21 220 km<sup>2</sup>, is located in the North Island and has a population of 317 751.<sup>12</sup> Hamilton, the administrative centre (population 114 915), has an increasingly diverse population.<sup>12</sup> The majority of the WHD's population live in the rural areas. A relatively high proportion of the population are Maori (20.2% compared with the national figure of 14.1%).<sup>12</sup> All notified cases of TB disease who were residing in the WHD at the time of notification from 1 January 1992 to 31 December 2001 were included in the study.

### Data collection

New Zealand legislation requires medical practitioners to notify all cases of TB, which are then entered into a national database. The data for each TB notification from the WHD were checked for completeness and accuracy, with missing data and errors corrected with reference to medical case-notes by one of the authors (CvdO). Deaths were documented as being attributable or not attributable to TB, based on clinical diagnosis or post-mortem report.

### Definitions of terms

A new case of TB disease was defined as satisfying one of the following criteria: 1) bacteriological confirmation by a positive culture for *Mycobacterium tuberculosis* or *M. bovis*, or a positive microscopic examination for acid-fast bacilli (AFB) when a culture was not or could not be obtained; 2) histology strongly suggestive of tuberculosis; 3) identification of *M. tuberculosis* nucleic acid (polymerase chain reaction [PCR] or ligase chain reaction [LCR] only); 4) in the absence of bacteriological or histological confirmation, symptoms or signs compatible with active TB, such as compatible radiology or clinical evidence of current disease, and full anti-tuberculosis treatment prescribed by a clinician.<sup>13</sup> The definition of TB relapse and all case outcome definitions were according to those used by the World Health Organization.<sup>14,15</sup> Definite cases of TB were defined as those that had bacteriological confirmation, a positive microscopic examination for AFB when a culture had not been or could not be obtained, positive histology or identification of *M. tuberculosis* nucleic acid. All other cases were defined as presumed cases.<sup>13</sup> The ICD10 reference system was also used to define the site of TB disease.<sup>16</sup>

The denominator population data for the calculation of rates were obtained from Statistics New Zealand. This included total population, overseas-born population and major ethnic group data for the WHD. The definition of ethnicity used in this study conformed to that of Statistics New Zealand (the ethnic group or groups with which a person identifies).<sup>17</sup> Individuals can therefore be included in more than one ethnic group. For the purposes of this study the ethnic classifications were defined as follows: Maori (indigenous New Zealanders), non-indigenous New Zealanders (New Zealand-born except Maori), Pacific Islanders (of Pacific Island ethnicity born in New Zealand), and overseas-born (anyone born overseas, regardless of how they fit into New Zealand ethnic groupings).

The category overseas-born was further subdivided according to the nature of their arrival in New Zealand. Refugees were those who arrived under the mandate of the United Nations High Commissioner for Refugees. Family reunification migrants were defined as those granted entry to New Zealand with relatives already resident in the country. Asylum seekers were

defined as those who sought refugee status on arrival at New Zealand's borders.<sup>10</sup>

### Analysis

Statistical analysis was performed using STATA™.<sup>18</sup> Logistic regression was used for multivariate and univariate comparisons and  $\chi^2$  statistics (including  $\chi^2$  tests for trend) were calculated using standard methods. Significance was taken at the 5% level and 95% confidence intervals (CI) were calculated. All analyses were then repeated on the data set after removing all of the presumed cases, and the results were compared with those for all cases combined. Geographical data were analysed and maps generated using GIS Information Systems.<sup>19</sup> TB rates by ethnicity were directly age-standardised to the 2001 total population of the WHD.

Approval for the study was obtained from the Waikato Ethics Committee and the Northern Territory University Human Research Ethics Committee.

## RESULTS

The analysis was performed on all notified cases, regardless of the mode of diagnosis. When the main outcome measures were repeated for definite TB cases, none of the results were significantly different.

