Kidney International, Vol. 63, Supplement 83 (2003), pp. S123–S127

Burden of end-stage renal disease among indigenous peoples in Australia and New Zealand

STEPHEN P. MCDONALD and GRAEME R. RUSS

ANZDATA Registry, The Queen Elizabeth Hospital, Woodville South, South Australia, Australia

Burden of end-stage renal disease among indigenous peoples in Australia and New Zealand. Rates of end-stage renal disease (ESRD) among indigenous people in Australia and New Zealand are considerebly higher than the non-indigenous population. This trend, apparent for several years, is described here using data from the Australia & New Zealand Dialysis and Transplant (ANZDATA) Registry. The average age at start of renal replacement therapy (RRT) is approximately 10 years less than non-indigenous people. Among those starting RRT, rates of "diabetic nephropathy" are higher among indigenous patients, reflecting higher rates of diabetes. The increased burden of illness extends to coronary artery disease and chronic lung disease, which are present at rates 1.5 to 2 times non-indigenous rates. Once dialysis treatment has commenced, indigenous people are less likely to be placed on the active cadaveric transplant waiting list, and less likely to receive a graft. Overall mortality outcomes are poorer for indigenous patients overall, and for each RRT modality. These outcomes are not simply due to increased frequency of co-morbid illness: for indigenous people receiving dialysis treatment the mortality rate adjusted for age and gender is around 1½ times the non-indigenous rate. These data are consistent with studies showing increased rates of markers of early renal disease (in particular albuminuria) among both Australian and New Zealand indigenous groups, and reflect a broader health profile marked by high rates of diabetes, cardiovascular disease and chronic lung disease. Addressing these issues is a major challenge for health care providers in these regions.

Indigenous peoples from Australia and New Zealand are comprised of several ethnically distinct groups. Aboriginal Australians are believed to have arrived in Australia 40 to 50,000 years ago, and currently number around 400,000 (2% of the overall population) [1]. The other Australian indigenous group is Torres Strait Islanders (TSI), who are of Melanesian origin and comprise around 11% of the Australian indigenous population. For reasons of small numbers, they are considered with Aboriginal Australians here.

In New Zealand, Maori are considered the first "indigenous" group; they are believed to have arrived from Polynesia in the 10th century and number 14.5% of the total NZ population of 3.8 million [2]. In more recent times migrants have arrived from other Pacific Islands in the region (Samoa, Cook Islands, Tonga, Niue, Fiji, Tokelau), and these now number 5.6% of the New Zealand population. They are included here because of their similar origin and health profiles to the Maori group.

In both countries, the health profile of indigenous groups has been poor, with life expectancies considerably less than nonindigenous groups. Other issues associated with indigenous status in both Australia and New Zealand are characteristic of populations suffering from the crisis of social, cultural and environmental transition, and include high birth rates, poor nutrition, poor education, high rates of unemployment, tobacco use, alcohol use, and poverty, and overall low socioeconomic status.

END-STAGE RENAL DISEASE INCIDENCE

The incidence of end-stage renal disease (ESRD) among all groups (including non-indigenous) has risen steadily over time, but the excess among indigenous groups has remained (Fig. 1). These differences become even more dramatic when age-adjusted (about 1.6 times higher [3]), as the ages of indigenous people commencing ESRD treatment are substantially younger than non-indigenous (Table 1).

These incidence rates are not constant across different areas; in Australia rates of ESRD among Aboriginal people vary widely from levels similar to non-Aboriginal rates in more urbanized areas to rates in excess of 1000/10^6/year in remote areas [4]. The areas of excess rates can also be characterized by poorer socioeconomic indices and access to health services as well as geography [5].

The etiology of renal disease among indigenous people in Australia and New Zealand differs from the non-indigenous group. Rates of diabetic nephropathy are much higher especially among Maori (Table 1). How reliable this rate is remains unclear; overall biopsy rates for ESRD cases attributed to "Diabetic nephropathy"

Key words: Aboriginal Australians, Torres Strait Islanders, Maori, health profile, dialysis, transplantation, Registry data.

