Estimating the components of Indigenous population change, 1996–2001

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Abbreviations and acronyms

ABS   Australian Bureau of Statistics
AIHW   Australian Institute of Health and Welfare
ANU   The Australian National University
CAEPR   Centre for Aboriginal Economic Policy Research
FR   fertility rate
IMR   infant mortality rate
TFR   total fertility rate

Summary

Every five years, the national Census of Population and Housing provides a window on the demographic, social and economic characteristics of Australia's Indigenous population. Of particular interest to demographers is the opportunity that this provides to benchmark intercensal population estimates and to estimate the components of intercensal population change. In line with each census count of Indigenous Australians since 1971, when a question on self-identified Indigenous origins was introduced, the 2001 count produced an intercensal change in numbers that cannot be explained by demographic processes alone. Unpredictability thus remains a hallmark of Indigenous population growth.

In accounting for the unexplained component of population growth we refer to changes in census coverage rather than specifically to changes in propensity to identify. The former may include the latter, although to what extent is unknown. In truth, we still cannot determine the factors that contribute to non-demographic population growth, although it is possible to speculate. There is evidence of a highly systematic movement of people into the census-identified Indigenous population in 1996, and out of the population in 2001. This is suggestive of procedural or processing change, as much as anything else.

A striking feature of the 2001 Census analysis is that Indigenous women's fertility has reached, or may even now be below, replacement level, confirming the findings from recent ABS analysis of births registration data. Aside from the momentum for growth already built into the Indigenous age structure, and any further increased identification, it is therefore only the contribution made by Indigenous births to non-Indigenous women that will now sustain Indigenous population growth. Of particular note is a substantial decline in Indigenous teenage fertility. Even if this is independent of any rise in economic participation, it nonetheless reduces one of the barriers to participation and, if it continued, would lead to further downward pressure on fertility. At the same time, Indigenous fertility levels vary regionally, with high levels still reported in many remote regions.

By contrast, the continued lack of convergence between Indigenous and non-Indigenous mortality rates is striking. The census provides confirmation of

mortality estimates from vital registration data and reveals that life expectancy for Indigenous males at 57 years has not changed since 1996, while female life expectancy has only slightly improved to 65 years. Both indicators remain way behind the rest of the Australian population. Comparison is also made with life expectancies among select South Pacific populations; only Papua New Guinea reports life expectancies below those observed among Indigenous Australians. The age profile of mortality indicates that significant progress towards closing the gap can only arise via sustained reduction in excessive rates of Indigenous adult mortality, especially among those over 40 years old.

This is further demonstrated by establishing the year in which infant mortality rates (IMRs) and expectation of life at birth were the same for the total population as they are now for the Indigenous population. Current Indigenous IMRs are at a level last seen for all Australians back in the early 1950s. For overall life expectancy, the corresponding reference point is the early 1920s. Given these excessive time lags in the profile of mortality, even if the pace of mortality change that has occurred among the total Australian population were to now apply to the Indigenous population, it would still take another 40 years before the Indigenous IMR reached the current level observed for the total population. Moreover, unless program efforts aimed at improving health outcomes for Indigenous Australians are dramatically enhanced, with commensurate effects, it will take another seven decades before the expectation of life at birth among Indigenous Australians reaches the level currently recorded for the total population. Clearly, the timetable for Indigenous mortality improvement is long-term, and this adds further weight to the opportunity cost argument that there is an imbalance between health expenditure on Indigenous Australians and their needs.

Acknowledgments

Background

Uncertainties inherent in Aboriginal and Torres Strait Islander population counts reflect the changing nature of race relations in Australia. So pervasive is the connection between the two that the demography of Indigenous Australians has been described as ultimately a 'political demography' (Gray 1985). This is because the statistical basis for constructing an 'Indigenous population' must take account of the interplay between political, administrative and cultural processes—in particular, the variable manner in which States, Territories and the Commonwealth have attempted to enumerate and categorise Indigenous people, and the choices made by respondents to such overtures.

In the not so distant past, these sociological and political processes served to exclude, devalue or deter Indigenous representation in official statistics. By contrast, the contemporary politics of data collection have sought to encourage identification. This is manifest most recently in the greater involvement of Indigenous personnel in the collection of census and survey data, as well as in agreements at ministerial level for the adoption, as a priority, of the standard self-reported Indigenous status question in Commonwealth, State and Territory data collections. Put simply, since the referendum of 1967 there has been an increasing desire on the part of the Commonwealth to count the descendants of the first Australians, and this has coincided with an increasing willingness on the part of Indigenous peoples to be counted.

Potentially, of course, the Indigenous population comprises all persons of any Aboriginal or Torres Strait Islander origin, but in all likelihood official counts reveal only variable fractions of this population at any given time. This mismatch means that Indigenous population counts are inherently incomplete, contestable and inconsistent with one another. Part of the issue here is methodological and relates to the effectiveness or otherwise of methods employed by the Australian Bureau of Statistics (ABS) for enumeration and data processing (Martin et al. 2002). At the same time, the meteoric rise observed in the Indigenous population since 1971 is difficult to attribute solely to census procedures, and must also reflect changes in the responses of individuals to census overtures. Against this background of uncertain parameters, the present paper attempts to account for the components of change in the census counts of the Indigenous population between 1996 and 2001. In the first section we estimate intercensal Indigenous fertility, drawing a distinction between this and the contribution to population growth from Indigenous births to non-Indigenous women. We then apply a range of measures for estimating and analysing Indigenous mortality levels and trends over time. A comparison is also made internationally between the Indigenous Australian population and select populations in the South Pacific region. Finally, we establish the components of intercensal population change and quantify the census error of closure.

Indigenous births and fertility

In vital registration a birth is declared as Indigenous when one or both parents are recorded as being of Indigenous origin (ABS 2001: 18). Consequently, in all official publications, as well as in studies conducted by independent researchers, all births to women who declare themselves as Indigenous on registration forms are employed in the construction of Indigenous fertility. Under normal circumstances, this information should be sufficient to work out the birth component of growth in a population. However, this is not so for the Indigenous population since a distinction may be drawn between Indigenous births and Indigenous fertility. Indigenous births may also be due to non-Indigenous women and Indigenous fathers, while some births to Indigenous women may not be classified as Indigenous.

In recent years, the ABS has endeavored to account for Indigenous births to non-Indigenous women by calculating partial paternity rates for Indigenous males. In these, births registered as Indigenous where the mother was non-Indigenous comprise the numerator, and Indigenous males comprise the denominator. These rates are now routinely employed in estimating the contribution of non-Indigenous women to Indigenous population growth, and in preparing projections of the Indigenous population (ABS 1998). Gray (1997) has proposed an alternative procedure in which births to Indigenous women are inflated by the reciprocal of the proportion of Indigenous births occurring to non-Indigenous mothers to yield total Indigenous births.

Neither approach captures the transaction of births between the Indigenous and non-Indigenous populations in its totality. In an attempt to accomplish this we adopt a slightly different perspective in our estimation of intercensal Indigenous births, by accounting for the cross-contribution of Indigenous and non-Indigenous women to the flow of births in the Indigenous and non-Indigenous populations. The rationale (indicated above) is that Indigenous women's fertility does not just result in Indigenous births: some children of Indigenous women are not identified as Indigenous and therefore contribute to growth in the non-Indigenous population.

Our analysis is based on the 'own-children' procedure for indirect estimation of fertility, using 2001 Census data. This method has been successfully applied in previous estimations of Indigenous fertility using 1986 and 1991 Census data (Dugbaza 1994; Jain 1989), while Abbasi-Shavazi and McDonald (2002) have also applied it in the analysis of immigrant fertility differentials in Australia. The 'own-children' method is a reverse-survival technique of estimating total and age-specific fertility rates for years (up to a maximum of 15) prior to an enumeration (Cho, Retherford and Choe 1986).[1] The main data required are a life table depicting the mortality experience of the study population in the most recent years, and the distribution of children under 10 or 15 years classified by single years of their own age and single years of age of their 'mothers'.[2] The latter information is often generated through matching children enumerated in a

household to 'mothers' living within households, using answers to questions on age and relationship between household members.

