Decreasing rates of natural deaths in a remote Australian Aboriginal Community, 1996-2010

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Abstract

Objective: To examine the trends of all-cause natural mortality for people aged 15+ years in a remote Australian Aboriginal community between 1996 and 2010.

Methods**:** The annual population in the community by gender and age group was obtained from the Australian Bureau of Statistics (ABS). All known deaths and all records of start of renal replacement therapy (RRT) for renal failure were recorded between 1996 and 2010. Five year aggregated death rates were calculated and the changes in natural mortality over the interval were evaluated. Mortality was compared with those of the Northern Territory (NT) Indigenous and non-Indigenous people as a whole from 1998 to 2006.

Results**:** Rates of natural deaths were progressively lower in the third interval 2006-2010 relative to the first interval 1996-2000, with higher, but more rapidly falling rates for females than males. Reductions were most prominent for both sexes in the 65+ age groups, but death rates in females of earlier middle age also trended lower. The trends applied whether or not the starting of RRT was considered as a natural death. There was a similar trend in rates of natural death in the aggregate Indigenous population of NT.

Conclusions: The downward trends probably reflect improvements in risk factor status since the 1960s, all-of-life health interventions, as well as better chronic disease management in the last two decades. The higher death rates in females than males in this community remain unexplained, but the rapid rate of decline of female death rates predicts that this gap will soon be minimised.

Key words: Aboriginal people, mortality, SMR, cohort study, ICD-10

Australian Indigenous people, particularly those living in remote areas, experience significantly higher all-cause mortality, cardiovascular deaths and end-stage renal disease, compared to those in mainstream Australians. [1-6] Other reports show that long term mortality has been improving for NT Indigenous people since the 1990s, and the increase in death rates for the major chronic disease has been slowing. [7-9] We have recently described reductions in deaths from chronic disease in indigenous people in the NT, and again, in remote/very remote living Indigenous people nationwide.[10,11]

One particular remote community in the Top End Northern Territory, which has participated in ongoing research and surveillance for more than 20 years, historically has had the highest rates of renal failure described globally, and a 6-fold increase in all-cause natural deaths relative to non-Indigenous Australians.[1,12] In 1911, the Catholic Church founded a mission that was one of the earliest sites for improved health service delivery. This was one of the earliest communities in remote areas of Australia to experience dramatic reductions in infant and childhood mortality, as we have described between the mid 1950s to the 1980s. [13] It was the also site of the first community-based dialysis unit, which was established about 14 years after the first community member started renal replacement treatment (RRT) in 1985, the setting in which the benefit of regular chronic disease surveillance and treatment in reducing natural deaths and renal failure was demonstrated, [14] and the first Australian site where the contribution of low birthweight to chronic disease and to chronic disease deaths has been demonstrated. [13, 15, 16.]

We have followed health profiles and terminal events in this population since 1992. Here we describe the trend of mortality for residents aged 15+ years between 1996 and 2010.

Methods

The profiles of this community have been described previously.[17, 18] The Aboriginal populations in this community were estimated based on ABS census data in 1996, 2001, 2006 and 2011. [19, 20] The annual Aboriginal population by age and sex for interval 1996-2000 was estimated using the average census figure between 1996 and 2001; the second interval 2001-2005 was based on the average census figure between 2001 and 2006 and the third interval 2006-2010 was based on the average census figure between 2006 and 2011. There were a total of 1,833 Aboriginal people in 1996 census, and 2,267 in 2011 census, with 70% of people aged 15+years in 1996 and 69% in 2010. [19, 20] The population is spread out over three main communities on two islands, with three main community clinics. The annual mortality was examined for subjects aged 15 years and over between 1st January 1996 and 31 December 2010. The documentation of deaths, natural and unnatural, has been described previously.[13, 14, 16] They were taken from community log books of deaths, whether they occurred in the community or in hospital, that were maintained by clinic staff, with the causes and associations described in narrative. This is a unique and valuable resource, because there were no community-specific death data available from the ABS. The currency of those community death records was checked at intervals through direct enquiry at each of the three community clinics. The identity and fate of individuals unknown to the investigators was checked through health workers and senior community members. The documentation of individuals starting dialysis was through the regional (Darwin-based) dialysis unit initially, supplemented later by the local dialysis unit records, and is known to be complete. Deaths were confirmed through the local Catholic Church Burial and Funeral Record, made available to the investigators through the kindness of Father Pat Han.