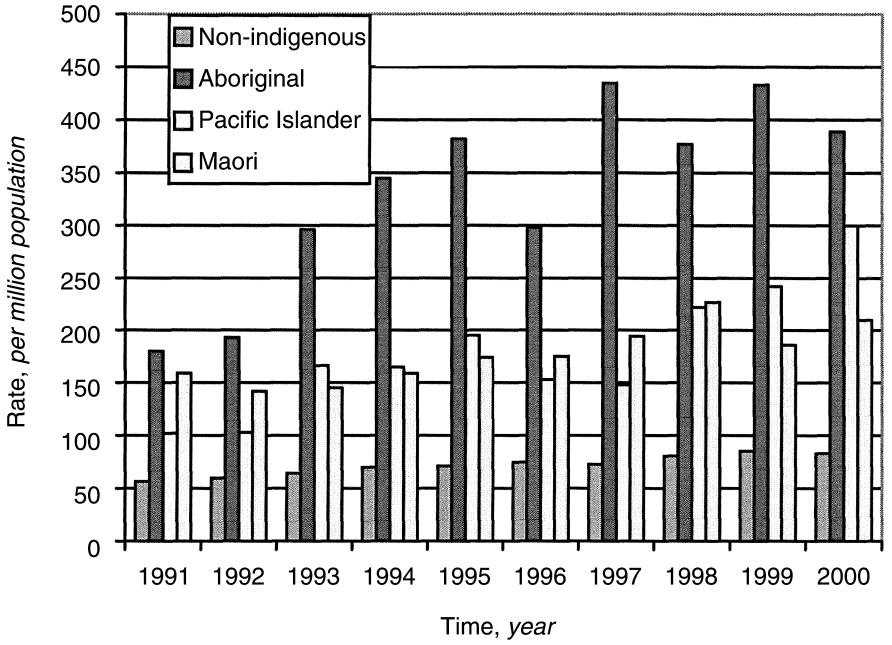

Fig. 1. Incident end-stage renal disease (ESRD) rates for indigenous people for Australia and New Zealand (data are not age-adjusted) [6].

Table 1. Distribution of gender, age and native renal disease by indigenous group for new ESRD patients treated in Australia and New Zealand 1991–2001 [6]

Group	Male %	Age at ESRD entry median (IQR)	Diabetic nephropathy %
Non-indigenous	59	60 (45–69)	17
Indigenous Australians	43	48 (40–57)	47
Maori	57	44 (45–61)	63
Pacific Islanders	48	51 (40–61)	55

Abbreviations are: ESRD, end-stage renal disease; IQR, interquartile range.

are around 20% in non-indigenous and Aboriginal Australians and as low 5% for Maori and 8% for Pacific Islanders, suggesting that an opportunity for reporting bias may arise.

The higher rates of comorbidities present in indigenous people starting ESRD treatment reflect the poorer general health of these groups. For example, age specific rates of coronary artery disease and lung disease are 1.5 to 2 times higher among indigenous ESRD patients [6]. This is consistent with the findings in the non-ESRD indigenous community, where ischemic heart disease and chronic lung disease are responsible for substantial proportions of the excess morbidity and mortality in these groups.

The greatest excess comorbidity among ESRD entrants, however, occurs for diabetes (Fig. 2). This is due to type 2 diabetes, and reflects the burden of this disease in the underlying populations, where excess rates of diabetes have been well documented among Aboriginal Australians [7] and Maori [8].

ESRD TREATMENT

In theory all modalities of treatment are available throughout Australia and New Zealand. There is variation in practice patterns, however. Around 60% of Maori and Pacific Islander people receive treatment by peritoneal dialysis, consistent with practice for the non-indigenous groups in the North Island of New Zealand. For Aboriginal/Torres Strait Islanders, crude figures suggest they are less likely to be treated with peritoneal dialysis [odds ratio (OR) 0.77, 95% CI, 0.67 to 0.88], but this is due to differences in PD prevalence between Australia states, and when adjusted for this there is no difference (OR 1.0, 95% CI, 0.9 to 1.2; Mantel-Haenszel adjustment by state) [6].

