



2005–2007

3302.0.55.003

EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS

AUSTRALIA

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For further information
about these and related
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NOTES

ABOUT THIS RELEASE

This publication presents experimental life tables for male and female Aboriginal and Torres Strait Islander Australians for the reference period 2005–2007, for New South Wales, Queensland, Western Australia, the Northern Territory and Australia.

CHANGE IN METHOD

As foreshadowed in *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002) released in November 2008, the ABS has introduced a new method to produce the 2005–2007 life tables. While the underlying method of construction of the life tables remains the same (that is, age/sex-specific death rates are derived from numbers of Indigenous deaths and the Indigenous population), the method for accounting for under-identification of Indigenous deaths has changed.

The estimates in this publication have been compiled using a direct demographic method, in which death registrations data are adjusted using under-identification factors obtained from the Census Data Enhancement Indigenous Mortality Quality Study to derive Indigenous deaths to be used as numerators in calculating age/sex-specific death rates. These factors are further adjusted to align Indigenous status as reported in the Census with Indigenous status as reported in the Post Enumeration Survey.

WARNING

Due to the significant changes in methodology, *ABS strongly advises that comparisons between the estimates presented here and previously published estimates should not be made. Differences should not be interpreted as measuring changes in Indigenous life expectancy over time.*

UPCOMING RELEASES

Experimental estimates and projections of the Aboriginal and Torres Strait Islander population of Australia for the period 1991 to 2021 will be published in *Experimental Estimates and Projections, Aboriginal and Torres Strait Islander Australians, 1991 to 2021* (cat. no. 3238.0) which is scheduled for release on 8 September 2009.

Brian Pink
Australian Statistician

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CHAPTER 1

MAIN FEATURES

INTRODUCTION

In this publication, the word 'Indigenous' refers to Aboriginal and Torres Strait Islander peoples of Australia. We thank Australian Aboriginal and Torres Strait Islander peoples for their cooperation and assistance in the collection of data, without which, this analysis would not have been possible.

The compilation of accurate life tables to derive life expectancy estimates for Indigenous Australians presents particular difficulties. The standard approach to compiling life tables requires complete and accurate data on deaths that occur in a period, and reliable estimates of the population (at the mid-point of the period) exposed to the risk of dying.

In the case of Indigenous mortality estimation, the situation is less than perfect. Registration of Indigenous deaths and Indigenous population estimates have limitations (for more information see *Chapter 2: Quality issues with Indigenous deaths and population data*). Due to the inherent uncertainties in these data, the life tables contained in this publication are referred to as experimental and as such, care should be exercised when interpreting them.

Use of experimental Indigenous life tables

The life tables in this publication have been produced to enable the construction of Australian Bureau of Statistics (ABS) estimates and projections of the Aboriginal and Torres Strait Islander population of Australia for the period 1991 to 2021. These data are produced using the cohort-component method, in which assumptions made about levels of mortality, fertility and migration are iteratively applied to a base population to obtain past and/or future populations.

Estimates of life expectancy at birth for Indigenous Australians are commonly used as a measure for assessing Indigenous population health and disadvantage. Due to significant changes in methodology, *ABS strongly advises that comparisons between the estimates presented here and previously published estimates should not be made. Differences should not be interpreted as measuring changes in Indigenous life expectancy over time.*

CHOICE OF METHOD

In considering the compilation of life tables for Indigenous Australians following the 2006 Census of Population and Housing, the ABS has investigated a range of different methodologies. The investigations highlighted the sensitivity of life expectancy estimates to underlying assumptions, input data and methods used, as reported in the *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002) released in November 2008.

CHOICE OF METHOD

continued

The discussion paper presented an ABS preferred methodology and allowed stakeholders the opportunity to provide feedback and to ensure issues associated with the compilation of the life tables were adequately considered before their finalisation. The discussion paper generated considerable feedback with general support for the adoption of a direct demographic method for the compilation of Indigenous life tables.

