

# Long-term trends in Indigenous deaths from chronic diseases in the Northern Territory: a foot on the brake, a foot on the accelerator

David P Thomas, John R Condon, Ian P Anderson, Shu Q Li, Stephen Halpin, Joan Cunningham and Steven L Guthridge

There are too many funerals; too many Aboriginal and Torres Strait Islander men and women die too early. New research is not needed to restate this ignominy, but Indigenous people, policymakers and all other Australians need to know if this problem is getting better or worse. This is not always possible because of limitations in data quality and availability.

Recent research has shown long-term reductions in Indigenous mortality in the Northern Territory. Trends in NT Indigenous all-cause mortality rates can be described because appropriate datasets for both deaths and population estimates from 1967 to 2000 have recently been developed; trends in specific causes of death can only be examined from 1977 because a high proportion were coded with an unknown or non-specific cause in earlier years. These datasets have been used to show statistically significant reductions in all-cause mortality, especially in those aged under 5 years, and in deaths from both communicable diseases and injuries in those aged 5 years and over.

In spite of these improvements, the ratio of NT Indigenous to total Australian mortality rates increased, except for a decrease in children aged under 5 years.<sup>1,2</sup> Further, NT Indigenous non-communicable disease mortality did not decrease from 1977 to 2000.<sup>2</sup> Were there differences between diseases in this large category? Mixed changes in cancer mortality, including increases in smoking-related cancer deaths, have already been reported.<sup>3</sup> In this article, we report mortality of the other non-communicable diseases causing the most NT Indigenous deaths<sup>4</sup> — ischaemic heart disease (IHD), chronic obstructive pulmonary disease (COPD), cerebrovascular disease (CVD), diabetes mellitus (DM), renal failure (RF) and rheumatic heart disease (RHD).

## METHODS

We used the previously described long-term time series of death and population data for Indigenous people in the NT, extended to include 2001.<sup>1</sup> Comparison death and population data for the total Australian popula-

## ABSTRACT

**Objective:** To examine trends in Northern Territory Indigenous mortality from chronic diseases other than cancer.

**Design:** A comparison of trends in rates of mortality from six chronic diseases (ischaemic heart disease [IHD], chronic obstructive pulmonary disease [COPD], cerebrovascular disease [CVD], diabetes mellitus [DM], renal failure [RF] and rheumatic heart disease [RHD]) in the NT Indigenous population with those of the total Australian population.

**Participants:** NT Indigenous and total Australian populations, 1977–2001.

**Main outcome measures:** Estimated average annual change in chronic disease mortality rates and in mortality rate ratios.

**Results:** Death rates from IHD and DM among NT Indigenous peoples increased between 1977 and 2001, but this increase slowed after 1990. Death rates from COPD rose before 1990, but fell thereafter. There were non-significant declines in death rates from CVD and RHD. Mortality rates from RF rose in those aged  $\geq 50$  years. The ratios of mortality rates for NT Indigenous to total Australian populations from these chronic diseases increased throughout the period.

**Conclusions:** Mortality rates from IHD and DM in the NT Indigenous population have been increasing since 1977, but there is evidence of a slower rise (or even a fall) in death rates in the 1990s. These early small changes give reason to hope that some improvements (possibly in medical care) have been putting the brakes on chronic disease mortality among Aboriginal and Torres Strait Islander peoples.

MJA 2006; 185: 145–149

tion were purchased from the Australian Bureau of Statistics (ABS).

The dataset included deaths coded according to the revision of the World Health Organization's International classification of diseases used at the time (ICD-8 [8th revision] for deaths registered 1977–1978, ICD-9 for 1979–1996, and ICD-10 for 1997–2002). The ICD groupings for the six diseases in NT government publications were used.<sup>5</sup> The comparability of deaths coded according to ICD-10 and ICD-9 was tested by means of an ABS sample of 34 780 Australian deaths coded according to both methods. The comparability factor (ICD-10 deaths/ICD-9 deaths) ranged from 93.4% to 105.1% for five of the six diseases. The much lower comparability factor of 68.8% for chronic RHD was based on a much smaller sample of deaths, and is of uncertain reliability.

All analyses were of the recorded single final underlying cause of death. Multiple causes of death, only available since 1997,

were compared with the underlying cause from 1997 to 2001.