Access to transplantation is lower for indigenous groups, and reflects differences throughout the process. The proportion of patients 15 to 65 years receiving dialysis treatment who have been listed (at least once) on the active waiting list for renal transplantation is lower among Maori and Aboriginal patients (31% for Australian Aboriginal, 34% for Maori and Pacific Islanders, compared to 59% in non-indigenous groups, all comparisons $P < 0.0001$). These differences are not explained by differences in prevalence of comorbidities, since, when stratified by comorbid condition the differences persist [6]. When all comorbid conditions and age category and gender are included in a multiple logistic regression analysis, the OR for listing on the active list for indigenous people compared to non-indigenous is 0.48 (95% CI, 0.42 to 0.54; $P < 0.0001$).

Once on the active transplant waiting list, indigenous people are less likely to receive a graft, with similar rates

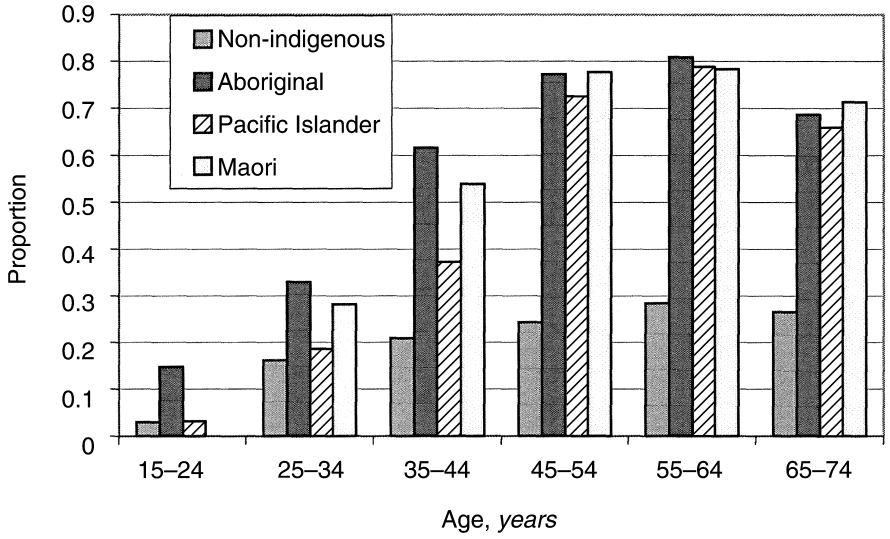

Fig. 2. Proportion of ESRD entrants in Australia and New Zealand 1991 to 2001 with diabetes (at time of ESRD entry) [6].

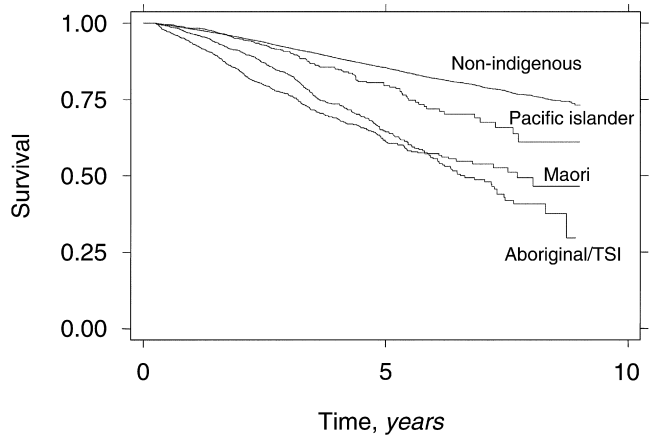

Fig. 3. Survival on renal replacement therapy (irrespective of HD, PD or transplant) by race adjusted for age, gender, diabetes, cardiac and pulmonary disease [6].

among the indigenous groups (overall OR for receiving graft once on waiting list for indigenous person 0.35, 95% CI, 0.29 to 0.43; $P < 0.0001$). Factors contributing to this statistic include lower rates of living related or unrelated transplants for Aboriginal (but not Maori of Pacific Islander) people. For those on the cadaveric waiting list, indigenous people receive fewer grafts allocated on the basis of matching rather than waiting time (OR for receiving cadaveric graft with 0 or 1 mismatches is 0.69, 95% CI, 0.47 to 0.98; $P = 0.03$ for indigenous vs. non-indigenous people).

ESRD OUTCOMES

Overall mortality rates among those receiving renal replacement therapy are higher in indigenous than non-indigenous patients, even when adjusted for traditional co-morbidities (Fig. 3). This is not due to confounding by lower rates of transplantation, as outcomes for each modality of treatment are worse for indigenous than non-indigenous groups.