Following consideration of those responses the ABS has decided to use a direct demographic method to derive 2005–2007 life tables for the Indigenous population by adjusting death registrations data by identification rates obtained from the Census Data Enhancement (CDE) Indigenous Mortality Quality Study. For more information see *Chapter 3: Data linkage to derive Indigenous deaths identification rates*.

The method adopted by the ABS to compile Indigenous life tables has two key features. First, the use of the CDE Indigenous Mortality Quality Study enables direct calculation of identification rates. Second, by aligning the deaths data to the population estimates derived from the 2006 Census and Post Enumeration Survey the methodology assures consistency between the numerator (that is, estimates of deaths) and the denominator (estimates of population at risk).

The method is similar to the ABS preferred method presented in *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002), the difference being that the 'PES Indigenous propensities' (see chapter 3) have been derived using weighted PES data to ensure consistency with the calculation of Indigenous estimated resident population (ERP), whereas in the discussion paper unweighted PES data were used. This change has resulted in slightly higher estimates of life expectancy at birth than presented in the discussion paper.

For completeness a number of alternative approaches to adjust for incomplete deaths data and the resulting life expectancy estimates are presented in *Appendix 2: Alternative approaches to adjust deaths*. For the reasons outlined in Appendix 2, in particular the need for consistency between the numerator and denominator, these methods were not adopted.

Life tables compiled on this basis for New South Wales, Queensland, Western Australia, the Northern Territory and Australia are presented in *Chapter 4: Life tables*. Due to the small number of Indigenous deaths in Victoria, South Australia, Tasmania and the Australian Capital Territory, it is not possible to construct life tables for these jurisdictions (see paragraphs 10–12 and 24–26 of the Explanatory Notes for more information).

Life expectancy estimates in this publication refer to the average number of additional years a person of a given age and sex might expect to live if the age/sex-specific death rates for 2005–2007 were to continue throughout his/her lifetime.

Life expectancy may be compiled for any particular age or age group, thus, life expectancy *at birth* refers to the average number of years a group of new-born babies could expect to live, if they experienced the 2005–2007 death rates throughout their lifetimes. This does not equate to the number of years of life any one person or group of persons will *actually* live.

LIFE EXPECTANCY AT BIRTH OF INDIGENOUS AUSTRALIANS

At the national level for 2005–2007, life expectancy at birth for Indigenous males is estimated to be 67.2 years, 11.5 years less than life expectancy at birth for non-Indigenous males (78.7 years). Life expectancy at birth for Indigenous females is estimated to be 72.9 years, 9.7 years less than life expectancy at birth for non-Indigenous females (82.6 years). Confidence intervals for these estimates are presented in *Appendix 1: Confidence intervals*.

Life expectancy at birth differs across the states and territories. For Indigenous males, life expectancy at birth is highest in New South Wales (69.9 years) and lowest in the Northern Territory (61.5 years). A similar pattern exists for Indigenous females, with the highest life expectancy at birth in New South Wales (75.0 years) and the lowest in the Northern Territory (69.2 years).

Differences in life expectancy at birth estimates between non-Indigenous and Indigenous Australians are greatest in the Northern Territory (14.2 years for males and 11.9 years for females) and Western Australia (14.0 years for males and 12.5 years for females).

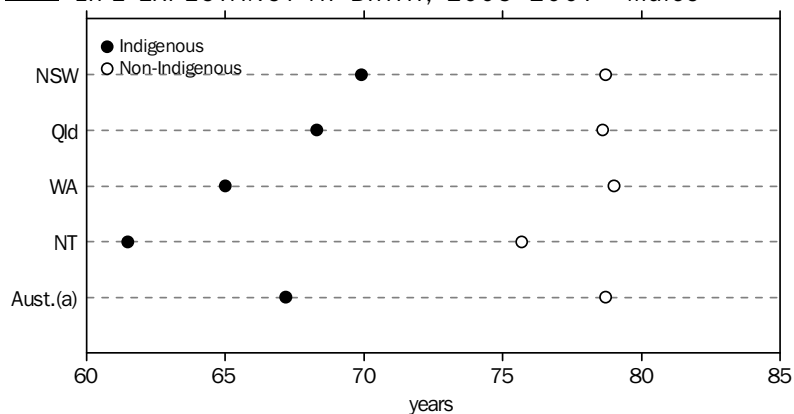
1.1 LIFE EXPECTANCY AT BIRTH(a), Indigenous status—2005–2007