## Statistical analysis

The annual change in the NT Indigenous mortality rate for each disease was estimated by means of Poisson regression models. The annual change in the ratio of the mortality rate of the NT Indigenous population to that of the total Australian population for each disease was estimated by means of negative binomial (rather than Poisson) regression models, as these data were found to be over-dispersed.

Models were built based on deaths from each of the six chronic diseases as the outcome variable, and the population for each age and sex group for each year as the exposure variable. Age was grouped in 5-year categories. Models tested variables for death year, sex, age, age squared (and a dichotomous variable distinguishing NT Indigenous deaths from total Australian deaths in the ratio trend models), and inter-

### 1 Estimated change in Northern Territory Indigenous mortality rates, 1977–2001\*

Disease	Deaths	Per cent average annual change (95% CI)	Per cent total change
Ischaemic heart disease	918	+ 2.5 (1.6 to 3.5)	+ 81.3
Chronic obstructive pulmonary disease	639	– 1.2 (– 2.2 to – 0.1)	– 25
Cerebrovascular disease	441	– 0.6 (– 1.9 to 0.6)	ns
Diabetes mellitus	369	+ 6.4 (4.7 to 8.0)	+ 338
Rheumatic heart disease	201	– 1.1 (– 3.0 to 0.8)	ns
Renal failure	179		
Age < 50 years <sup>†</sup>		– 6.5 (– 10.7 to – 2.0)	– 79.8
Age ≥ 50 years		+ 3.3 (0.8 to 5.7)	+ 117.2

ns = Not statistically significant ( $P \geq 0.05$ ).

\* Estimated by Poisson regression models. † There were only 35 NT Indigenous deaths from renal failure among those aged < 50 years from 1977 to 2001, so estimated average annual changes for this age group should be interpreted with caution. ◆

### 2 Comparison of estimated annual change in Northern Territory Indigenous mortality rates in 1977–1989 and 1990–2001\*

Disease	Per cent average annual change (95% CI)		P <sup>‡</sup>
	1977–1989	1990–2001	
Ischaemic heart disease	+ 5.7 (2.7 to 8.8)	+1.1 (– 1.3 to 3.5)	< 0.05
Chronic obstructive pulmonary disease	+ 3.5 (0.5 to 6.7)	– 5.7 (– 8.6 to – 2.6)	< 0.001
Cerebrovascular disease	+ 0.3 (– 3.3 to 4.0)	– 1.3 (– 4.9 to 2.5)	0.5
Diabetes mellitus	+ 13.5 (7.2 to 20.2)	+3.2 (– 0.4 to 6.9)	< 0.01
Rheumatic heart disease	+ 5.9 (0.4 to 11.7)	+1.6 (– 4.2 to 7.6)	0.3
Renal failure			
Age < 50 years <sup>†</sup>	– 17.1 (– 27.4 to – 5.3)	– 10.5 (– 22.6 to 3.4)	0.4
Age ≥ 50 years	+ 6.1 (– 1.3 to 14.0)	+ 6.0 (– 0.3 to 12.7)	1.0

\* Estimated by Poisson regression models. † There were only 19 (1977–1989) and 16 (1990–2001) NT Indigenous deaths from renal failure in those aged < 50 years in the two periods, so estimated average annual changes for this age group should be interpreted with caution. ‡ Probability that the ratio of estimated annual change in 1977–1989 to change in 1990–2001 is not different from unity. ◆

action terms. Variables were deleted until the most parsimonious model was found.

The estimates of change in the NT Indigenous mortality rate over the entire 25-year period were calculated by raising the estimated annual change to the power of 24: the number of years less one. Dummy variables were added to each model to estimate the annual change in rates and ratios in the first half of the period (1977–1989) compared with the second half (1990–2001), and the effect of the change to ICD-10 on annual change in the NT Indigenous death rates. A sensitivity analysis of the effect of different cutpoints on the comparison between the first and second halves of the period was also performed. The effect of possible coding changes within circulatory diseases was

assessed by building models for all circulatory diseases combined, and for all circulatory diseases other than IHD, CVD and RHD.

To show trends graphically, mortality rates were directly age-standardised and sex-standardised to the estimated NT Indigenous population on 30 June 2001, with the year of death described by means of five 5-year groups.

Stata software (version 8.2; StataCorp, College Station, Tex, USA) was used for statistical analyses. A more detailed technical report about methods and results is available from the first author.