For those on dialysis treatment, mortality rates for the Aboriginal Australia and Maori groups are significantly higher. This difference applies when adjusted for age category, gender and comorbidity; hazard ratios (HR) for death on dialysis relative to the non-indigenous group are 1.41 (95% CI, 1.24 to 1.60; $P < 0.001$) for Aboriginal, (95% CI, 1.30 to 1.68; $P < 0.001$) for Maori and 0.80 (95% CI, 0.65 to 1.00; $P = 0.05$) among Pacific Islanders [6].

For transplant recipients, there is a similar excess of mortality rates as well as of graft loss (Table 2). Nevertheless, there is a clear mortality benefit when graft recipients are compared with those on the waiting list (Fig. 4).

DISCUSSION

The excess of ESRD among indigenous groups in Australia and New Zealand is striking, and has increased greatly over the past decade. Is some of this increase due to ascertainment bias? Although a possible factor in years past, this is unlikely to apply to the statistics quoted here for the past decade. During that time virtually every community has had access to a health clinic and ESRD treatment services have been provided in all states and territories of Australia and New Zealand. Increased uptake rates of renal replacement therapy are possible, but the age of almost all indigenous ESRD patients is such that they would not be affected by the recent changes in propensity to dialyze the elderly. The absolute size of this epidemic of ESRD ultimately remains unmeasured, because there are no accurate data about the numbers of people dying due to untreated ESRD. Death certificates unfortunately are often inade-

Table 2. Graft survival and patient survival for transplants in Australia and New Zealand 1991–2000, by indigenous racial group

Group	Graft survival, % [95% CI]		Patient survival, % [95% CI]	
	1 year	5 years	1 year	5 years
Non-indigenous	88.6 [87.7–89.5]	77.4 [76.1–78.8]	97.5 [96.9–98.0]	93.1 [91.8–94.2]
Aboriginal Australian	84.5 [77.9–89.3]	48.7 [38.4–58.3]	93.5 [86.1–97.1]	86.4 [75.5–92.7]
Maori	83.3 [75.9–88.6]	58.8 [47.7–68.2]	97.9 [91.7–99.5]	87.9 [71.2–95.0]
Pacific Islander	83.1 [73.4–89.5]	41.6 [26.4–56.2]	96.3 [85.7–99.1]	96.3 [85.7–99.1]

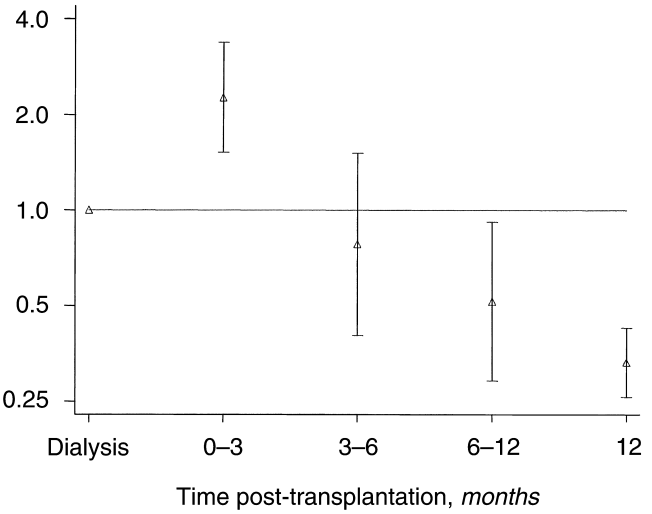

Fig. 4. Hazard ratio for mortality after cadaveric transplantation compared to those on the active waiting list for indigenous people only. Statistics are for the years 1991 to 2000; Cox regression with discrete time varying covariates, adjusted for age category and gender.

quate in attributing causality to chronic illnesses such as renal disease and diabetes.

Not only do these indigenous groups suffer greatly increased rates of ESRD, but the mortality rates on treatment are considerably higher, further emphasizing the burden of disease this imposes. Consistent with the ESRD rates is widespread early renal disease seen in several communities where detailed studies have been performed, in particular showing high rates of albuminuria [8–12]. As well as denoting increased risk of progression to renal failure [13], in this environment albuminuria marks an increased risk of both cardiovascular and all-cause mortality [14, 15].