	LIFE EXPECTANCY AT BIRTH			Difference between non-Indigenous and Indigenous life expectancy at birth(b)
	Indigenous	Non-Indigenous	Total(c)	
	years	years	years	years
MALES				
NSW	69.9	78.7	78.5	8.8
Qld	68.3	78.6	78.4	10.4
WA	65.0	79.0	78.7	14.0
NT	61.5	75.7	72.0	14.2
Aust.(d)	67.2	78.7	78.5	11.5
FEMALES				
NSW	75.0	82.5	82.4	7.5
Qld	73.6	82.5	82.3	8.9
WA	70.4	82.9	82.5	12.5
NT	69.2	81.2	77.6	11.9
Aust.(d)	72.9	82.6	82.4	9.7
DIFFERENCE BETWEEN MALES AND FEMALES				
NSW	–5.1	–3.9	–3.9	..
Qld	–5.3	–3.9	–4.0	..
WA	–5.4	–3.8	–3.9	..
NT	–7.7	–5.4	–5.6	..
Aust.(d)	–5.6	–3.8	–3.9	..

- (a) Due to significant changes in methodology, estimates of life expectancy at birth for 2005–2007 are not comparable to previously published estimates.
- (b) Differences are based on unrounded estimates.
- (c) Estimates of life expectancy at birth for the total population presented in this publication differ from estimates in Deaths, Australia, 2006 (cat. no. 3302.0). See paragraph 27 of the Explanatory Notes for more information.
- (d) Includes all states and territories.

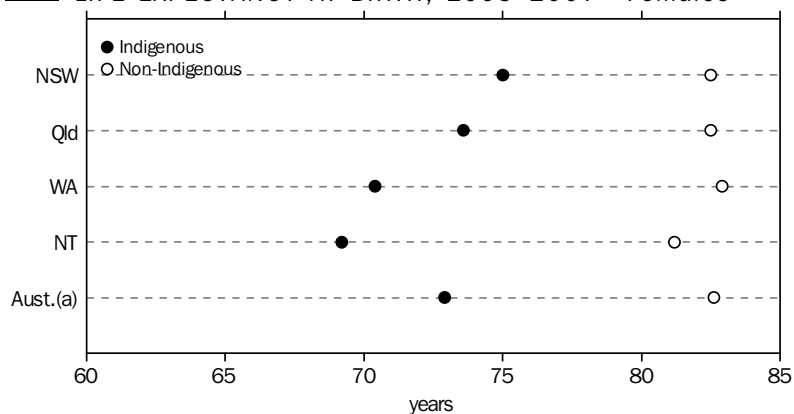
LIFE EXPECTANCY AT
BIRTH OF INDIGENOUS
AUSTRALIANS *continued*

1.2 LIFE EXPECTANCY AT BIRTH, 2005–2007—Males



(a) Includes all states and territories.

1.3 LIFE EXPECTANCY AT BIRTH, 2005–2007—Females



(a) Includes all states and territories.

LIFE EXPECTANCY AT
BIRTH OF INDIGENOUS
AUSTRALIANS *continued*

Table 1.4 presents life expectancy at selected ages for Indigenous and non-Indigenous Australians. At all ages, for both males and females, life expectancy for Indigenous Australians is lower than for non-Indigenous Australians.