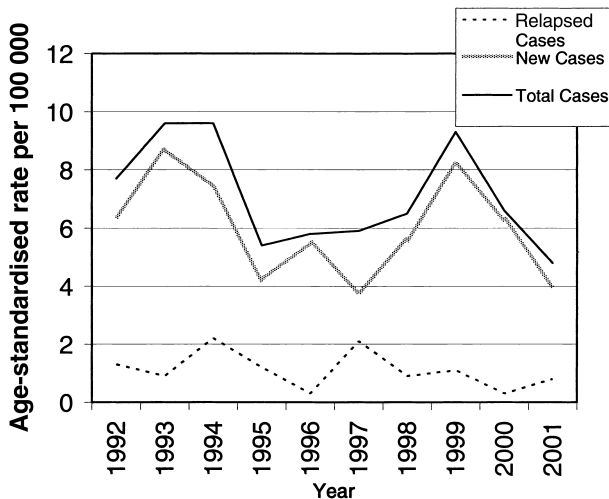
### TB diagnosis

Diagnostic modalities were undertaken in the investigation of all of the 244 cases and the diagnostic method was reported for 243 (99%) of the notified cases. Thirty-four per cent of the cases were smear-positive, with no significant change in the incidence of smear-positive cases during the study period. There was no significant difference in the incidence of smear-positive cases between New Zealand-born and migrant populations or by ethnic group. Drug sensitivities were recorded for 139 (57%) of the 244 cases: 88% were fully sensitive to all first-line anti-tuberculosis drugs. There were no cases of multidrug-resistant tuberculosis (MDR-TB, defined as resistance to at least isoniazid and rifampicin). HIV testing was only undertaken in refugees and newly arrived migrants, unless the patient history identified other risk factors. Of the 244 notified TB cases, two were HIV-positive.

### Characteristics of TB notifications

During the study period, 244 cases were notified, with 189 (78%) new cases and 37 (15%) relapse cases (18 cases were unclassified). Relapse cases were most frequently reported from the Maori population and accounted for 15% of Maori cases. The number of notified TB cases has not significantly changed over this 10-year period (Figure). The average incidence rate per year over the 10 years from 1992 to 2001 was 7.2 cases per 100 000 population.

Tuberculosis was notified more frequently in men



**Figure** Incidence rate of total, new and relapsed TB cases for each year, WHD, 1992–2001. WHD = Waikato Health District.

(total notifications: male 52%, female 48%,  $P = 0.7$ ). The TB incidence in each age group remained stable during the study period. There was, however, a significant difference in the age of TB cases between the ethnic groups, with the Pacific Island group (average age 23.0 years) younger than the overseas-born (average age 37.9 years), the Maori (average age 43.4 years) and the non-indigenous New Zealand populations (average age 57.1 years) ( $P < 0.001$ ). Sixteen per cent of cases were aged over 70 years, with most of the cases in this age group from the non-indigenous New Zealand population; 90% of cases in children (age <15 years) occurred in Maori or the overseas-born. Nine cases of TB occurred in children under 5 years of age; 78% of these cases were in Maori.

Maori accounted for 110 (45%) TB cases. The annual incidence rate for Maori decreased significantly from 30.3 cases/100 000 in 1992 to 12.5/100 000 in 2001 ( $P = 0.03$ ). By contrast, the non-indigenous New Zealand population accounted for only 46 (19%) TB cases. The incidence rate for the non-indigenous New Zealand population, although low, has decreased significantly further (from 3.0/

100 000 in 1992 to 0.7 in 2001,  $P = 0.03$ ). Pacific Islanders accounted for only 4 (2%) notified TB cases. The country of birth was known for 222 (91%) TB notifications. The incidence rate of TB notifications occurring among overseas-born New Zealand residents has increased significantly, from 4.6/100 000 in 1992 to 21.2 in 2001 ( $P = 0.04$ ). The changing age-standardised rates of cases for each of the major ethnic groups, non-indigenous New Zealand, Maori, and overseas-born, is shown in Table 1.