These data, cross-classified by the Indigenous status of both children and their 'mothers', were prepared by the ABS as customised tabulations for the purposes of reverse-surviving children and mothers to obtain number of births by age of mother in single calendar years prior to the 2001 enumeration. Reverse survival was similarly applied to the female population, irrespective of whether they have children or not, to estimate the number of women by single years of age for the same period. Following some adjustment for unmatched children, age-specific fertility rates were calculated as a ratio of estimated births to the estimated number of women. The results are presented in Fig. 1 and Appendix Table A1.

Fig. 1. Age-specific fertility rates by Indigenous status, 1991–1996 and 1996–2001
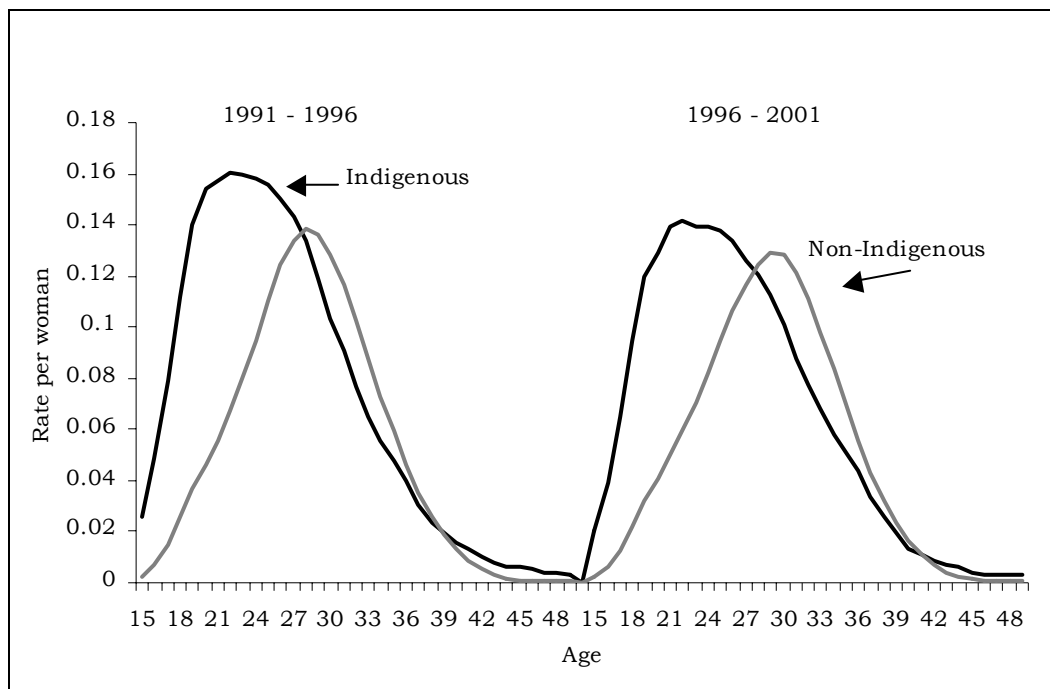
Source: Calculated by the authors from unpublished 2001 Census data.

According to these estimates, the total fertility rate (TFR) of Indigenous women was 2.29 children during the period 1996–2001, and 2.53 children in the previous intercensal period. The corresponding figures for non-Indigenous women were 1.76 for the period 1996–2001, and 1.80 for 1991–1996. Thus, the TFR for Indigenous women during 1996–2001 was 11 per cent lower than the level recorded in 1991–1996. The equivalent rate of decline between the same two periods for non-Indigenous women was 3 per cent, indicating a much more rapid fertility decline among Indigenous women.

As noted earlier, the fertility of Indigenous women does not result solely in Indigenous births. Indeed, about 3 per cent of births to Indigenous women in 1991–1996, and 4 per cent over the 1996–2001 period, were reported as non-Indigenous births. By comparison, around 1 per cent of births to non-Indigenous women in both the 1991–1996 and the 1996–2001 intercensal periods were classified as Indigenous. As a consequence, the rate at which births to Indigenous women are lost to the Indigenous population is greater than the rate of gain to the Indigenous population via births to non-Indigenous women. However, because non-Indigenous mothers are far greater in number this means that in absolute terms the net transfer of births between the populations was very much in favour of the Indigenous side of the ledger. Thus, between 1996 and 2001 an estimated 1,522 births to Indigenous women were classified as non-Indigenous births, while 14,633 births to non-Indigenous women were classified as Indigenous births. Given an overall estimate of 53,812 Indigenous births during the intercensal period, the contribution to Indigenous population growth from non-Indigenous mothers—at 27 per cent—is not insignificant. This proportion has risen steadily over time and will continue to do so as intermarriage rates increase (Gray 1997). One effect of this supply of additional births from non-Indigenous mothers is to constantly augment the base of the Indigenous age structure, leading to sustained and high population momentum.

It should be pointed out that comparison of these results with that of the number of births reported in vital registration data show remarkable consistency. During the intercensal period a total of 52,487 births were identified in vital statistics as Indigenous. This figure is very close to our estimate and implies a coverage rate in vital statistics as high as 98 per cent—an increase on the 95 per cent estimated by the ABS based on registered births against projected population estimates (ABS 2001: 76).

The recent decline in Indigenous women's fertility observed in the present analysis continues a pattern evident since the 1960s towards convergence in fertility levels with those reported for non-Indigenous women, although Indigenous fertility clearly remains higher (see Fig. 2). In the 1960s, the TFR of Indigenous women, then about 5.8, was nearly twice that recorded for all women in Australia. By the late 1970s, the rate for Indigenous women had declined by over 45 per cent to 3.2 births per woman, and the most recent estimate is much lower still at 2.3 for the intercensal period 1996–2001. Of course, the extent to which this trend reflects a real decline in Indigenous fertility or is the result of compositional change in the census-identified female population remains a moot point and requires further investigation.

That aside, it should be noted that the single-year TFR estimate of 2.1 for Indigenous women in 2000 is very close to replacement fertility level, if not already below it given the context of persistently high Indigenous mortality. This figure agrees with the latest estimate of Indigenous fertility from vital registration (ABS 2001: 18), and is significant for public policy for two reasons. First, official projections based on 1996 Census levels (ABS 1998) did not assume fertility levels as low as this until much later in the decade, and new projections will need

to reflect this. Second, if the fertility of Indigenous women is now below replacement level, notwithstanding the effects of population momentum and identification change, then future growth of the Indigenous population will henceforth be dependent on the contribution made by Indigenous births to non-Indigenous women. For demographic accounting and projection purposes, this places greater emphasis on the need to better understand the sociology and politics of identity in charting Indigenous population growth.