#### Ethical approval

The project was approved by the Human Research Ethics Committee of the Menzies

School of Health Research and the NT Department of Health and Community Services, and by its Aboriginal Ethics Subcommittee.

## RESULTS

In the 25 years from 1977 to 2001, the six chronic diseases caused 2747 deaths among NT Aboriginal and Torres Strait Islander people, comprising 29.7% of NT Indigenous deaths from 1977 to 2001.

### Trends in NT Indigenous death rates

Over the 25 years, NT Indigenous mortality rates increased significantly for IHD and DM and fell significantly for COPD (Box 1). There were decreases in CVD and RHD mortality, but these were not statistically significant. RF mortality trends were different for younger and older people. The mortality rate decreased for those aged less than 50 years, but increased for those aged 50 years and older; both trends were statistically significant, but there were only 35 deaths from RF among people aged under 50 years. The change in coding from ICD-9 to ICD-10 did not appear to significantly modify, and thus explain, these mortality trends.

There were differences in the mortality trends for the six diseases between the 1980s and 1990s (Box 2). For COPD, mortality increased before 1990, but decreased thereafter. Mortality from IHD and DM increased throughout the period 1977–2001, but the rate of increase slowed significantly after 1990. Similar differences between the 1980s and 1990s were found in CVD and RHD death rates, but these differences were not statistically significant. The differences between the two periods were not sensitive to changing the end date of the first period.

A third of circulatory disease deaths (755/2315) were from causes other than IHD, CVD and RHD. There was no statistically significant estimated annual change in all deaths from circulatory disease, but the annual 3.1% decline in deaths from circulatory diseases other than IHD, CVD and RHD was statistically significant.

### Trends in the comparison of NT Indigenous and total Australian death rates

Trends in both the NT Indigenous and total Australian death rates are shown in Box 3. From 1977 to 2001, the Australian direct standardised rates fell for IHD, CVD, RHD

and COPD, remained largely unchanged for DM, and increased for RF. The ratio of NT Indigenous to total Australian mortality rates increased for all six diseases; this increase was statistically significant for all except COPD (Box 4).

**Underlying cause versus multiple causes of death**

In most of the deaths where RF was listed as one of the multiple causes of death in 1997–2001 (79%), it was not listed as the underlying cause of death. In such cases, the underlying disease was most likely to be listed as DM or IHD. This occurred less often in the other five chronic diseases.

**DISCUSSION**

It has previously been reported that NT Indigenous death rates from all non-communicable diseases did not change between 1977 and 2000 (there was a 5% increase which was not statistically significant).<sup>2</sup>

We have now shown that death rates from IHD and DM increased in the NT Indigenous population between 1977 and 2001, and that the gap between the NT Indigenous death rates and total Australian death rates is getting larger for six common chronic diseases. This is consistent with the popular perception that things have not improved for Indigenous peoples and that Australia is becoming less fair.

However, recent research on Indigenous mortality trends has reported more optimistic news. Statistically significant Indigenous mortality declines in the 1990s have been reported in non-communicable diseases (and circulatory diseases in particular) in Western Australia, and communicable diseases in males in WA and South Australia.<sup>6</sup> Indigenous infant mortality declined in NT, WA and SA in the 1990s.<sup>6</sup> Data are of insufficient quality to determine mortality trends in other states.<sup>6</sup>

Similarly, our comparisons between the two halves of the 25-year period give reason for hope. NT Indigenous death rates from all six chronic diseases were increasing more slowly (or even decreasing) in the 1990s compared with the 1980s. If this trend continues, we might see significant improvements in NT Indigenous chronic disease mortality when more data from the current decade are available.

The magnitude of the IHD, COPD and DM trends are all larger than the previously reported all-cause mortality trends in NT Indigenous people aged over 5 years. The

largest estimated trends (in DM deaths and in COPD deaths in 1990–2001) were even greater than the reported fall in mortality in those aged under 5 years.<sup>2</sup>

**Data limitations**

Some misclassification of Indigenous status in the datasets probably occurred, but this is likely to be rare compared with other states and territories. Misclassification of underlying cause of death is known to be a problem in death registrations, including in the NT; deaths from circulatory and respiratory diseases were overcounted and endocrine diseases (mainly DM) were undercounted in a sample of 220 NT Indigenous deaths in 1992.<sup>7</sup> However, no information is available on whether this misclassification of diseases was constant over the 25-year period.