1.4 LIFE EXPECTANCY AT SELECTED AGES, Australia—2005–2007

LIFE EXPECTANCY				Difference between non-Indigenous and Indigenous life expectancy(a)
	Indigenous	Non-Indigenous	Total	
	years	years	years	years
MALES				
0	67.2	78.7	78.5	11.5
1	67.0	78.1	77.9	11.1
5	63.2	74.2	74.0	11.0
25	44.1	54.6	54.4	10.5
50	23.8	31.0	30.9	7.2
65	13.4	17.9	17.9	4.5
85	4.2	4.6	4.6	0.4
FEMALES				
0	72.9	82.6	82.4	9.7
1	72.5	81.9	81.7	9.4
5	68.6	77.9	77.8	9.3
25	49.1	58.2	58.0	9.0
50	27.0	33.9	33.8	6.9
65	15.5	20.2	20.2	4.7
85	4.4	4.8	4.8	0.4
DIFFERENCE BETWEEN MALES AND FEMALES				
0	-5.6	-3.8	-3.9	..
1	-5.4	-3.8	-3.8	..
5	-5.4	-3.8	-3.8	..
25	-5.0	-3.5	-3.6	..
50	-3.3	-2.9	-2.9	..
65	-2.1	-2.3	-2.3	..
85	-0.2	-0.1	-0.2	..

(a) Differences are based on unrounded estimates.

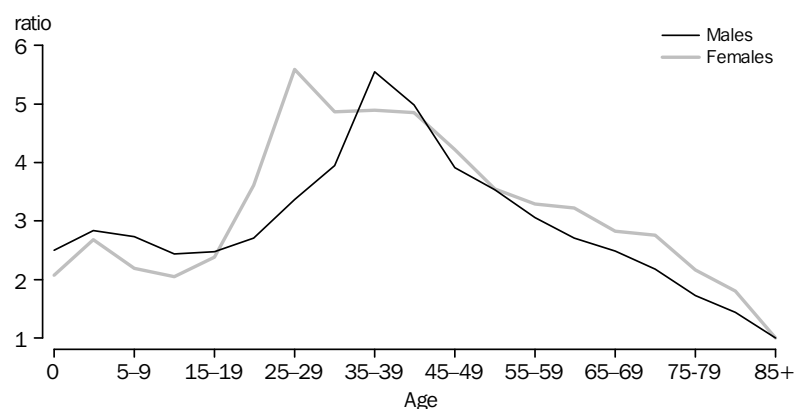
Ratio of mortality rates

Graph 1.5 illustrates the differences in mortality for Indigenous and non-Indigenous Australians for 2005–2007.

For Indigenous men for all age groups to 70–74 years, mortality rates were at least twice those of non-Indigenous men. The largest differences were in the 35–39 year and 40–44 year age groups, where mortality rates for Indigenous men were five times greater than rates for non-Indigenous men.

For Indigenous women, the largest differences were in the 25–29 year to 40–44 year age groups, where mortality rates were around five times greater than rates for non-Indigenous women.

1.5 RATIO OF MORTALITY RATES(a), Indigenous and non-Indigenous Australians—2005–2007



(a) Ratio of Indigenous mortality rate (qx) to non-Indigenous mortality rate.

ILLUSTRATIVE LIFE
EXPECTANCY ESTIMATES
FOR 2000–2002 BASED
ON ASSUMED
IDENTIFICATION RATES

The 2006 Census Data Enhancement (CDE) Indigenous Mortality Quality Study referred to deaths which occurred from 9 August 2006 to 30 June 2007. While Indigenous deaths identification rates and adjustment factors derived from the study were assumed to be applicable to Indigenous deaths registered during 2005–2007, they cannot be applied to Indigenous deaths for more distant periods for use in estimating Indigenous life expectancy for these periods.

However, assumptions can be made about the level of identification of Indigenous deaths for other periods, using the CDE-derived identification rates as a reference point. Using these assumptions, illustrative life expectancy estimates using direct demographic methods can be derived.

A range of illustrative life expectancy estimates for 2000–2002 are presented in Appendix 3, based on three assumptions on the level of identification of Indigenous deaths during this period.

As the estimates are only illustrative and based on assumptions regarding improvements in identification of Indigenous deaths over time, *they cannot be considered to be true estimates of life expectancy at birth for 2000–2002. Nor should differences between these estimates and estimates for 2005–2007 be interpreted as measuring changes in Indigenous life expectancy at birth over time.* However it is worth noting that the

ILLUSTRATIVE LIFE
EXPECTANCY ESTIMATES
FOR 2000–2002 BASED
ON ASSUMED
IDENTIFICATION RATES

continued

estimates for each scenario are considerably higher than the previously published ABS Indigenous life expectancy estimates for 1996–2001.