Fig. 2. Total fertility rates for Indigenous women and all women, 1958–2001
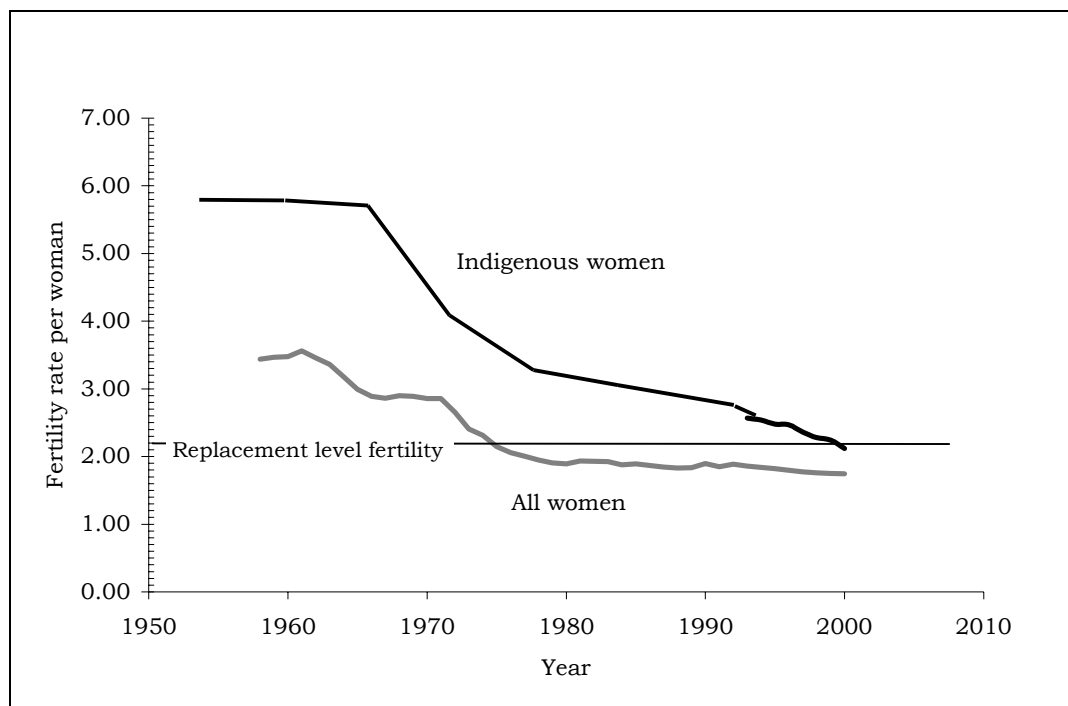
Sources: ABS (2002a); Gray (1997); the authors' calculations from unpublished 2001 Census data.

Decomposition of the rate of fertility decline by age of Indigenous mother reveals a fall in age-specific fertility across most ages (except in the 32–39 age-group), but most significantly among teenage and older women (Fig. 3). At ages under 20 years, rates observed for 1996–2001 among Indigenous women were, on average, about 20 per cent below the 1991–1996 level. This produced a decline in teenage fertility not dissimilar to that observed for other teenage women. Much greater contrast between Indigenous and non-Indigenous women is evident at ages over 30 years with Indigenous fertility in decline beyond age 38, and non-Indigenous fertility rising at all ages over 30. Thus, notwithstanding a clear reduction in Indigenous teenage fertility, relatively high fertility at young ages remains a hallmark of the Indigenous profile (see Fig. 1 and Appendix Table A1). Indeed,

fertility rates of Indigenous teenage women remain almost 4.5 times higher than those of their non-Indigenous counterparts.

Fig. 3. Age pattern of intercensal fertility change by Indigenous status, 1996–2001
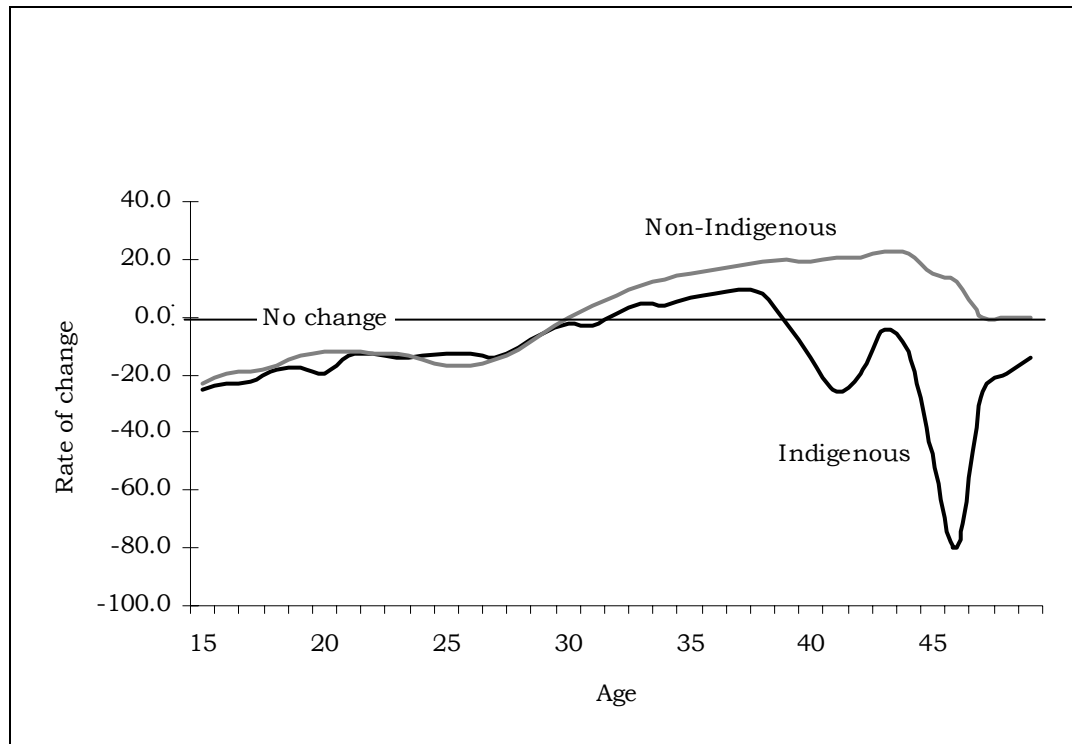
Source: Calculated by authors from unpublished 2001 Census data.

Difference in the age pattern of fertility change between Indigenous and non-Indigenous women partly reflects variation in childbearing patterns. As noted, fertility among non-Indigenous women is concentrated around the middle age-range with considerable delay until well into the 20s resulting in peak fertility as late as the 30–34 age group. By contrast, Indigenous women's fertility is more widely spread across the entire reproductive period, with childbearing generally starting early in life and continuing through to older ages.

Estimates of Indigenous mortality

Incomplete recording of Indigenous status in death records and the experimental nature of population estimates continue to pose challenges in estimating mortality for Indigenous Australians. For the 1996–2001 intercensal period, registration data produce crude death rates of 6.0 per 1000 males and 4.4 per 1000 females, yielding expectations of life at birth of 65 and 72 years respectively. These crude death rates are clearly too low, and the expectation of life too high,

against the background of previous estimates (ABS 2001; Gray 1997). They simply serve to confirm ongoing deficiencies in deaths registration. For this reason, the practice to date has usually been to benchmark Indigenous mortality using a combination of registration data and census counts to produce national estimates (Gray 1990b, 1997; Gray & Tesfaghiorghis 1993), using the balancing procedure due to Preston and Hill (1980). This procedure applies relationships that must hold between successive census counts and registered deaths in the intercensal period to estimate the completeness of the first population count relative to the second census, and the completeness of the estimates of deaths relative to the first census. Similar Preston–Hill estimates are calculated here for the purposes of comparison with previous years, revealing life expectancies at birth for 1996–2001 of 57 years for males and 65 years for females. This indicates no change in mortality for males since the previous intercensal period, and only a slight improvement for females (Gray 1997: 12).

However, the Preston–Hill method has been found to be unstable in practice because cohort deaths obtained from the age distribution of successive censuses are seriously distorted by age misreporting errors, particularly the increasing exaggeration of ages as age increases (Gray 1997; Hill 1987: 9). To alleviate this problem, Hill (1987) has proposed a modification to the method. Rather than focusing on changes in the size of cohorts from census to census, this alternative technique focuses on changes in the size of age groups. We prefer this method here for the more detailed analysis of 1996–2001 intercensal mortality.