The annual age and sex-specific death rates were aggregated over each of three 5-year intervals, i.e. 1996-2000, 2001-2005 and 2006-2010, and the trends over those intervals were evaluated. Two approaches to the definition of death were taken. The first is the occurrence of death as commonly accepted, when an individual actually expires. The second is the consideration of the start of renal replacement therapy as a natural death of renal causes. This concept, commonly used in nephrology, acknowledges that without institution of RRT that person would have died of terminal renal failure within weeks or a few months. It provides a standard by which mortality rates can be compared over time, independent of the changing availability or application of RRT (and across populations regardless of the availability of RRT). It also allows a more accurate assessment of causes of death, which is critical for targeted interventions. Although people who start dialysis have actually experienced a "renal death", when they actually expired their recorded cause of death they usually reflects other process, most commonly cardiovascular disease, which is a usual accompaniment of renal disease. In fact, in a large proportion of people dying on RRT Australia-wide, a renal contribution to death is not even acknowledged.[21] By the only existing published estimates, the introduction of RRT in a remote living Aboriginal person in the NT prolongs life by a median of about 3.5 years: thus community-based life expectancy that does not acknowledge RRT as a "renal death" will always exceed the “renal death” life expectancy, to an extent dependent on the number of people on RRT at any time.

Mortality data for Indigenous and non-Indigenous people in the Northern Territory (NT) between 1998 and 2006 were obtained from ABS in the form of de-identified death unit record files, and were used for comparison with the aggregated mortality data in the study community during the same period. The underlying cause of death was determined from the 10th version of the International classification of diseases (ICD-10) associated with the NT mortality data. The coding includes: all cause death codes between A00 and Y98 and all natural death codes between A00 and R95. These ABS death data address final expiration only, and do not accommodate considerations of RRT or calculations of renal-inclusive natural deaths.

The estimated resident populations of NT were derived from ABS publications. [22, 23] Mortality data for NT people were indirectly standardised for age and sex using the demographic structure of this study community as a reference population.

All data management and statistical analyses were undertaken using Stata 11.1 (Stata Corp. Stata Statistical Software: Release 11.1, College Station. TX: StataCorp LP, 2009). Pearson's Chi-square test was applied to examine the difference in death rates between different interval periods. The standardised mortality ratios (SMRs) and mid-P exact 95% confidence intervals were also determined. Statistical significance was defined at the level of $p < 0.05$ (two-tailed) or if the 95% confidence interval of SMR did not include 1.0.

This study was approved by the Ethics Committee of the Menzies School of Health Research and Territory Health Services and The Behavioural and Social Science Ethical Review Committee of the University of Queensland within the broader context of a longitudinal study of the community.

Results

Profiles of deaths

There were 176 all-cause deaths in males over the overall study interval. Of these, 64 were deaths from misadventure, such as accidents, suicides and homicides and mostly in young adults. There were 112 male deaths from natural causes, four of which were infants and were not considered further. Eight males were on dialysis at the start of the observation period, and another 19 started dialysis during the observation periods (1996-2010). Eighteen males on dialysis died during the observation periods, and 9 were still alive at the end of the observation period. Therefore the following analysis focuses on the 108 “true” natural deaths and 117 “deaths” if 9 participants who started dialysis were included for males aged 15 year and older (“adults” by WHO definition)

There were 150 all-cause deaths among females: of these 11 were deaths from misadventure, and 139 were natural deaths. Five of these were infant deaths and not considered further. Nine females were already on dialysis at the start of the observation period, another 39 started dialysis during the observation period. A total of 32 females on dialysis died during the observation interval and 16 were still alive on dialysis at the end of the observation period. The 134 “true” natural deaths, and 150 “deaths” if 16 participants who started dialysis were included for females aged 15+ years, were the subjects of this analysis.