The decline in the other circulatory disease deaths may indicate a trend in the classification of circulatory diseases away from these codes, perhaps even towards IHD codes, and so may account for some of the upward trend in IHD-coded deaths. We are not convinced by the most extreme explanation that would mean that NT Indigenous chronic disease mortality was only increasing for DM, with other death rates constant or falling. But if true, this would paint a less complex and even more optimistic picture of NT Indigenous chronic disease mortality. It seems more likely that the true IHD and DM trends, with their similar risk factors, were in parallel as coded.

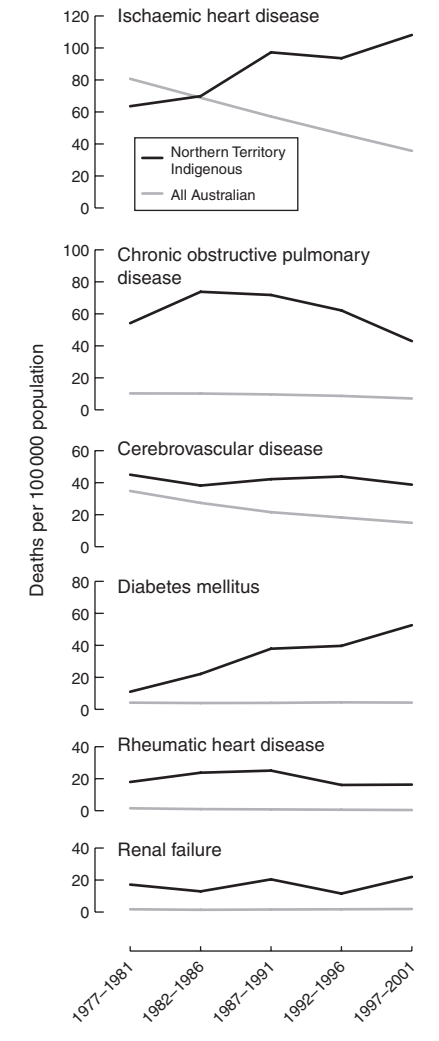
Our analysis of the underlying cause of death, rather than multiple causes, does not adequately count the association of RF with many NT Indigenous deaths, because it is often not subsequently listed as the underlying cause of death.

The regression models provide the most accurate estimates of the 25-year trends as they use data from the whole period, rather than just comparing death rates at the start and end of the period (which is very sensitive to the endpoints chosen).<sup>6</sup> However, the models and their estimates rely on the assumption that the annual percentage change in death rates is constant. This was most clearly untrue for COPD death rates, which increased and then fell. Box 2 and Box 3 indicate where these estimated 25-year trends do not appear to have been constant.

**Patterns in mortality trends**

The patterns of the different mortality trends of the six chronic diseases can be used to generate hypotheses about why these

**3 Northern Territory Indigenous and total Australian death rates, 1977–2001\***



\* Direct age-standardised and sex-standardised to the 2001 NT Indigenous population.

**4 Estimated annual change in ratio of Northern Territory Indigenous to total Australian mortality rates\***

Disease	Per cent average annual change in ratio (95% CI)
Ischaemic heart disease	+ 8.1 (7.0 to 9.1)
Chronic obstructive pulmonary disease	+ 1.2 (0 to 2.4)
Cerebrovascular disease	+ 4.9 (3.5 to 6.2)
Diabetes mellitus	+ 6.5 (4.8 to 8.2)
Rheumatic heart disease	+ 6.6 (4.4 to 8.9)
Renal failure	+ 5.1 (2.7 to 7.6)

\* Estimated by negative binomial regression models.

changes have occurred. The length of the intervening period between changes in determinants and changes in chronic disease mortality is uncertain, may be quite long, and is likely to vary between diseases and between determinants.

**Smoking:** In the NT, 20% of Aboriginal adult deaths in 1986–1995 were attributed to smoking.<sup>8</sup> COPD, IHD, lung cancer and CVD were the four leading causes. We have shown that COPD peaked in the 1980s and began to decline in the 1990s. Decreased smoking was not responsible, as three large surveys in 1986–1987, 1994 and 2002 showed little change in NT Indigenous smoking rates.<sup>9–11</sup> Other possible reasons for the decline in COPD deaths include improved intrauterine growth, fewer childhood infections and less exposure to tobacco, improved nutrition and less overcrowding decades ago, and, more recently, better prevention and management of adult respiratory infections and acute exacerbations of COPD.<sup>12</sup>

**Physical inactivity, poor diet and being overweight:** DM, IHD and CVD are the chronic diseases most associated with physical inactivity, poor diet and being overweight, and rates of death from IHD and DM in the NT Indigenous population had similar upward (although slowing) trajectories, and are the most similar of the six diseases. There are no long-term NT-wide trend data available to accurately describe changes in these behavioural determinants of disease.