Table 1 provides measures of the intensity of mortality generated using Hill's modified procedure. The results show that of those Indigenous children born during the 1996–2001 period, some 3 per cent of the girls and 4 per cent of the boys will die before reaching age 18, while a further 10 per cent of females and 17 per cent of males will have no chance of reaching age 40. These indicators contrast sharply with the data for non-Indigenous Australians. According to results shown in the table, almost 96 per cent of non-Indigenous males and 98 per cent of their female counterparts are expected to die after age 40. The differences in survival rate between Indigenous and non-Indigenous Australians is also further illustrated by the life expectancy values shown in the same table. For instance, a newborn male Indigenous child can expect to live some 59 years as opposed to 76 years for his non-Indigenous counterpart. Similarly, the life expectancy at birth for an Indigenous girl is about 17 years shorter than for her non-Indigenous counterpart.

To place these data in an international context, Figs 4 and 5 compare the chances among Indigenous males and females of surviving to age 65 with selected equivalent populations in the South Pacific region. These data show that as many as 90 per cent of non-Indigenous female Australians, and well over 80 per cent of non-Indigenous male Australians, survive to age 65. As is to be expected, these proportions are higher than for any other population in the region. However, the estimates for Indigenous Australians indicate that only 47 per cent of males and 53 per cent of females survive to age 65. Only Papua New Guinea reports worse

survival outcomes, while Maori and other Pacific populations experience intermediate levels in this regional comparative context.

Table 1. Measures of intensity of mortality by Indigenous status and sex, 1996–2001

Survival measure	Males		Females	
	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
Per cent expected to die before age:				
1	2.7	0.6	2.3	0.5
5	3.1	0.8	2.5	0.6
18	3.9	1.1	3.1	0.8
40	16.8	4.1	9.6	1.9
Expected number of remaining years of life at age:				
0	58.9	75.9	65.1	81.8
18	43.2	58.5	48.5	64.6
35	29.4	42.8	33.1	48.1

Source: Computed by authors from unpublished ABS data.

Fig. 4. Proportion not expected to survive to age 65: Indigenous Australian males compared with selected South Pacific male populations, 1996–2001
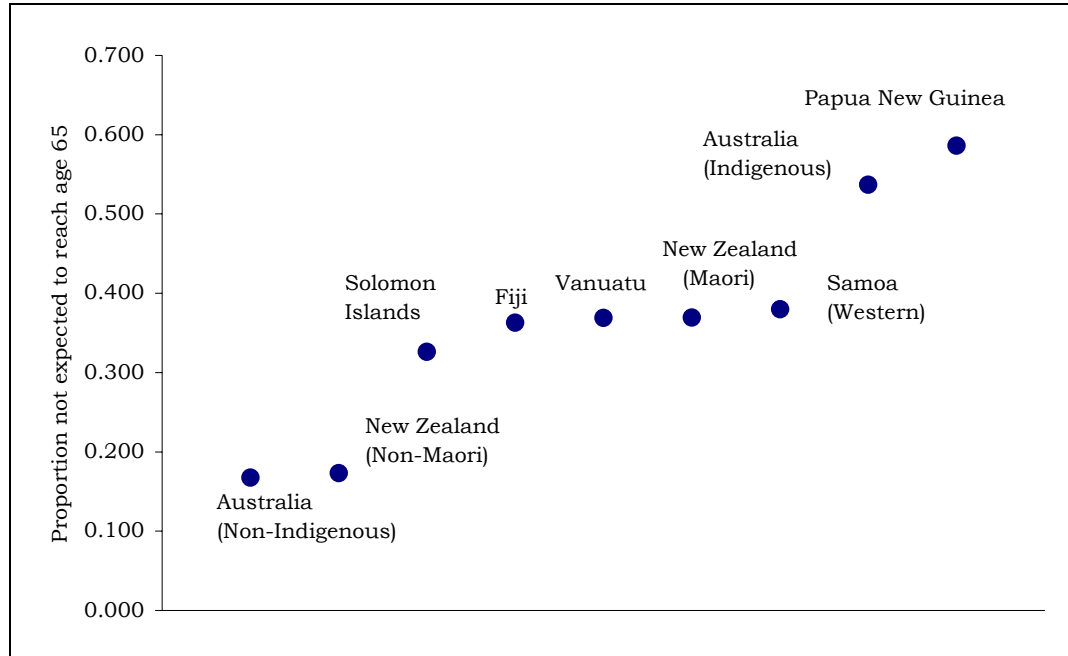
Sources: United Nations (1999); Statistics New Zealand (2000); the authors' own calculations from unpublished ABS data.

Fig. 5. Proportion not expected to survive to age 65: Indigenous Australian females compared with selected South Pacific female populations, 1996–2001
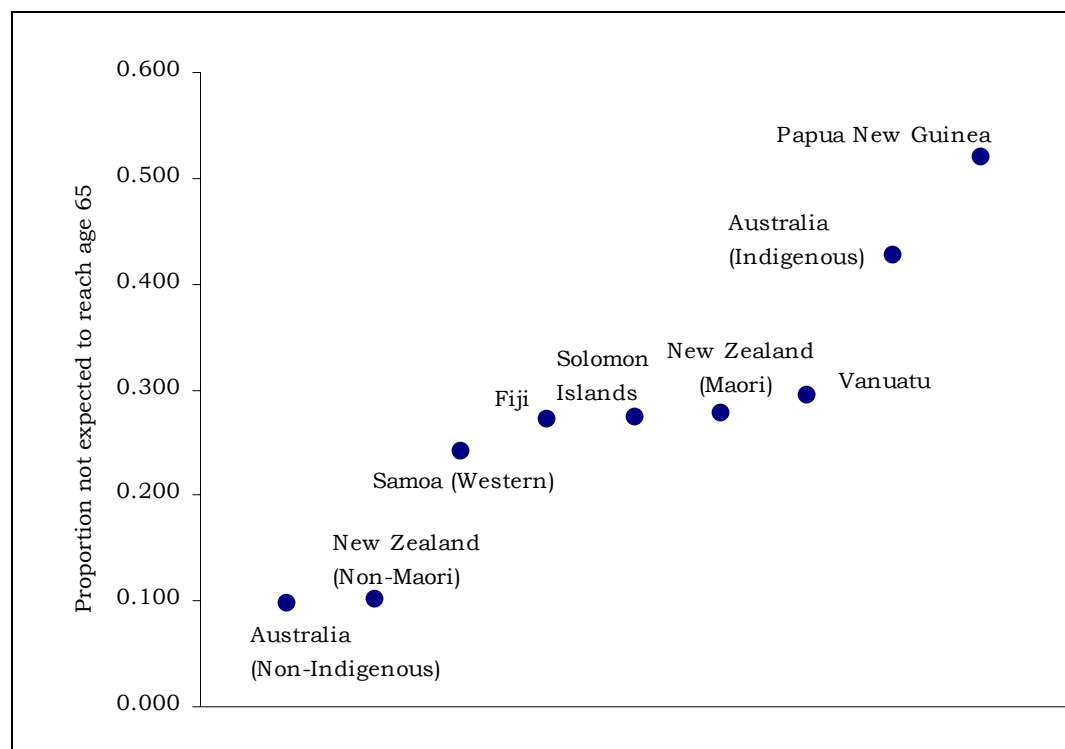
Sources: United Nations (1999); Statistics New Zealand (2000); the authors' own calculations from unpublished ABS data.