Trend in mortality by age and sex

Tables 1 and 2 show the numbers of natural deaths of subjects aged 15+ years by gender and 10- yr age group. The first row “a” in each age group gives the number and rates of “true” natural deaths, while the second entry ”b” shows the same data including dialysis starts as renal death, which are, of course, generally higher. Deaths rates increased with increasing age. The table also shows that the total number of deaths by both definitions remained fairly stable over time, despite the increasing size of the populations at most risk. There were apparent reductions in mortality in the third interval relative to the first interval in both sexes and mortality in females decreased steadily over the whole observation period especially in females aged 65+ years. This is demonstrated for the composite definition of death that includes start of RRT as a renal death in Figures 1 and 2. Trends of deaths defined as final expiry were similar, around somewhat lower rates. For people aged 65 +, the trend was significant for males (p=0.041) and all persons (p=0.016) while it was not significant for females (p=0.196).

Figure 3 shows the trends in natural death for this population over the study period. It also shows falling mortality from natural deaths in the aggregated Indigenous population in the NT. Analyses showed that NT Indigenous people aged 50-64 years and aged 65+ years had the highest death rate reduction (data not shown). The high mortality rates in general and the higher rates in females in this community are one substantial difference. However, the steep downward trend in females predicts that this gap between the sexes will soon be minimised.

From 1998-2006, the SMRs of all-cause natural mortality for males aged 15+ years in this community compared with NT Indigenous males was 1.17 (95% CI: 1.10-1.24) and compared with non-Indigenous males was 5.39 (5.09-5.72). The SMRs for females in this community were 1.84 (1.74-1.94) compared with the NT Indigenous females, and 6.77 (6.41-7.13) compared with non-indigenous females.

Table 1 Profiles of natural death in males by age groups.

	1996-2000			2001-2005			2006-2010		
age group	death no.	population	death rate*	death no.	population	death rate	death no.	population	death rate
15-24									
a	1	1115	89.7 (2.3-498.7)	0	1050	0.0	0	998	0.0
b	1	1115	89.7 (2.3-498.7)	0	1050	0.0	0	998	0.0
25-34									
a	2	893	224.0 (271.3-806.7)	3	863	347.6 (71.8-1012.5)	1	900	111.1 (2.8-617.5)
b	2	893	224.0 (271.3-806.7)	3	863	347.6 (71.8-1012.5)	1	900	111.1 (2.8-617.5)
35-44									
a	9	635	1417.3 (650.1-2673.4)	12	728	1648.4 (854.6-2861.6)	6	788	761.4 (279.9-1649.9)
b	10	635	1574.8 (757.7-2877.0)	12	728	1648.4 (854.6-2861.6)	7	788	888.3 (357.9-1821.6)
45-54									
a	8	420	1904.8 (825.8-3718.5)	10	458	2183.4 (1051.9-3978.6)	9	515	1747.6 (802.1-3291.4)
b	9	420	2142.9 (984.4-4028.7)	11	458	2401.7 (1204.9-4256.7)	11	515	2135.9 (1071.0-3789.6)
55-64									
a	6	163	3681.0 (1362.6-7839.5)	8	190	4210.5 (1835.1-8127.6)	10	225	4444.4 (2151.6-8021.4)
b	6	163	3681.0 (1362.6-7839.5)	9	190	4736.8 (2188.6-8801.3)	12	225	5333.3 (2785.8-9130.9)
65+									
a	10	63	15873.0 (7883.4-27259.8)	5	88	5681.8 (1870.4-1276.3)	8	130	6153.8 (2694.0-11765.5)
b	10	63	15873.0 (7883.4-27259.8)	5	88	5681.8 (1870.4-1276.3)	8	130	6153.8 (2694.0-11765.5)
all									
a	36	3289	1094.6 (767.8-1512.1)	38	3377	1125.3 (797.5-1541.3)	34	3556	956.1 (663.0-1333.6)
b	38	3289	1155.4 (818.9-1582.4)	40	3377	1184.8 (847.5-1609.5)	39	3556	1096.7 (781.0-1496.3)