**Primary and specialist care:** There is some evidence, at least among people with diabetes, that blood pressure screening and control are routinely occurring in NT Indigenous bush communities at similar levels to those in the non-Indigenous population.<sup>13,14</sup> Reviews of randomised clinical trials show that blood pressure control leads to a reduction in mortality from CVD at least three times greater than that from IHD.<sup>15</sup> This may explain the more modest changes in death rates from CVD than IHD among NT Indigenous people.

The considerable expansion of primary care (clinical, disease prevention and health promotion) services for Indigenous people in the NT from 1977 to 2001,<sup>16,17</sup> combined with more recent increasing attention to chronic disease prevention and management,<sup>18</sup> may have contributed to improving control of hypertension over the period.

Hospital care can prevent deaths from CVD or IHD by improving survival immediately after a stroke or acute myocardial

infarction (AMI). Indigenous people experience significant and dangerous delays in access to NT hospitals after an AMI.<sup>19</sup> NT Indigenous IHD hospital separation rates increased only slightly faster than IHD deaths from 1979 to 1991, whereas CVD hospitalisations nearly trebled when death rates were stable,<sup>20</sup> possibly contributing to the better CVD than IHD mortality trends.

**Birthweight:** Low birthweight and poor infant growth are associated with chronic disease mortality, although the mechanisms and public health significance of this association remain contested.<sup>21</sup> NT Indigenous birthweights improved over the study period,<sup>22</sup> but it is not possible to describe with similar accuracy the birthweight trends of earlier periods, when those dying of chronic diseases in 1977–2001 were born.

**Underlying social determinants of health:** Accompanying (and often driving) the gradual improvements in access to health care have been enormous social, economic and political changes for Indigenous peoples in the NT since the political struggles of the 1960s. Changing experiences of racism and social exclusion in parallel with these political changes, together with improvements in absolute, but not relative, incomes<sup>23</sup> and educational outcomes,<sup>24</sup> may have helped reduce mortality from all diseases.

## Conclusion

There is now evidence that the increase in death rates for all the chronic diseases examined is slowing, or even, as with COPD, beginning to fall. Some developments (possibly including improving access to medical care) have been putting the brakes on increasing chronic disease mortality, but it is not yet clear whether these positive changes will eventually lead to a fall in deaths from all chronic diseases. Now is not the time for giving up or changing everything because “nothing has worked”, but for investigating further what has worked, and for increased and sustained effort to ensure these early promises of the possibility of lasting improvements to Indigenous health are realised in the NT and beyond.

## ACKNOWLEDGEMENTS

David Thomas and John Condon are supported by an NHMRC Population Health Capacity Building Grant. Joan Cunningham is supported by an NHMRC Career Development Award. Core funding for Onemda VicHealth Koori Health Unit (in the Centre for Health and Society) is provided by the Victorian Health Promotion Foundation and the Commonwealth Department of Health and Ageing.

## COMPETING INTERESTS

None identified.

## AUTHOR DETAILS

David P Thomas, MMedSc, PhD, FAFPHM, Postdoctoral Research Fellow<sup>1,2</sup>

John R Condon, MPH, PhD, FAFPHM, Postdoctoral Senior Research Fellow<sup>1</sup>

Ian P Anderson, MB BS, FAFPHM, Director<sup>2</sup>

Shu Q Li, MB, MPH, Epidemiologist<sup>3</sup>

Stephen Halpin, BSc, MSc, Biostatistician<sup>1</sup>

Joan Cunningham, ScD, Principal Research Fellow and Head of Environments, Services and Populations Research Division<sup>1</sup>