Although there is the appearance of a "plateau" in the rates among Aboriginal Australians in Figure 1, this needs to be seen in the context of a rapid increase in the proportion of the Australian population counted by the Census as Aboriginal. This increase is in excess of that accounted for by birth rates. An increased propensity to self-identify as Aboriginal is the cause, seen particularly in areas around the capital cities [16]. As rates of renal disease are lower among indigenous people in these areas [4], this will bias the overall Australian indigenous rate downward relative to previous years. Although the variation in absolute rates between communities can be considerable, in communities in the Northern Territory of Australia the pattern of increasing rates is similar between various communities [17]. One can speculate this is related to different phases of the transition between traditional and "Western" lifestyle, depending on the time of exposure to these "Western" influences.

The underlying causes of the excess ESRD rates among indigenous groups have been well studied. A number of factors have been associated with renal disease in addition to the diabetes. Low birth weight [18], reduced renal volume in childhood [19], occurrence of childhood post-streptococcal glomerulonephritis [20], obesity and insulin resistance, alcohol use, repeated acute bacterial infections and hypertension [9] have all been implicated as factors contributing to the high incidence rates.

Although the data here describe ESRD treated in Australia and New Zealand, there is some evidence this increase in rates among indigenous people extends throughout the Oceania region. High rates of ESRD have been described in American Samoa [21] and Saipan (S. Abidi, unpublished data).

Reducing the effect of this burden will require action on several fronts. Improvement of survival rates on renal replacement therapy will require meticulous attention to cardiovascular risk factors. Transplantation brings the need for judicious balancing of the requirement for immunosuppression against susceptibility to infection in a person more likely to have diabetes, coronary artery disease or bronchiectasis, and who is exposed to an environment marked by crowding and repetitive bacterial infections. A further burden on patients receiving hemodialysis therapy is that of distance. Although less of an issue in New Zealand, in Australia many of the ESRD patients live in areas considerable distances from hemodialysis facilities, and treatment thus involves considerable dislocation away from social supports with all its consequences on family, employment, and the community. To try and address this dilemma, several units have examined the provision of dialysis facilities away from large population centers. One approach is to utilize peritoneal dialysis. Although this may seem an ideal approach, it has not been utilized extensively in this group of Aboriginal Australians. Rates of PD are much higher in New Zea-

land, but this reflects practice across all groups. There is evidence, however, that the rates of peritonitis are higher among indigenous than non-indigenous people, with a reduction in peritonitis free survival from 63% among non-indigenous groups to 45% for Australian Aborigines and 35% for Maori and Pacific Islanders receiving PD treatment [22]. Another approach is to decentralize the provision of hemodialysis services. In the region around Darwin (Northern Australia), satellite hemodialysis units have been set up in two locations with some success in improving levels of attendance and adherence to dietary and fluid guidelines (G. Gorham, Royal Darwin Hospital, unpublished data).

Clearly the best option is to reduce the number of people reaching ESRD. Reductions in rates of both ESRD and mortality have been demonstrated in this context with an integrated treatment program using angiotensin-converting enzyme (ACE) inhibitors [23]. In the short term, however, there will be major demands on the health sector to address the need for both preventive and treatment services to counter the increasing burden of disease. The challenge confronting nephrologists is to meet the requirement of improving the level of care and the outcomes for those with chronic renal impairment and ESRD, while at the same time intervening to prevent future disease.

ACKNOWLEDGMENTS

Declaration of Interest

The author's salary is supported by a grant from AMGEN Australia to the ANZDATA Registry.

Unless otherwise stated, the data used here are derived from the Australia and New Zealand Dialysis and Transplant Registry, and refer to the period 1991 to 2000. Their use and interpretation is that of the author and not official Registry policy. The contribution of all Australian and New Zealand renal units, their staff and patients to the Registry is gratefully acknowledged.