INTERNATIONAL
COMPARISON

The comparison of life expectancy across countries is problematic for a range of reasons, including differing methodologies, reference periods and definitions of a person's indigenous or ethnic status, as well as issues associated with the accurate measurement of deaths of indigenous persons and indigenous populations. As a result, life expectancy estimates between countries are not directly comparable.

In Canada, the most recently available estimates of life expectancy are for four Inuit-inhabited areas where 80% of the combined populations of these areas are Inuit. The estimates do not distinguish between life expectancy for Inuit and non-Inuit people but use total life expectancy for these areas as an overall indicator. Life expectancy at birth in Inuit-inhabited areas of Canada for 2001 (1999–2003) was 64.4 years for males and 69.8 years for females (Statistics Canada, 2008).

In New Zealand, a definition based on ethnicity is used in producing life tables for the Maori and non-Maori populations. Ethnicity in this context relates to the ethnic group or groups that people identify with, or perceive they belong to. For 2005–2007, life expectancy at birth was 70.4 years for Maori men and 75.1 years for Maori women (Statistics New Zealand, 2008).

For more information see the Statistics Canada <<http://www.statcan.gc.ca>> and Statistics New Zealand <<http://www.stats.govt.nz>> websites.

AUSTRALIAN INSTITUTE
OF HEALTH AND WELFARE
INDIGENOUS MORTALITY
DATA LINKAGE STUDY

The Australian Institute of Health and Welfare (AIHW) Indigenous Mortality Data Linkage Study has linked deaths from the AIHW National Mortality Database to the AIHW National Hospital Morbidity Database, the AIHW National Perinatal Data Collection, the Aboriginal Health Liaison Officer Dataset and to the Australian Government Department of Health and Ageing Residential Aged Care Dataset for 2001–2006 to enhance identification of Indigenous deaths.

Preliminary data from the study were provided to the ABS. From these data ABS investigated the effect of differential identification of Indigenous deaths according to age and sex on estimates of Indigenous life expectancy at birth. These estimates are presented in *Appendix 2: Alternative approaches to adjust deaths*.

AIHW intends to continue analysis in a number of directions that may include state/territory level data, investigating the availability of Medical Certificate of Cause of Death information for linkage, back-casting of life expectancy estimates and making estimates for years beyond 2001–2006.

CHAPTER 2

QUALITY ISSUES WITH INDIGENOUS DEATHS AND POPULATION DATA

INTRODUCTION

The standard approach to compiling life tables and resulting life expectancy estimates requires complete and accurate data on deaths that occur in a period, and reliable estimates of the population (at the mid-point of the period) exposed to the risk of dying. These data are required by age and sex so as to calculate age-sex specific death rates.

In the case of Indigenous mortality estimation, this situation is less than perfect. Information on death registrations of Indigenous Australians has limitations while a number of quality issues associated with Indigenous population estimates exist. In combination, these present particular methodological challenges to compiling high quality life tables and making comparisons over time.

This chapter discusses the data limitations of death registrations of Indigenous Australians and ABS Indigenous population estimates in more detail.

DEATHS OF ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS

The first component necessary for the compilation of life tables for Indigenous Australians is information on all Indigenous deaths, by age and sex. These are required as numerators in the calculation of age-specific death rates from which life tables are constructed.

Death registrations are collected in the form of administrative by-product data from the Registrars of Births, Deaths and Marriages in each state/territory. While Australia maintains a high quality registration system of deaths, the level of Indigenous identification can vary across collections, across geography and over time. For all states and territories, death registration forms use a standard question to elicit information about a person's Indigenous origin. However, response to this question can be influenced by a number of factors, including the perception of why such information is required, who completes the question on behalf of others, and personal and cultural aspects associated with identifying as Indigenous.