Notes: * aggregated death rate per 100,000 populations (95% CI); a- "true" natural death; b- same natural death data plus number starting dialysis

Table 2 Profiles of natural death in females by age groups

	1996-2000			2001-2005			2006-2010		
	death no.	population	death rate*	death no.	population	death rate	death no.	population	death rate
15-24									
a	1	1040	96.2 (2.4-534.6)	1	948	105.5 (2.7-586.3)	0	930	0.0
b	1	1040	96.2 (2.4-534.6)	1	948	105.5 (2.7-586.3)	0	930	0.0
25-34									
a	1	880	113.6 (2.9-631.5)	1	878	113.9 (2.9-632.9)	3	855	350.9 (72.4-1022.0)
b	1	880	113.6 (2.9-631.5)	2	878	227.8 (27.6-820.4)	3	855	350.9 (72.4-1022.0)
35-44									
a	6	645	930.2 (342.1-2013.7)	5	713	701.3 (228.1-1628.9)	5	828	603.9 (196.4-1403.6)
b	8	645	1240.3 (537.0-2429.2)	7	713	981.8 (395.6-2012.3)	10	828	1207.7 (580.6-2209.8)
45-54									
a	9	448	2008.9 (922.6-3779.2)	13	500	2600.0 (1391.5-4405.0)	12	605	1983.5 (1029.0-3439.1)
b	9	448	2008.9 (922.6-3779.2)	14	500	2800.0 (1539.1-4653.3)	12	605	1983.5 (1029.0-3439.1)
55-64									
a	10	185	5405.4 (2622.2-9715.9)	10	210	4761.9 (2306.8-8582.8)	10	295	3389.8 (1637.3-6145.5)
b	10	185	5405.4 (2622.2-9715.9)	11	210	5238.1 (2643.5-9179.0)	14	295	4745.8 (2618.5-7834.5)
65+									
a	20	145	13793.1 (8633.2-20495.6)	16	150	10666.7 (6221.1-16743.6)	11	150	7333.3 (3717.5-12742.4)
b	20	145	13793.1 (8633.2-20495.6)	16	150	10666.7 (6221.1-16743.6)	11	150	7333.3 (3717.5-12742.4)
all									
a	47	3343	1405.9 (1034.8-1865.2)	46	3399	1353.3 (992.5-1801.1)	41	3663	1119.3 (804.4-1515.4)
b	49	3343	1465.7 (1086.3-1933.2)	51	3399	1500.4 (1119.2-1968.1)	50	3663	1365.0 (1014.8-1795.7)

Notes: * aggregated death rate per 100,000 populations (95% CI); a- “true” natural death; b- same natural death data plus number starting dialysis