Of the 81 cases (33% of total cases) born overseas, 65 cases were born in Asian or African countries. Refugees, including those arriving under the ‘family reunification category’, accounted for 40 (49%) cases in the overseas-born population. Thirty (37% of the overseas-born) were born in Somalia, reflecting the immigration policies of the period. For the 81 cases born outside New Zealand, the date of arrival was known for 64 (79%); 31 (48%) were notified within 12 months of their arrival and 48 (75%) arrived in New Zealand in the 5 years preceding their notification. For the 40 TB cases occurring in refugees, the majority (60%) were notified within 12 months of arrival.

There was a wide geographical spread of notified cases. Forty-one per cent of the cases resided in the urban centre of Hamilton, with the remainder residing in rural areas. The number of cases residing in Hamilton significantly increased between 1992 (28% of notifications) and 2001 (47% of notifications,  $P = 0.03$ ). This is consistent with the urban geographic distribution of the overseas-born community groups most affected by TB who are establishing themselves in this region.

*Diagnostic delay*

The time between the development of symptoms and notification of the case was documented for 152 (62%) cases, and was not significantly different between the main ethnic groups. The majority of the patients had delayed diagnosis of over 4 weeks (84.7%). There was no significant association between diagnostic delay and ethnic group, distance from a diagnostic centre or sex. There was a significant trend towards longer delay with advancing age ( $P = 0.02$ ).

**Table 1** Age-standardised rate of TB for Maori, overseas-born and non-indigenous New Zealander populations, WHD 1992–2001

Ethnicity*	Age-standardised rate (per 100 000 population) <sup>†</sup>										<i>P</i> (trend) <sup>‡</sup>
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Maori	30.3	50.2	64.4	27.0	14.9	29.6	35.5	21.0	7.9	12.5	0.03
Overseas	4.6	21.0	13.8	7.9	28.4	20.7	15.5	32.0	34.2	21.2	0.04
NI NZers	3.0	1.6	2.2	2.1	2.2	1.5	0.7	2.1	1.3	0.7	0.03
All	7.7	9.6	9.6	5.4	5.8	5.9	6.5	9.6	6.6	4.8	0.23

\* An accurate age-standardised rate could not be calculated for the Pacific Islander population because of the small number of cases.

<sup>†</sup> TB rates by ethnicity were directly age-standardised to the 2001 total population of the WHD.

<sup>‡</sup> Trend was calculated using STATA™ using a non-parametric test for trend across ordered groups.

TB = tuberculosis; WHD = Waikato Health District; NI NZers = non-indigenous New Zealanders (all New Zealand-born except Maori).

**Table 2** Factors affecting the treatment of notified TB cases, WHD, 1992–2001

Factor	OR	95%CI	P	Adj OR	95%CI	Adj P
DOT	3.65	1.24–10.76	0.02	2.60	0.85–7.98	0.09
Migrant	3.52	1.74–7.09	<0.01	2.52	1.18–5.36	0.02
Age	0.98	0.97–1.00	0.01	0.98	0.97–1.00	0.07
Delay	1.02	0.99–1.04	0.15			

Note: The following factors were included in a logistic regression model to determine those that significantly contributed to a favourable treatment outcome: age, sex, distance from a public health nurse, utilisation of DOT, time between development of symptoms and diagnosis, ethnicity, migrant status, and country of origin.

TB = tuberculosis; WHD = Waikato Health District; DOT = directly observed treatment; OR = odds ratio; CI = confidence interval.

### Treatment outcome

The outcome of treatment was documented for 214 (88%) cases of TB, with 79% of patients for whom data were available successfully completing treatment. Directly observed treatment (DOT) was not universally employed in the study period, but all cases in which DOT was utilised completed their treatment course. There were 22 deaths, seven of which were directly attributable to TB (case fatality rate = 2.9%). Logistic regression analysis was undertaken to determine which factors significantly contributed to a favourable treatment outcome (Table 2). Treatment completion rates significantly improved during the study period (odds ratio [OR 1.15], 95%CI 1.04–1.27). This improvement was mainly explained by the increased use of DOT, which in turn was related to the changing demographic profile of the patients, and in particular use of DOT in patients from migrant communities (Table 2).