It is considered likely that most deaths of Indigenous Australians are registered. However, some of these deaths are not identified as Indigenous when they are registered. This may arise from the failure to report a person's Indigenous status on the death registration form or from an incorrect identification of their Indigenous status (that is, recording non-Indigenous instead of Indigenous) on the death certificate. Such mis-identification may occur because some Indigenous people may have non-Indigenous ancestries which may create uncertainty for those completing the death registration form as to how a deceased person should be identified. This issue remains a major limitation in developing Indigenous life tables, as well as in estimating the Indigenous population between Census years.

Numbers of Indigenous deaths

Table 2.1 shows Indigenous deaths registered from 1991 to 2007. Some observations may be made by a simple assessment of the numbers for each state and territory over time. Since 1991 the numbers of Indigenous deaths registered in South Australia, Western Australia and the Northern Territory have been fairly consistent. However, in the remaining jurisdictions, especially New South Wales and Queensland, data for the first half of the 1990s are clearly incomplete. They show relatively few, if any, Indigenous deaths were registered as such. Since around 1998, death registrations in these two states have begun to display greater consistency. For Victoria the number of registered Indigenous deaths was higher for 1996–2001 than for 2001–2006. Numbers for both Tasmania and the Australian Capital Territory are very small. At the national level, Indigenous death registrations increased by around 6% in both 2006 and 2007.

2.1 REGISTERED INDIGENOUS DEATHS(a), State/territory of usual residence—1991 to 2007

Year (b)	New South Wales	Victoria	Queensland(c)	South Australia	Western Australia	Tasmania	Northern Territory	Australian Capital Territory	Australia(d)
1991	206	50	np	135	401	np	412	np	1 208
1992	165	53	np	107	346	np	397	np	1 074
1993	194	50	np	111	386	np	376	9	1 134
1994	207	50	np	123	377	np	380	10	1 153
1995	224	50	np	121	384	np	387	9	1 182
1996	177	49	258	118	370	np	328	np	1 306
1997	88	93	531	132	351	5	458	4	1 662
1998	462	123	593	127	378	13	415	3	2 114
1999	435	130	529	116	350	11	399	6	1 976
2000	473	108	535	144	407	np	450	np	2 127
2001	481	93	565	125	345	np	429	np	2 072
2002	516	64	590	107	371	20	462	4	2 136
2003	485	82	569	137	338	23	435	9	2 079
2004	490	54	579	131	400	20	449	10	2 136
2005	507	71	519	142	406	28	454	11	2 141
2006	530	111	584	124	443	20	452	14	2 279
2007(e)	601	95	594	138	502	24	461	6	2 421

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Due to differing levels of coverage for the states and territories and over time, care should be taken in interpreting change in numbers of deaths. As a result, data for Australia should not be analysed as a time series.

(b) Deaths are by registration year.

(c) Queensland began to register Indigenous deaths as Indigenous in 1996.

(d) Includes Other Territories.

(e) From 2007, Indigenous status for deaths registered in South Australia, Western Australia, Tasmania, Northern Territory and Australian Capital Territory is sourced from both the Death Registration Form and Medical Certificate of Cause of Death.

Deaths for which Indigenous status is unknown

In addition to those deaths identified as Indigenous, a number of deaths occur each year for which Indigenous status is not stated on the death registration form. In 2006, there were 1,100 deaths registered in Australia for whom Indigenous status was not stated, representing 0.8% of all deaths registered. While this proportion has decreased over time (from a high of 4.4% in 2001) it is possible that some Indigenous deaths are included in this category, further contributing to the uncertainty as to the true number of Indigenous deaths.

*Year of registration and
year of occurrence of
death*

Deaths and related mortality statistics can be reported according to the period in which the death was registered or the period in which the death occurred. Ideally, mortality statistics should be based on year of occurrence, but in reality ABS data, including life tables, are based on year of registration. This is due to known lags in the time between the occurrence and registration of deaths: while the majority of deaths in Australia are registered in the year they occur, some deaths registered in any given year have in fact occurred in previous years, and some which occur in a particular year are not registered until subsequent years. These delays in registration can arise due to a variety of reasons, and are more common for Indigenous deaths than non-Indigenous deaths.