Figure 1 Natural death rate in males by age groups and intervals

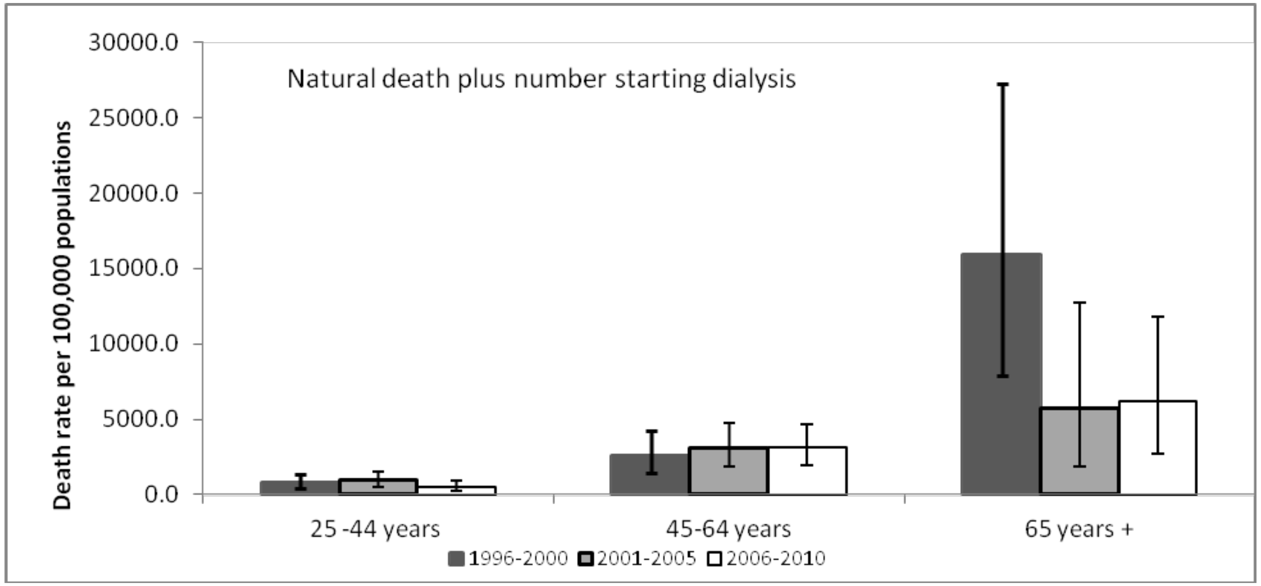


Figure 2 Natural death rate in females by age groups and intervals

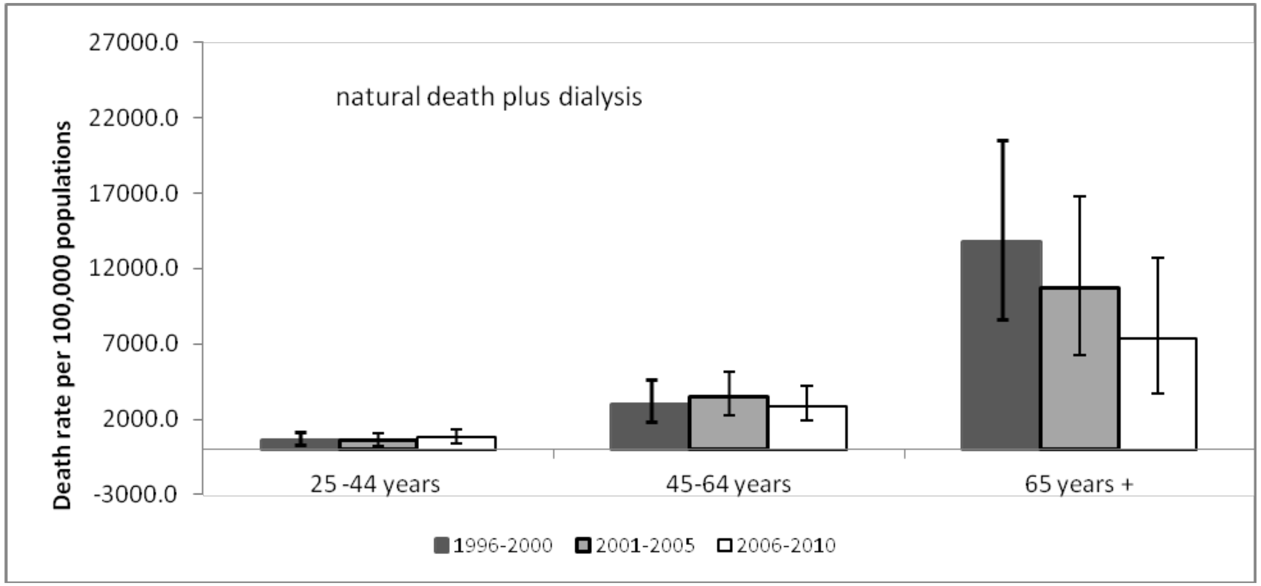
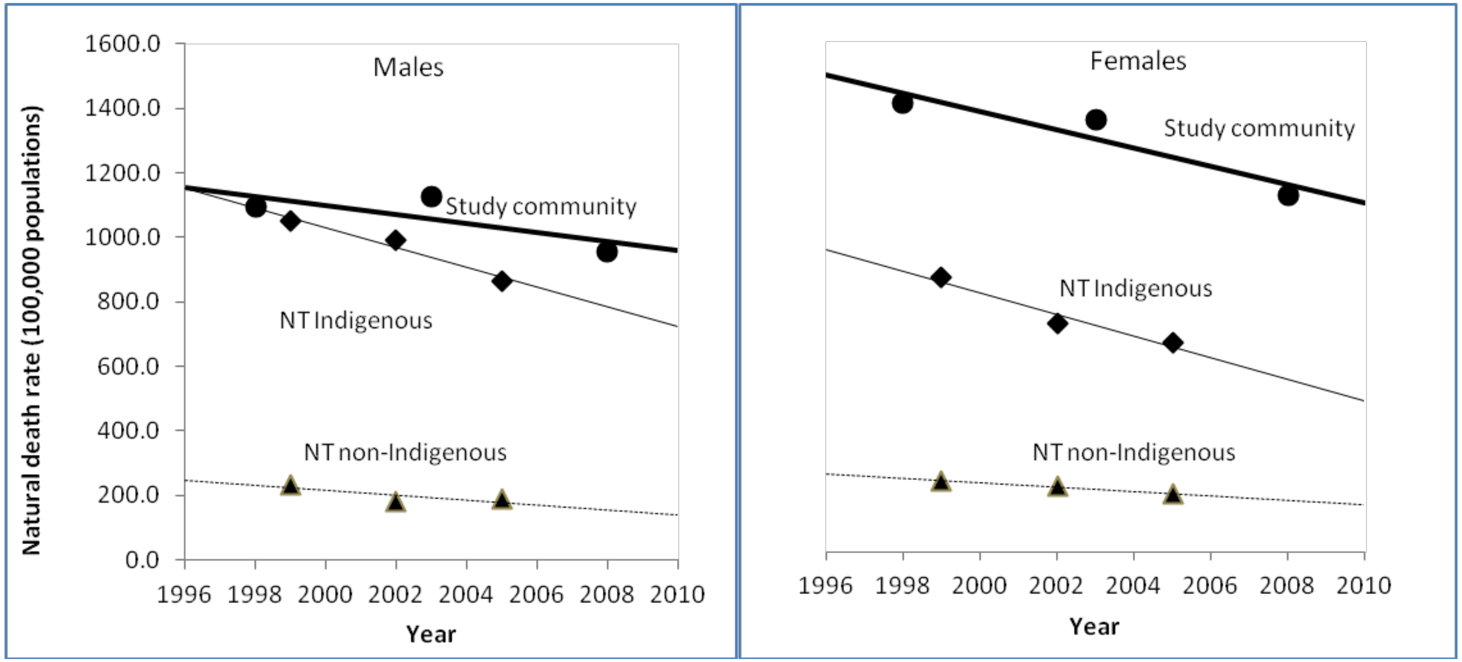


Figure 3 Comparison of all-cause natural death rate between Tiwi community and NT people aged 15 years+



Notes: Data for this Aboriginal remote community were aggregated death rate for period 1996-2000, 2001-2005 and 2006-2010 respectively; data for NT Indigenous and non- Indigenous people were for period 1998-2000, 2001-2003 and 2004-2006 respectively, and NT data were indirectly standardised for age using this Aboriginal remote community as the reference population.