Further insight into the age structure of Indigenous mortality is provided by Table 2, which presents probabilities of dying by sex and Indigenous status conditional upon reaching selected ages. According to these data, the chances that a newborn Indigenous male will reach age 15 is about 97 per cent. For those who reach age 15, about 19 per cent will die before age 45, while one-quarter of them will not reach age 50. Statistically, more than half of Indigenous males who reach age 15 have no chance of surviving to age 65. Compared to non-Indigenous males, these results imply an intensity of mortality among Indigenous Australian males which is 2.7 per cent higher than the rest of the population between ages 0 and 15 years, 18 per cent higher between ages 15 and 45 years, and as much as 75 per cent higher between ages 15 and 65 years. Clearly, much of the difference in mortality between Indigenous and non-Indigenous Australians—both male and female—results from a sustained high intensity of Indigenous mortality in adult ages.

Table 2. Conditional probabilities of survival at various ages by Indigenous status and sex, 1996–2001

Survival measure[a]	Males			Females		
	Indigenous	Non-Indigenous	Relative Risk	Indigenous	Non-Indigenous	Relative Risk
$_{15}P_0$	0.9650	0.9908	1.027	0.9718	0.9928	1.022
$_{30}P_{15}$	0.8117	0.9597	1.182	0.8961	0.9829	1.097
$_{35}P_{15}$	0.7528	0.9470	1.258	0.8484	0.9751	1.149
$_{45}P_{15}$	0.5916	0.8936	1.510	0.6976	0.9419	1.350
$_{50}P_{15}$	0.4801	0.8401	1.750	0.5891	0.9083	1.542

Note: a) $_{15}P_0$ represents probability of survival from exact age 0 to exact age 15; $_{30}P_{15}$ represents probability of survival from exact age 15 to exact age 45; $_{35}P_{15}$ represents probability of survival from exact age 15 to exact age 50; $_{45}P_{15}$ represents probability of survival from exact age 15 to exact age 60; $_{50}P_{15}$ represents probability of survival from exact age 15 to exact age 65.

Source: Computed by authors from unpublished ABS data.

The policy impact of this mortality pattern can be demonstrated by establishing the year in which infant mortality rates (IMRs) and expectation of life at birth were the same for the total population as they are now for the Indigenous population. Thus, current IMRs for Indigenous males and females are at a level last seen for all Australian males and females back in 1952 and 1950 respectively (Taylor 2000). In terms of life expectancy, which includes all ages, the corresponding years are 1919 and 1925 (see Appendix Fig. A1). With these excessive time lags in the profile of mortality, even if the pace of mortality change that has occurred among the total Australian population were to henceforth apply to the Indigenous population, it would take another 40 years for the Indigenous IMR to reach the current level observed for the total population. Under the same assumption, unless program efforts aimed at improving health outcomes for Indigenous Australians are dramatically enhanced, with commensurate effects, it will be another seven decades or so before the expectation of life at birth among Indigenous Australians reaches the level currently recorded for the total population.

As Table 3 shows, the key to narrowing the health disadvantage of Indigenous Australians lies in improving Indigenous mortality at adult and older ages. At present, about 6 years (or approximately 33%–35%) of the 17-year difference in life expectancy between Indigenous and non-Indigenous Australians results from excess mortality among Indigenous Australians in the age-group 40–64 years. Put another way, if program efforts to eradicate inequalities in health and socio-economic status for Indigenous Australians between 40 and 64 years were to achieve their aim, then life expectancy at birth among Indigenous Australians would, according to these life table estimates, rise from 59 to 64 years for males and from 65 to 71 years for females. Similar equalisation among infants and children would raise the life expectancy of Indigenous Australians further, to 67 years for males and 73 years for females.

Table 3. Age decomposition of difference in life expectancy at birth between Indigenous Australians and total Australian population, 1996–2001

| Target population | Deficit in life expectancy at birth due to mortality difference in age group: | | | |
| | Males | | Females | |
	Years	% of total	Years	% of total
0–4	2.79	16.5	2.50	15.0
5–14	1.43	8.5	1.23	7.4
15–24	2.44	14.4	1.54	9.3
25–39	2.52	14.9	1.75	10.5
40–64	5.55	32.8	5.82	35.0
65 and over	2.15	12.7	3.79	22.8
All ages	16.90	100.0	16.63	100.0

Source: Calculated by the authors from unpublished ABS data.

Change in the size of the Indigenous population: explicable and inexplicable components

The amount needed to make intercensal increase in a population balance after accounting for births, deaths and migration (if any) is usually small. However, research on the demography of socially-constructed populations reveals that this 'error of closure', as the American demographer Passel (1996) has described it, is often large. Indigenous population growth in Australia provides extreme examples: the share of growth between 1991 and 1996 that could not be accounted for by demographic factors was just over half (51%) of the intercensal increase (Ross 1999: 24). For the most recent intercensal period, the ABS has estimated a reduction in this error of closure to 26 per cent (ABS 2002c). This still leaves a sizeable error of closure, although the ABS estimate is preliminary only, and fairly crude. For one thing, no account is taken of change to census edits for Indigenous status in the ABS calculation,[3] and incomplete vital registration data are used for births and deaths, although, as noted, the use of vitals data is more of a problem for correct estimation of deaths than it is for births. By correcting for census edits, and by applying adjusted estimates of births and deaths, an alternative and improved set of estimates of the components of change is provided, in Table 4.

As indicated, the Indigenous population increased by some 17 per cent between the 1996 and 2001 Censuses. Of this increase, 69 per cent can be explained in terms of natural increase. The unexplained component, which amounts to 19,243 persons, accounts for 31 per cent of the intercensal population change and represents about 4.7 per cent of the total Indigenous count in 2001. This improved estimate of the error of closure is still substantially lower than that observed for the 1991–1996 period (Gray 1997; Ross 1999).

Table 4. Components of intercensal Indigenous population change, 1996–2001

a) Increase in population 1996–2001

	Population count		Increase: 1996–2001		Adjusted Increase: 1996–2001[a]	
	1996	2001	No.	%	No.	%
Kinfu & Taylor	352,970	410,003	57,033	16.2	61,335	17.4
ABS	352,970	410,003	57,033	16.2	Not available	Not available

Note: a) Calculated after deleting 4,302 cases from the 1996 Census count.

Sources: Calculated by the authors from unpublished ABS data (K&T); ABS 2002c (ABS).

b) Natural increase and the inexplicable component of population change, 1996–2001

	Flows of births and deaths: 1996–2001				Explicable component due to natural increase		Inexplicable component	
	Birth I [a]	Birth II [a]	Total births	Deaths	No.	%	No.	%
Kinfu & Taylor	39,179	14,663	53,812	11,720	42,092	68.6	19,243	31.4
ABS	Not available	Not available	51,123	9,185	41,938	73.5	15,095	26.5

Note: a) Birth I and Birth II represent Indigenous births to Indigenous women and non-Indigenous women, respectively.

Sources: Calculated by the authors from unpublished ABS data (K&T); ABS 2002c (ABS).

Allowing for census edit changes, the results in Table 4 imply an intercensal rate of growth of about 3.2 per cent per annum. This rate of increase is substantially higher than the 1.1 per cent recorded for the total Australian population for the same period, but it is much lower than the 5.7 per cent observed for the Indigenous population between 1991 and 1996 (Gray 1997; Ross 1999). It is worth mentioning that if the rate of growth for the period 1996–2001 were to be restricted to the explained component only, then the growth rate would have been about 2.3 per cent per annum instead of 3.2, at which rate the Indigenous population would double in size in 30.4 years instead of in 21.4 years. Furthermore, without the contribution of births due to non-Indigenous mothers, the growth rate would have been around 1.5 per cent, implying a doubling time of

45.7 years. These results therefore indicate that both the 'unexplained' component of population change and births contributed by non-Indigenous mothers are likely to play vital roles in the dynamics of Indigenous population change in the years to come.