## DISCUSSION

This study demonstrates major changes in the demographic characteristics of TB notifications in a rural health district of New Zealand over a 10-year period. These changes have major implications for TB control activities at the study site, which may be generalisable to other parts of New Zealand and to other high-income countries with a relatively low incidence of TB.

### TB incidence in the Waikato, a rural health district of New Zealand

The incidence of TB in New Zealand has been increasing in recent years, and New Zealand now has an average annual rate of TB of 10/100 000.<sup>8</sup> This is comparable to the UK (10/100 000), but is higher than in the US (6/100 000), Canada (7/100 000) and Australia (5/100 000).<sup>1,8</sup> Although the validity of international comparisons is limited by variations in case detection and reporting practices, the higher rates in New Zealand have raised concerns about the effectiveness of current prevention and control activities.<sup>8</sup>

There are considerable regional differences in the

incidence of TB in New Zealand, with higher rates in urban areas related to the geographic distribution of ethnic groups most affected by disease.<sup>8,20</sup> The major multi-cultural urban regions of Wellington and Auckland have a high incidence of overseas-born cases,<sup>2,4</sup> and also report the highest rates.<sup>8</sup> This study shows that TB incidence in the WHD has remained stable.

In the WHD, most TB cases live in rural areas. People living in the rural WHD are not disadvantaged by delays in diagnosis or reduced cure rates, but by distance from secondary health care services. The proportion of urban TB cases is increasing, and the tendency for new migrants to reside in urban Hamilton is likely to accelerate this trend.<sup>20</sup> As Hamilton becomes a major urban centre this will increase the potential for the region's TB incidence rate to climb. The implication for TB control services in this region, as in other regions and low-incidence countries, is the need to remain reactive to the changing geographical distribution of TB cases, and to retain the flexibility to incorporate these changes into their service delivery.

### Ethnicity, country of birth and TB

This study highlights the significant increase in the incidence of TB in the overseas-born population, and the associated dramatic reduction of TB in the Maori population in this region, echoing the findings of other New Zealand studies.<sup>2–4,8</sup>

The decline in the incidence of TB in the Maori population has been encouraging. This reflects a similar decline in the Auckland region, where the indigenous TB incidence fell from 191 cases/100 000 in 1974, to 37.8/100 000 in 1992–1993,<sup>4</sup> and 10.5/100 000 in 1999.<sup>3</sup> This decline in TB incidence in indigenous people has also occurred in Native Americans<sup>21</sup> and the aboriginal people of Canada.<sup>22</sup> By contrast, no decline in TB in the indigenous Australian population has occurred.<sup>23</sup> It should be noted that the Statistics New Zealand denominator data included individuals in more than one ethnic group if the individuals wished,<sup>10</sup> and unfortunately this could not be adjusted for. This has the potential effect of inflating the ethnic group population data, with the net result that age-standardised rates for the ethnic populations may be marginally higher than those calculated in the analysis. However, this issue is unlikely to explain the whole of the decrease in TB rates in Maori shown in this study. An alternative explanation is that it reflects a local TB outbreak in 1992–1993; however, this explanation has less merit because the decreasing incidence reflects a similar overall decline in the neighbouring Auckland province.<sup>3,4</sup>

Several factors are thought to be responsible for the decrease in TB incidence. One is improved secondary prevention by the TB control programme through improved contact tracing and treatment adherence monitoring. This was confirmed by a significant improvement in the number of TB cases who completed treatment and was significantly aided by the use of

DOT. An improvement in the health status of Maori<sup>24</sup> may also be an important associated factor, the measurement of which is beyond the scope of this study.