Discussion

Trends in mortality

The study confirms very high death rates from natural causes in this remote Aboriginal community. It also shows the astonishing rates of terminal renal failure, reflected in the numbers of people starting dialysis during the observation interval. These constituted 19/117 or 16.2% of all adult males and 39/150 or 26.0% of adult female natural deaths by the comprehensive renal-inclusive definition. These must be considered in analysis of mortality rates. From previous estimates in this setting,[14] we know that institution of RRT in people with terminal renal failure extends survival by a median of 3.5 years, which will be reflected in reduced overall mortality. On average, in this community, rates of natural death by the renal-death inclusive definition are 8% higher in males and 12 % higher in females than the rates of natural death calculated on final expiry. However, institution of RRT, by prolonging survival, supplements the numbers of people in older age groups (survivors to this point) with individuals with a seriously shortened life expectancy. In this study specifically, of people expiring from natural causes, 18/108 (16.7%) of males and 32/134 (23.9%) females were already on RRT. These people had been experiencing the modest extension of life expectancy conferred by RRT and were surviving to populate older age groups, where, through dying prematurely nonetheless, they could exacerbate mortality rates in those age groups beyond historical levels.

For purposes of comparing mortality rates with those of other populations for whom RRT is not generally available, the valid statistic is the expanded definition of death, which includes institution of RRT as an endpoint. For accurate ascertainment of cause-specific contributions to death, and therefore to potentially guide targeted interventions, this is also the correct statistic to employ. However, comparison with other mortality statistics in Australiia can only employ the “final expiry” statistic, because consideration and timing of RRT is not included those datasets. Such statistics, however, understate the contribution of renal disease to deaths, and overstate the contributions of other conditions, usually cardiovascular events, from which patients on RRT usually die.

This study also shows downward trends in rates of all-cause natural death in the third consecutive 5-year intervals relative to the first interval. Absolute numbers of adult deaths have not risen, despite generally larger population denominators, most markedly in older age groups. The trends applied whether people who started RRT were considered as deaths when (and if) they actually died during the observation intervals, or whether they were considered as deaths at the start of RRT. The trends were largely restricted to the people age 65+ years. Females, who started from a much higher mortality rate in the first interval, had a more marked reduction, which, if sustained, predict that their mortality rates might approach those of males within the next decade. These reductions predict continued ageing of the population, as is already evident in the larger numbers of people aged 65+ in the last interval compared with the first interval, and which is mirrored in an increase in the total population. For example, the aggregated number of Aboriginal people aged 65 + in this community has increased from 63 during 1996-2000 to 130 during 2006-2010 for males, and from 145 to 150 for females. [19, 20] These are important trends.

The credibility of these findings is supported by a similar trend we reported in natural deaths rates of males and females in the aggregate Indigenous population of the NT.[10] That past work also showed that mortality in Indigenous people were higher in remote areas. [24] Moreover the findings are compatible with the recent falling mortality, both as absolute numbers of deaths and as rates, which our group has described in remote communities across Australia in all states/territories that have adequate Indigenous assignment. [11] However, data from our study community differ from the territory-wide data in the relative excess mortality rates for females.

That excess mortality in females is paralleled by the greater predisposition of females to renal failure, with an age-adjusted incidence more than twice that of men in this community. In fact, a female predominance is reflected in RRT data in remote Indigenous communities nationwide. [5] This predisposition results not only in higher rates of renal-inclusive natural deaths, but, given the short life expectancy of people on dialysis, also in higher rates of natural deaths defined as final expiry. The heightened mortality risk in females is marked by their higher prevalence of albuminuria which is more than twice as common as in males, [25] and marks the underlying renal disease. As we have shown repeatedly, and in this specific community, this albuminuria predicts, not only renal failure, but also the majority of nonrenal natural deaths. [17, 18, 26, 27.] Females also have higher rates of diabetes than males throughout the life course, but we have previously shown that all the excess risk carried by diabetes is expressed through concomitant levels of albuminuria.[16]

Factors contributing to excess of albuminuria in females probably include their demonstrated lower birthweights than males, historically and currently, [13, 16] their lack of relative protection against the endemic and epidemic poststreptococcal glomerulonephritis that is rife in this community,[28] and their higher adult BMIs and rates of diabetes, all compounded by the lower nephron endowment, which is a characteristic of females generally. [29, 30] Regardless, it is certain that factors that will reduce or contain albuminuria will mitigate the excess mortality risk females rates are expressing. Moreover, if current rates of decline in mortality in females are maintained, it appears that this excess mortality gap will be greatly reduced or eliminated.