Steven L Guthridge, MB BS, MTH, FAFPHM, Director<sup>3</sup>

1 Menzies School of Health Research, Darwin, NT.

2 Onemda VicHealth Koori Health Unit, Centre for Health and Society, University of Melbourne, Melbourne, VIC.

3 Health Gains Planning Unit, Department of Health And Community Services, Darwin, NT.

## Correspondence:

david.thomas@menzies.edu.au

## REFERENCES

- Condon J, Barnes T, Cunningham J, Smith L. Demographic characteristics and trends of the Northern Territory Indigenous population, 1966 to 2001. Occasional paper. Darwin: Cooperative Research Centre for Aboriginal Health, 2004.
- Condon J, Barnes T, Cunningham J, Smith L. Improvements in Indigenous mortality in the Northern Territory over four decades. *Aust N Z J Public Health* 2004; 28: 445–451.
- Condon J, Barnes T, Cunningham J, Armstrong B. Long-term trends in cancer mortality for Indigenous Australians in the Northern Territory. *Med J Aust* 2004; 180: 504–507.
- Dempsey K, Condon J. Mortality in the Northern Territory 1979–1997. Darwin: Territory Health Services, 1999.
- Li SQ, Guthridge SL. Mortality in the Northern Territory 1981–2000. Part 1. Key indicators and overview. Darwin: Department of Health and Community Services, 2004.
- Australian Bureau of Statistics and Australian Institute of Health and Welfare. The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples 2005. Canberra: ABS, 2005. (Cat. No. 4704.0.)
- Weeramanthri T. A medical cause of death: validation study of adult Aboriginal deaths in the Northern Territory of Australia in 1992. *Public Health* 1997; 111: 429–433.
- Measey M, d'Espaignet E, Cunningham J. Adult morbidity and mortality due to tobacco smoking in the Northern Territory, 1986–1995. Darwin: Territory Health Services, 1998.
- Watson C, Fleming J, Alexander K. A survey of drug use patterns in Northern Territory Aboriginal communities: 1986–1987. Darwin: Northern Territory Department of Health and Community Services Drug and Alcohol Bureau, 1988.

## RESEARCH

- 10 Cunningham J. Cigarette smoking among Indigenous Australians, 1994. Canberra: Australian Bureau of Statistics, 1997. (Occasional paper 4701.0.)
- 11 Australian Bureau of Statistics. National Aboriginal and Torres Strait Islander Social Survey 2002. Canberra: ABS, 2004. (Cat. No. 4714.0.)
- 12 Maguire GP. Respiratory health and disease in Aboriginal Australians in the Northern Territory [PhD thesis]. Sydney: University of Sydney, 2004.
- 13 McDermott R, Tulip F, Schmidt B. Diabetes care in remote northern Australian Indigenous communities. *Med J Aust* 2004; 180: 512-516.
- 14 Bailie R, Si D, Robinson G, et al. A multifaceted health-service intervention in remote Aboriginal communities: 3-year follow-up of the impact on diabetes care. *Med J Aust* 2004; 181: 195-200.
- 15 Cutler JA, MacMahon SW, Furberg CD. Controlled clinical trials of drug treatment for hypertension: a review. *Hypertension* 1989; 13 Suppl: I36-I44.
- 16 House of Representatives Standing Committee on Aboriginal Affairs. Aboriginal health. Canberra: AGPS, 1979.
- 17 Territory Health Services. Annual report 2000/2001. Darwin: Government Printer of the Northern Territory, 2001.
- 18 Weeramanthri T, Morton S, Hendy S, et al. Northern Territory preventable chronic disease strategy — overview and framework. Darwin: Territory Health Services, 1999.
- 19 Ong M, Weeramanthri T. Delay times and management of acute myocardial infarction in indigenous and non-indigenous people in the Northern Territory. *Med J Aust* 2000; 173: 201-204.
- 20 Plant AJ, Condon JR, Durling G. Northern Territory health outcomes, morbidity and mortality 1979–1991. Darwin: Northern Territory Department of Health and Community Services, 1995.
- 21 Kuh D, Ben-Shlomo Y, editors. A life course approach to chronic disease epidemiology. Oxford: Oxford University Press, 1997.
- 22 Markey P, d'Espaignet E, Condon J, Woods M. Trends in the health of mothers and babies, Northern Territory, 1986–95. Darwin: Territory Health Services, 1998.
- 23 Taylor J. Indigenous economic futures in the Northern Territory: the demographic and socioeconomic background. Canberra: Centre for Aboriginal Economic Policy Research, 2003. (Discussion paper no. 246.)
- 24 Northern Territory Department of Education. Learning lessons: an independent review of Indigenous education in the Northern Territory. Darwin: Northern Territory Department of Education, 1999.

(Received 5 Dec 2005, accepted 14 Jun 2006) □