Despite this improvement, in 2001 Maori in the WHD still had a TB incidence rate five times that of the non-indigenous New Zealand population. It is interesting to contrast the WHD with other, similar countries with indigenous populations. In indigenous Australians, TB notification rates are 10 to 15 times higher than for non-Aboriginal Australians,<sup>23</sup> Canadian aboriginal people have 18 times the incidence rate of Canadian-born non-aboriginal people,<sup>22</sup> and Native Americans in the US have an incidence two to three times higher than in the non-indigenous population.<sup>21</sup>

Like other indigenous populations, Maori have increased risk factors for TB, including poor socio-economic status, diabetes, renal disease, smoking, alcohol abuse and poor nutrition, all of which need to be addressed.<sup>8,23</sup> Although the TB control programme targeting the Maori population in the WHD has shown some success, these increased risk factors, in addition to delays in diagnosis (possibly resulting from difficulties in accessing primary health care services), and limited public health funding will continue to hamper efforts at TB eradication. Similar problems face control programmes in other New Zealand health districts and countries such as Australia, Canada and the US.<sup>11,22-23</sup>

In the WHD, the increased incidence of TB in the overseas-born population also reflects international trends<sup>11</sup> and current immigration policies.<sup>2</sup> Of the overseas-born cases, almost half were refugees who had originated from the high TB prevalence regions of South-East Asia and the Horn of Africa; high TB rates have been documented in refugees from these regions.<sup>3,25</sup> Tuberculosis control strategies in refugees and immigrants from high-incidence countries are an important issue for their countries of origin and for recipient countries such as New Zealand.<sup>26</sup>

Similar to other recent studies,<sup>2-4</sup> this study demonstrates an increased incidence of TB in immigrants after resettlement. It also shows that migrant communities are settling in low socio-economic urban areas with cultural and structural barriers to health services, education, employment and adequate housing, which is hampering efforts at TB eradication.<sup>20</sup> These barriers will be explored in a second paper in preparation.

Calls have recently been made for improvements in New Zealand immigration screening policies.<sup>3,4</sup> One of the areas needing review, identified in this study, is the lack of formal screening requirements for immigrants arriving under the 'family unification category' and for overseas students. As a result of discussions between the New Zealand Immigration Service and the Ministry of Health, a number of changes to TB screening of migrants have recently been proposed.<sup>8</sup>

This study concurs with international studies on

the need for ongoing TB surveillance in immigrant populations, in addition to pre- and post-migration screening.<sup>25</sup> The national shortage of screening resources is an impediment to attaining an appropriate level of TB surveillance, and there is a need for a shift in government policy to facilitate this. Improvements in case prevention in the WHD and other New Zealand health districts may be possible with updated guidelines and better implementation of screening policy.

#### *Developing more effective TB control strategies for the WHD*

There is a need for the health service to respond to the demographic changes of TB notifications in the WHD observed during the 10-year period of this study. The increasing number of overseas-born cases and the continued relatively high incidence in the Maori and Pacific Island populations highlights the need for more effective TB control strategies. The implications of not meeting this change in the epidemiology of TB include the risks of an accelerating incidence of TB, increased numbers of HIV-associated cases,<sup>27-28</sup> and potential increases in MDR-TB.<sup>29</sup> As in other countries that have indigenous and overseas-born populations, these TB control strategies would incorporate appropriate immigration screening for migrants<sup>3,4</sup> and targeted ongoing surveillance of high TB incidence populations.<sup>25</sup> The importance of correct and rapid diagnosis, appropriate treatment and efficient contact tracing cannot be underestimated. The increased utilisation of DOT for TB cases<sup>22</sup> and epidemiological surveillance of the genetic markers of isolated TB organisms would be an important aspect of this strategy.<sup>7,29</sup> Ensuring that TB health services are appropriately geographically situated to target the predominance of TB cases that occur in the rural WHD, in addition to the significantly increasing proportion of urban cases, is also important.

Another strategy integral to TB control in indigenous and overseas-born populations, both in New Zealand and internationally, is improvements in their socio-economic status and community involvement in disease management.<sup>30-32</sup> These aspects could be addressed through an intersectoral approach to TB services such as that recently developed by Intersect Waikato, to improve services for migrants in this health district.<sup>30,31-33</sup> Increased interaction with primary health care organisations (PHO) will also facilitate this. Similar changes should be considered in other regions of New Zealand, and in Australia, Canada and the US.