Indigenous life expectancy in the NT has been improved significantly from the late 1960s. [31] The potential reasons for the improvement in life expectancy noted here are many. They include monumental changes in life style, environment, and nutrition, and continually improving health service delivery in all its dimensions of primary prevention (immunisations etc), disease mitigation and retrieval of patients from life-threatening complications. Dramatic reductions in infant and childhood mortality since the mid 1960s have now allowed two generations of babies to survive to adult life, many of them the less robust babies of lower birthweights**,** who, as we have shown in this community, are at higher risk for chronic disease and chronic disease deaths as adults. [15,16] This phenomenon provides a partial explanation for the chronic disease epidemic, and hope for its mitigation as birthweights continue to improve. More recently the application of systematic chronic disease surveillance and treatment protocols for people with early or established disease is improving health and delaying renal failure and death. This approach, first modelled in this community in the late 1990s, faltering later and then readopted, was evident in 2004-2006, when a community screen showed that 30.4% of adults overall, and 52% of those of 50+ years had prescriptions for angiotensin-converting enzyme inhibitors, and 18.1% overall, and 34% of those age 50+ years had prescriptions for hypoglycaemic agents. [32] The principles of chronic disease surveillance and treatment have been endorsed nationally, are well supported by Medicare and PBS items, and increasingly applied in remote Indigenous health services nationwide. Finally, we have shown, in this community, improvement in some chronic disease risk factors in younger adults on no medication, between two community-wide health screens from 1992-1996, and 2004-2006, which indicate a true improvement in baseline health profiles, which we hope can be sustained. [32]

Strengths and limitations

To our knowledge, this is the best long-term study of mortality available for remote Australian Aboriginal community so far. The death information is as well documented as possible, combining data from clinical and burial records with certainty of community assignment provided by elders. The official deaths statistics do not provide those safeguards, and community assignment is incomplete in those statistics. Furthermore, this is the only study that has accommodated considerations of RRT for people with renal failure, and is based in a community in which the recording of RRT has been meticulous. It demonstrates improved survival whether renal deaths are included as natural deaths at time of institution of RRT or whether the date of death is that of true expiry. Findings are supported by a simultaneous fall in territory-wide Indigenous rates of natural death, which does not incorporate considerations of RRT. An additional strength of this report lies in the good ascertainment of Indigenous status among deaths in the NT, ranging from 88% to 94% in 2005, [33] making the mortality comparison between this Aboriginal community and NT Indigenous people more accurate, and the similar trends more reassuring.

There are limitations in this study. We have probably missed some deaths of people who were originally community members. These were most likely people who had been long-term residents in other places, and who died and were buried elsewhere, without a ceremony in the community. Some people who died might also have been counted in the numerator but not in the denominator because the community was not their usual place of residence. This potential error might have lessened over the time as the team has been working with this community from 1992 onwards. In addition, there might also be some underestimation in the denominators supplied by ABS census data. However as the same approach was applied in the three 5-year observation intervals, results still reflect the actual trend change of death rate and it is also a only reliable approach we can use in the analysis. Finally, NT-wide Indigenous mortality data we used for comparison is subject to the vagaries of identfication and recording of Indigenous identifiers [34]

Conclusion

These data support and extend recent reports on improving mortality rates in remote indigenous people. They probably reflect improvements in risk factor exposure since the 1960s, all-of-life health interventions, as well as better chronic disease management in the last two decades. The data are very encouraging for community members and health care providers alike. With decreased mortality for those aged 65+ years, the numbers of seniors will rapidly increase and the Life Expectancy Gap relative to Australians will be reduced. The higher death rates in females than males in this community are related to their higher rates of underlying renal disease. The rapid rate of decline in female death rates predicts that this gap will soon be minimised.

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