Reprint requests to Stephen P. McDonald, ANZDATA Registry, The Queen Elizabeth Hospital, 28 Woodville Rd, Woodville, South, South Australia 5011, Australia.
E-mail: stephenm@anzdata.org.au

REFERENCES

1. Australian Bureau of Statistics: *Population distribution - Indigenous Australians. Catalogue number 4705.0*. Canberra, Australian Bureau of Statistics, 1996
2. Statistics New Zealand: Profile of New Zealand, 2000: *http://www.stats.govt.nz/domino/external/web/ProfileNZ.nsf/htmldocs/People*. Accessed October 28, 2001
3. Cass A, McDonald S, Wang W: Australians with renal disease: A new national survey. *Med J Aust* 171:444, 1999
4. Cass A, Cunningham J, Wang Z, Hoy W: Regional variation in the incidence of end-stage renal disease in Indigenous Australians. *Med J Aust* 175:24–27, 2001
5. Cass A, Cunningham J, Wang Z, Hoy W: Social disadvantage and variation in the incidence of end-stage renal disease in Australian capital cities. *Aust N Z J Public Health* 25:322–326, 2001
6. McDonald SP, Russ GR: Current incidence, treatment patterns, and outcome of end-stage renal disease among indigenous groups in Australia and New Zealand. *Nephrology* 8: In press, 2003
7. Daniel M, Rowley KG, McDermott R, *et al*: Diabetes incidence in an Australian aboriginal population. An 8-year follow-up study. *Diabetes Care* 22:1993–1998, 1999
8. Simmons D, Harry T, Gatland B: Prevalence of known diabetes in different ethnic groups in inner urban South Auckland. *N Z Med J* 112:316–319, 1999
9. Hoy WE, Mathews JD, McCredie DA, *et al*: The multidimensional nature of renal disease: rates and associations of albuminuria in an Australian Aboriginal community. *Kidney Int* 54:1296–1304, 1998
10. Guest CS, Ratnaike S, Larkins RG: Albuminuria in aborigines and Europids of south-eastern Australia. *Med J Aust* 159:335–338, 1993
11. Rowley KG, Iser DM, Best JD, *et al*: Albuminuria in Australian Aboriginal people: Prevalence and associations with components of the metabolic syndrome. *Diabetologia* 43:1397–1403, 2000
12. Shephard M, James J, Allen G, *et al*: *A Preventative Model for Aboriginal Kidney Disease*, in http://som.flinders.edu.au/FUSA/renal/renhome.htm, accessed 10 October 2001
13. Hoy W, Wang Z, van Buynder P, *et al*: The natural history of renal disease: Part 1. Changes in albuminuria and glomerular filtration rate over time in a community-based cohort of Australian Aborigines with high rates of renal disease. *Kidney Int* 60:243–248, 2001
14. McDonald S, Wang Z, Hoy W: Physical and biochemical predictors of mortality in an Australian Aboriginal cohort. *Clin Exp Physiol Pharmacol* 26:618–621, 1999
15. Hoy W, Wang Z, van Buynder P, *et al*: The natural history of renal disease in Australian Aborigines. Part 2. Albuminuria predicts natural death and renal failure. *Kidney Int* 60:249–256, 2001
16. Australian Bureau of Statistics: *Experimental estimates of the Aboriginal and Torres Strait Islander Population, Australia, 1998. Catalog number 3230.0*. Canberra, Australian Bureau of Statistics, 1998
17. Spencer JL, Silva DT, Snelling P, Hoy WE: An epidemic of renal failure among Australian Aboriginals. *Med J Aust* 168:537–541, 1998
18. Hoy WE, Rees M, Kile E, *et al*: A new dimension to the Barker hypothesis: Low birth weight and susceptibility to renal disease. *Kidney Int* 56:1072–1077, 1999
19. Spencer J, Wang Z, Hoy W: Low birth weight and reduced renal volume in Aboriginal children. *Am J Kidney Dis* 37:915–920, 2001
20. White AV, Hoy WE, McCredie D: Childhood post-streptococcal glomerulonephritis as a risk factor for chronic renal disease in later life. *Med J Aust* 174:492–496, 2001
21. Crews D: Multiple causes of death and the epidemiological transition in American Samoa. *Soc Biol* 35:188–213, 1988
22. Collins J: Peritoneal dialysis, in *ANZDATA Registry Report 2000*, edited by Disney APS, Adelaide, South Australia, ANZDATA Registry, 2000, pp 44–56
23. Hoy WE, Baker PR, Kelly AM, Wang Z: Reducing premature death and renal failure in Australian aboriginals. A community-based cardiovascular and renal protective program. *Med J Aust* 172: 473–478, 2000