## **CONCLUSION**

The study highlights the need for a TB control programme in a predominantly rural region of New Zealand to develop strategies to control the rising

incidence of TB in the overseas-born population, and to continue to reduce the incidence of TB in the region's Maori population. These strategies will include the continuing development of culturally appropriate and geographically targeted services, immigration TB screening, and targeted surveillance for high-risk populations. For this to occur and for the incidence of TB to fall further in these population groups, adequate public health funding must be secure.

The implications of these challenges for the current TB control programme in the WHD are of equal relevance to TB control in other parts of New Zealand and in other countries with indigenous populations and a low national prevalence of TB.

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### RÉSUMÉ

**CONTEXTE :** Le District de Santé de Waikato (WHD), Nouvelle-Zélande.

**OBJECTIF :** Décrire les modifications de l'épidémiologie de la tuberculose (TB) dans le WHD ainsi que les facteurs qui en sont responsables.

**SCHÉMA D'ÉTUDE :** Étude épidémiologique descriptive de tous les cas déclarés de TB dans le WHD entre le 1<sup>er</sup> janvier 1992 et le 31 décembre 2001. Critères princi-

paux de résultats : retard de diagnostic et résultat du traitement.

**RÉSULTATS :** Ont été inclus 244 cas. Au cours de la période de 10 ans, l'incidence de la TB est restée stable dans le WHD. On a noté une réduction significative de la TB dans la population Maori (de 30,3 à 12,5/100.000 ;  $P = 0,03$ ). Ceci a été parallèle à une augmentation de la population née outre-mer (4,6 à 21,2/100.000 ;  $P =$

0,04). La tuberculose est devenue une maladie à prédominance urbaine au cours de la période d'étude. Le retard du diagnostic (>4 semaines) est survenu dans 85% des cas et un retard de diagnostic significativement plus élevé est survenu dans les groupes d'âge plus avancé. Ont été en association avec une amélioration des résultats du traitement, l'utilisation du traitement directement observé (OR 3,65 ; IC95% 1,24-10,76) et le fait d'être un immigrant (OR 3,52 ; IC95% 1,74-7,09).

**CONCLUSION :** Une modification significative de l'épidémiologie de la TB est survenue au cours de la dernière décennie. Des stratégies de lutte antituberculeuse doivent être développées pour diagnostiquer et traiter avec efficacité des patients provenant de contextes culturels différents.

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#### RESUMEN

**CONTEXTO :** Distrito de Salud de Waikato (WHD), Nueva Zelandia.

**OBJETIVO :** Describir los cambios epidemiológicos de la tuberculosis (TB) en el WHD y los factores que han sido responsables de ellos.

**DISEÑO DEL ESTUDIO :** Estudio epidemiológico descriptivo de todos los casos de TB declarados, provenientes del WHD entre el 1° de enero de 1992 y el 31 de diciembre del 2001. La medición de los resultados se realizó principalmente por la demora del diagnóstico y los resultados del tratamiento.

**RESULTADOS :** Se incluyeron 244 casos. En el período de 10 años, la TB había permanecido estable en el WHD. Se constató una reducción significativa de la TB en la población maorí (de 30,3 a 12,5/100 000 ;  $P = 0,03$ ). Esto se vio aparejado con un aumento en la pobla-

ción nacida en ultramar (4,6 a 21,21/100 000 ;  $P = 0,04$ ). La TB se transformó en una enfermedad predominantemente urbana en este período. La demora diagnóstica (>4 semanas) se observó en el 85% de los casos, con mayor demora diagnóstica en los grupos de edad más avanzada. La aplicación del tratamiento directamente observado (OR 3,65 ; IC95% 1,24-10,76) y el hecho de ser inmigrante (OR 3,52 ; IC95% 1,74-7,09) fueron factores significativamente asociados al mejoramiento de los resultados del tratamiento.

**CONCLUSIÓN :** Se ha observado un cambio significativo de la epidemiología de la TB en la última década. Es necesario desarrollar estrategias de control de la TB para diagnosticar y tratar eficazmente los pacientes que provienen de diversos contextos culturales.

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