The continuing large size of the unexplained component raises concerns about the possible effect on vital rates, for it may induce compositional change in the census-identified population. As already noted, it is possible that newly-enumerated Indigenous women at the 2001 Census contributed to the decreased fertility rates which have been estimated in this paper, if they had lower fertility than those enumerated in earlier censuses. Having said that, it seems equally plausible that they had survival rates similar to those of other Indigenous people given the overall lack of change in life expectancies. In Figs 6 and 7 we examine the age pattern of growth between 1991–1996 and 1996–2001 to learn more about the 'unexplained' component of population change observed in the present analysis.

Fig. 6. Age pattern of non-Indigenous intercensal population growth, 1991–1996 and 1996–2001
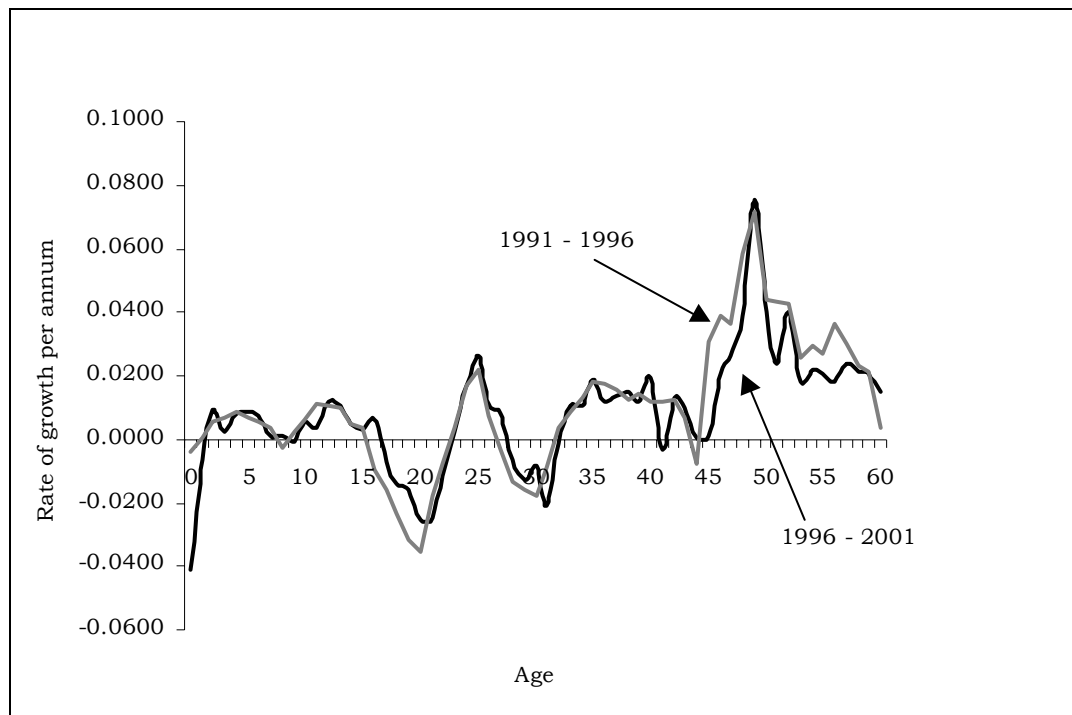
Source: Calculated by the authors from unpublished 1991–2001 Census data.

Fig. 7. Age pattern of Indigenous intercensal population growth, 1991–1996 and 1996–2001
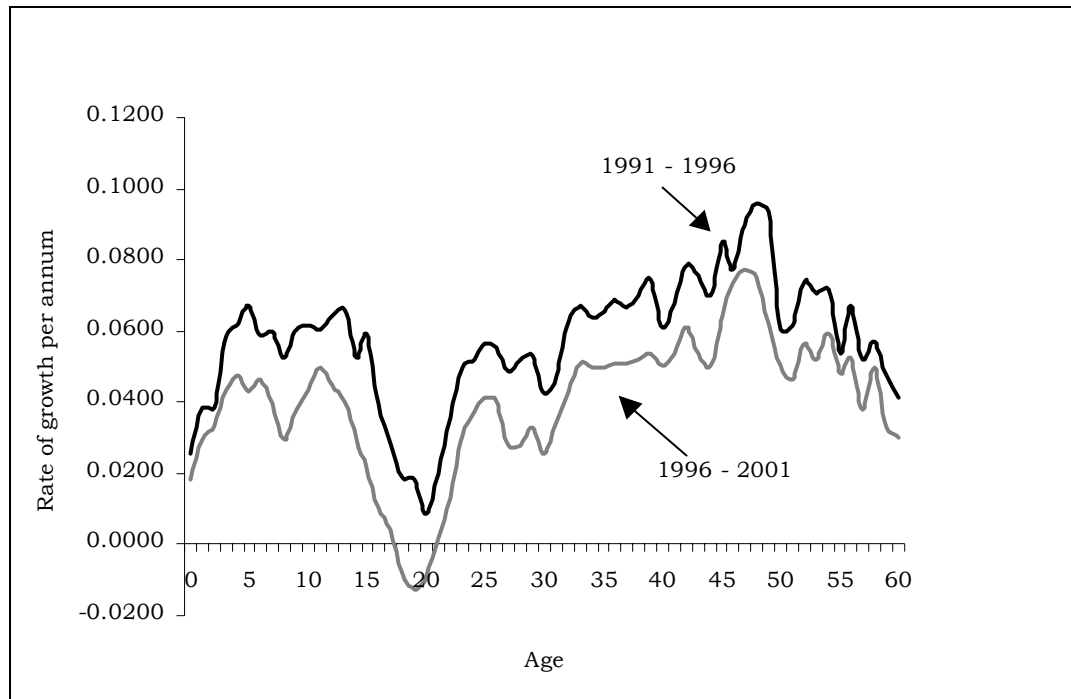
Source: Calculated by the authors from unpublished 1991–2001 Census data.

Under normal circumstances age-specific growth rates calculated from two or more censuses for the same population are expected to match each other, and this is illustrated in Fig. 6, which depicts the age pattern of population growth for the non-Indigenous population. The age-specific growth rates calculated for the 1996–2001 and 1991–1996 periods for Indigenous Australians clearly depart from this pattern. The intercensal age-specific growth rates calculated for the period 1991–1996 were much higher than those for the previous 1986–1991 period (Gray 1997), while those shown in Fig. 6 for 1996–2001 are substantially lower (Gray 1997). Interestingly, for all three intercensal periods the age patterns observed are almost identical, despite substantial upward then downward shift in growth levels. These systematic shifts cannot be explained by demographic processes. If anything, they are suggestive of whole households moving in and then out of scope in the census count of the Indigenous population, as previously postulated by Gray (1997: 15). If this is the case, it raises questions about how and why this might occur, and which aspects of census collection and processing are most responsible.

Policy and research implications

In line with each census count of Indigenous Australians since 1971, when a question on self-identified Indigenous origins was introduced, the 2001 count produced an intercensal change in numbers that cannot be explained by demographic processes alone. However, the most recent error of closure is substantially less than for the previous intercensal period, enhancing confidence in the estimation of demographic parameters. This is similar to the situation reported for the 1986–1991 period by Gray and Tesfaghiorghis (1993). At the same time, the error of closure estimated here is 23 per cent higher than the preliminary estimate produced by the ABS. This highlights two facts: unpredictability remains a hallmark of Indigenous population growth, and the methods used to estimate change matter greatly.

In discussing this error of closure our preference is to refer to changes in census coverage rather than in propensity to identify. The former may include the latter, though to what extent is unknown. In truth, we cannot presently determine the factors that contribute to non-demographic population growth, although it is possible to speculate. Methodologically, we see only two future options for decomposition, either by way of conducting a larger post-enumeration sample survey, or by the matching of unit records from one census to the next. Neither, it seems, are likely eventualities, and so the conundrum will remain.

Part of the hesitation to settle on 'identity change' as an explanator is founded in the systematic shifting in, and then out, of the population count across the age distribution which has been observed since 1991. The fact of sudden entry and then withdrawal over successive censuses (especially of households if it is these that are supposedly moving in and out of scope), is far more suggestive of procedural or processing change than anything else.

More precise conclusions may be drawn about the changing levels and patterns of fertility and mortality. The striking feature that analysis of the 2001 Census data reveals is that Indigenous women's fertility has reached, or may even now be below, replacement level. This confirms the findings from the ABS analysis of recent registration data. Aside from the momentum for growth already built into the Indigenous age structure, it is therefore only the contribution of births from non-Indigenous women that will sustain Indigenous population growth.

The national TFR of 2.1 for Indigenous women is interesting, as we know from reliable registration data that TFRs in many remote regions are close to and even exceed 3.0 (ABS 2001; Taylor & Bell 2002: 8). That being the case, Indigenous TFRs in some regions, notably in the south and east, and most probably in metropolitan areas, are relatively low. This geographic distribution of Indigenous fertility is poorly understood and research is required to determine the extent to which female participation in education and employment is impacting on fertility across the country. Certainly, earlier work on the determinants of Indigenous

fertility suggested a spatial link between fertility levels and economic participation (Gray 1990a), and this requires updating in the context of steady progression to fertility convergence. For Australian women generally, the move to lower fertility has been clearly linked to human capital factors (McDonald 2000), and what is interesting about our results for 1996–2001 is that a substantial decline in Indigenous teenage fertility has occurred. Even if this is independent of any rise in economic participation, it nonetheless reduces one of the barriers to participation and, if it were to continue, would lead to further downward pressure on fertility.

By contrast, the continued lack of convergence in mortality rates is striking. While there is some variation in estimates, all methods produce similar levels, although deaths registration is still far from complete. Given the pattern of age-specific death rates, it is clear that significant progress towards closing the gap can only arise through sustained reduction in the excessive rates of Indigenous adult mortality, especially among those over 40 years old. In any event, the timetable for Indigenous mortality improvement is long-term, and this adds further weight to the opportunity-cost argument that there is an imbalance between health expenditure on Indigenous Australians and their needs as measured by prevailing mortality (Australian Institute of Health and Welfare 2001).

The fact that the 2001 Census count and post-censal estimates were higher than anticipated on the basis of anticipated natural growth from 1996 and ABS 1996-based low series projections, means that policy settings based on the 1996 projections will need to be revised, probably upwards. One example is the estimation of future employment needs. We note that the Indigenous employment to population ratio actually fell slightly in 2001 compared to 1996, as did the rate of labour force participation. Nonetheless the 2001 Census levels and their associated postcensal estimates raise the prospect of an increase in the projected Indigenous labour force by 2006 beyond the previous estimate of 156,000. Given intercensal trends in CDEP and non-CDEP employment growth, which have been very much in favour of the former (Hunter & Taylor 2001), this could require an upward revision of previously projected estimates of mainstream job requirements. Further CAEPR research will fine-tune these estimates.

Notes

1. Reverse survival is a method of reconstructing a past population by replacing deaths in the population using an appropriate life table.
2. In calculating the fertility level using the 'own children' method it is not a requirement that children are linked to their real mothers as the technique overcomes this constraint. Any problems that might arise are more to do with differences in age between real mothers and matched mothers as this may affect the age pattern of fertility. Comparison with the age pattern of fertility based on vital registration reveals

that the 'own-children' method produces an age pattern of fertility older than it should be. The age pattern of fertility from the 'own-children' method has been adjusted to counter this effect in the calculation of births.

3.   During the processing of census data, the Indigenous status variable is edited to change responses of 'Aboriginal and/or Torres Strait Islander' to 'non-Indigenous' for persons who the ABS considers unlikely to be Indigenous. For the 2001 Census, the variables used for these edits were 'Birthplace of male parent' and 'Birthplace of female parent'. For the 1996 Census these edits were based on the variable 'Birthplace of individual', as well as the parents' birthplaces. Had the 2001 edits been applied to the 1996 Census, then 4,302 individuals who were counted as Indigenous would have been reclassified as non-Indigenous. Proper accounting of intercensal change needs to incorporate these changes either by adding 4,302 to the 2001 count or subtracting that number from the 1996 count. The ABS preliminary exercise did neither; we chose to delete from 1996.

Appendix: Table A1 and Fig. A1

Table A1. Levels and trends in age-specific fertility by Indigenous status, 1991–2001 (continues on facing page)

Age	Age-specific Indig. births per Indig. women		Age-specific non-Indig. births per Indig. women		Age-specific birth rate per Indigenous women	
	1996–01	1991–96	1996–01	1991–96	1996–01	1991–96
15	0.0199	0.0249	0.0004	0.0006	0.0204	0.0255
16	0.0384	0.0475	0.0011	0.0013	0.0395	0.0487
17	0.0630	0.0772	0.0017	0.0020	0.0647	0.0792
18	0.0922	0.1092	0.0026	0.0028	0.0948	0.1120
19	0.1157	0.1370	0.0038	0.0034	0.1195	0.1404
20	0.1252	0.1508	0.0042	0.0036	0.1294	0.1544
21	0.1343	0.1537	0.0047	0.0035	0.1390	0.1572
22	0.1363	0.1560	0.0058	0.0040	0.1420	0.1601
23	0.1342	0.1556	0.0054	0.0041	0.1396	0.1597
24	0.1339	0.1534	0.0052	0.0043	0.1391	0.1577
25	0.1329	0.1509	0.0050	0.0046	0.1379	0.1556
26	0.1283	0.1458	0.0052	0.0044	0.1335	0.1502
27	0.1206	0.1388	0.0055	0.0046	0.1261	0.1434
28	0.1156	0.1295	0.0051	0.0041	0.1207	0.1336
29	0.1074	0.1156	0.0051	0.0034	0.1125	0.1190
30	0.0966	0.0998	0.0043	0.0035	0.1009	0.1034
31	0.0842	0.0870	0.0037	0.0037	0.0879	0.0907
32	0.0740	0.0736	0.0034	0.0031	0.0774	0.0766
33	0.0650	0.0623	0.0030	0.0026	0.0680	0.0649
34	0.0554	0.0534	0.0026	0.0025	0.0580	0.0559
35	0.0488	0.0456	0.0022	0.0021	0.0510	0.0477
36	0.0413	0.0381	0.0023	0.0019	0.0436	0.0400
37	0.0317	0.0287	0.0018	0.0015	0.0334	0.0302
38	0.0245	0.0225	0.0013	0.0013	0.0258	0.0237
39	0.0184	0.0189	0.0008	0.0007	0.0192	0.0196
40	0.0132	0.0148	0.0005	0.0007	0.0136	0.0155
41	0.0104	0.0128	0.0003	0.0007	0.0107	0.0135
42	0.0085	0.0100	0.0001	0.0002	0.0086	0.0103
43	0.0073	0.0074	0.0000	0.0002	0.0073	0.0076
44	0.0059	0.0066	0.0000	0.0000	0.0059	0.0066
45	0.0042	0.0062	0.0000	0.0000	0.0042	0.0062
46	0.0030	0.0054	0.0000	0.0000	0.0030	0.0054
47	0.0031	0.0039	0.0000	0.0000	0.0031	0.0039
48	0.0031	0.0037	0.0000	0.0000	0.0031	0.0037
49	0.0029	0.0033	0.0000	0.0000	0.0029	0.0033
TFR	2.2	2.45	0.09	0.08	2.29	2.53
15–19	0.0643	0.0794	0.0018	0.0020	0.0662	0.0803
20–24	0.1328	0.1539	0.0051	0.0039	0.1378	0.157
25–29	0.1213	0.1364	0.0052	0.0042	0.1265	0.1403
30–34	0.0754	0.0760	0.0034	0.0031	0.0788	0.0791
35–39	0.0335	0.0313	0.0017	0.0015	0.0352	0.0331
40–44	0.0092	0.0106	0.0002	0.0004	0.0094	0.0111
45–49	0.0033	0.0046	0.0000	0.0000	0.0033	0.0046
TFR	2.2	2.45	0.09	0.08	2.29	2.53

Source: Calculated by the authors from unpublished 2001 Census data.

Age	Age-specific Indig. births per non-Indig. women		Age-specific non-Indig. births per non-Indig. women		Age-specific birth rate per non-Indig. women		Age-specific birth rate per Australian women	
	1996–01	1991–96	1996–01	1991–96	1996–01	1991–96	1996–01	1991–96
15	0.0001	0.0001	0.0021	0.0025	0.0022	0.0027	0.0028	0.0033
16	0.0004	0.0003	0.0057	0.0069	0.0061	0.0073	0.0071	0.0083
17	0.0008	0.0007	0.0119	0.0144	0.0127	0.0151	0.0142	0.0166
18	0.0011	0.0009	0.0209	0.0247	0.0219	0.0256	0.0239	0.0277
19	0.0013	0.0012	0.0310	0.0355	0.0322	0.0366	0.0346	0.0390
20	0.0014	0.0012	0.0396	0.0447	0.0410	0.0459	0.0433	0.0483
21	0.0014	0.0012	0.0483	0.0546	0.0497	0.0557	0.0520	0.0579
22	0.0014	0.0012	0.0582	0.0659	0.0596	0.0671	0.0616	0.0691
23	0.0014	0.0012	0.0693	0.0786	0.0707	0.0798	0.0724	0.0854
24	0.0013	0.0012	0.0812	0.0936	0.0825	0.0948	0.0838	0.0960
25	0.0013	0.0013	0.0934	0.1094	0.0947	0.1107	0.0957	0.1115
26	0.0012	0.0012	0.1053	0.1229	0.1065	0.1241	0.1071	0.1246
27	0.0012	0.0012	0.1155	0.1328	0.1167	0.1340	0.1169	0.1345
28	0.0011	0.0011	0.1233	0.1373	0.1244	0.1383	0.1243	0.1382
29	0.0010	0.0009	0.1279	0.1351	0.1289	0.1361	0.1286	0.1358
30	0.0010	0.0009	0.1271	0.1275	0.1280	0.1283	0.1275	0.1279
31	0.0008	0.0007	0.1206	0.1162	0.1214	0.1170	0.1208	0.1165
32	0.0007	0.0006	0.1101	0.1021	0.1109	0.1028	0.1103	0.1023
33	0.0006	0.0005	0.0972	0.0868	0.0979	0.0873	0.0973	0.0870
34	0.0005	0.0004	0.0833	0.0726	0.0838	0.0730	0.0834	0.0728
35	0.0004	0.0003	0.0691	0.0589	0.0695	0.0592	0.0692	0.0590
36	0.0003	0.0002	0.0552	0.0460	0.0555	0.0462	0.0553	0.0461
37	0.0003	0.0002	0.0424	0.0350	0.0427	0.0352	0.0425	0.0352
38	0.0002	0.0001	0.0320	0.0260	0.0322	0.0261	0.0321	0.0261
39	0.0002	0.0001	0.0234	0.0188	0.0235	0.0189	0.0235	0.0189
40	0.0001	0.0001	0.0162	0.0131	0.0163	0.0132	0.0163	0.0132
41	0.0001	0.0000	0.0106	0.0085	0.0107	0.0085	0.0107	0.0086
42	0.0000	0.0000	0.0067	0.0052	0.0067	0.0053	0.0067	0.0053
43	0.0000	0.0000	0.0040	0.0031	0.0040	0.0031	0.0041	0.0032
44	0.0000	0.0000	0.0023	0.0017	0.0023	0.0018	0.0023	0.0019
45	0.0000	0.0000	0.0013	0.0011	0.0013	0.0011	0.0013	0.0011
46	0.0000	0.0000	0.0008	0.0007	0.0008	0.0007	0.0008	0.0007
47	0.0000	0.0000	0.0005	0.0005	0.0005	0.0005	0.0006	0.0005
48	0.0000	0.0000	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005
49	0.0000	0.0000	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
TFR	0.02	0.02	1.74	1.79	1.76	1.8	1.77	1.82
15–19	0.0007	0.0007	0.0142	0.0173	0.0149	0.0180	0.0153	0.0193
20–24	0.0014	0.0012	0.0599	0.0675	0.0613	0.0687	0.0610	0.0695
25–29	0.0012	0.0011	0.1132	0.1277	0.1143	0.1288	0.1134	0.1264
30–34	0.0007	0.0006	0.1074	0.1012	0.1081	0.1018	0.1088	0.1031
35–39	0.0003	0.0002	0.0446	0.0372	0.0448	0.0374	0.0464	0.0389
40–44	0.0001	0.0000	0.0081	0.0064	0.0081	0.0064	0.0085	0.0069
45–49	0.0000	0.0000	0.0007	0.0006	0.0007	0.0006	0.0007	0.0007
TFR	0.02	0.02	1.74	1.79	1.76	1.8	1.77	1.82

Fig. A1 Indigenous and non-Indigenous male and female life expectancies, 1881–2001
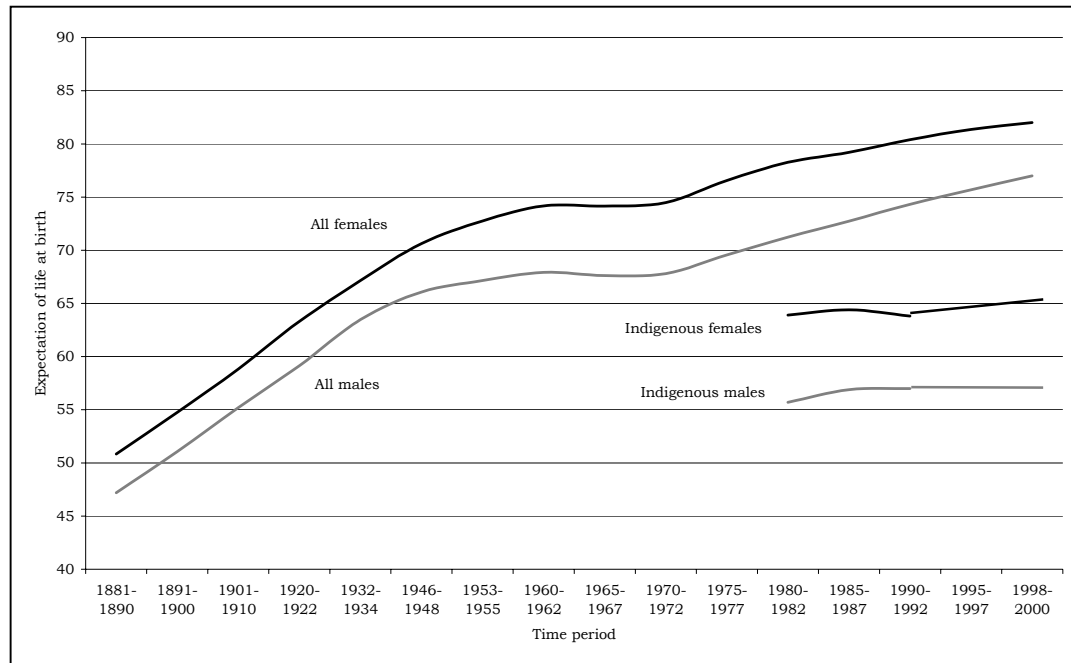
Source: ABS (2002b); Gray (1997); the authors' own calculations from 2001 ABS Census data.

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