For example, of all non-Indigenous deaths which occurred in Australia in 2006, around 95% were registered in 2006 (table 2.2). The corresponding figure was about 88% for Indigenous deaths.

2.2 PROPORTION OF DEATHS REGISTERED IN THE YEAR OF OCCURRENCE—1991–2006(a)

<i>Year of occurrence</i>	<i>Indigenous</i>	<i>Non-Indigenous</i>
	%	%
1991	85.6	94.2
1992	85.4	94.9
1993	86.2	95.4
1994	86.3	95.4
1995	87.4	95.2
1996	81.1	95.7
1997	83.6	96.2
1998	87.8	96.0
1999	86.3	95.9
2000	86.7	95.5
2001	86.7	95.3
2002	87.6	95.8
2003	87.7	96.0
2004	89.1	96.1
2005	86.7	95.6
2006	87.8	95.2

(a) Based on deaths registered up to December 2007.

While the proportion of deaths registered in the same year of occurrence is lower for Indigenous deaths than non-Indigenous deaths, there is little difference between the number of deaths registered in a given year and the number of deaths that occurred in the same year (see table 2.3). This is because, for each year, the number of deaths not registered in the year they occur are compensated for by deaths that occurred in previous years but were registered late [see also *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, 2008* (cat. no. 4704.0)]. This indicates that Indigenous deaths according to year of registration will produce similar death rates and life expectancy estimates as Indigenous deaths according to year of occurrence data.

*Year of registration and
year of occurrence of
death continued*

2.3 INDIGENOUS DEATHS BY REGISTRATION AND OCCURRENCE—July 2001–June 2006

State/territory	MALES		FEMALES	
	Registered	Occurred	Registered	Occurred
	no.	no.	no.	no.
NSW	1 453	1 448	1 074	1 064
Vic.	218	217	149	147
Qld	1 634	1 591	1 195	1 188
SA	368	374	266	264
WA	1 086	1 080	845	846
Tas.	57	57	55	55
NT	1 303	1 307	934	940
ACT	26	27	19	20
Aust.	6 150	6 106	4 542	4 529

POPULATION ESTIMATES OF INDIGENOUS AUSTRALIANS

The second component necessary for the compilation of life tables for Indigenous Australians is information on the relevant population exposed to the risk of dying; that is, the population of Indigenous Australians, by age and sex. These are required as denominators in the calculation of age-specific death rates from which life tables are constructed.

*Census of Population and
Housing*

The Census of Population and Housing is the principal source of information about Australia's population. It has been held on a five-yearly basis since 1961, with the most recent conducted in August 2006.

The Census provides the benchmark from which Australia's official population figures—estimated resident population (ERP)—is calculated. The Census count of the population is adjusted for:

- estimates of the number of people missed in the Census;
- estimates of those counted more than once in the Census;
- temporary visitors from overseas;
- Australian residents temporarily overseas (RTO) on Census night; and
- backdating from Census night to the ERP reference date of 30 June using data on births, deaths, and interstate and overseas migration.

This process results in an estimate of Australia's total population (by age and sex) as at 30 June of the Census year. For intercensal years (that is, years other than the Census year), this Census-based ERP is incremented by adding births and net overseas migration and subtracting deaths. However, estimating the size and composition of the Indigenous population is more complicated. In intercensal years this standard approach cannot be used due to the lack of sufficiently reliable data on Indigenous births, deaths or migration.

For the five-yearly Census, there are a number of issues that make compilation of Indigenous ERP problematic. These include:

- undercount of the Indigenous population;
- non-response to the Indigenous status question on the Census form; and
- unexplained growth in Indigenous Census counts relative to the previous Census.

*Census of Population and
Housing continued*

UNDERCOUNT OF INDIGENOUS POPULATION

While every effort is made to ensure full coverage of people and dwellings in the Census, some people are missed (undercount) and others are counted more than once (overcount). In Australia, more people are missed from the Census than are counted more than once. The net effect of overcount and undercount is called net undercount. The ABS conducts a Post Enumeration Survey (PES) about one month after each Census to measure the extent of net undercount in the Census. Estimates of net undercount provide direct information on the quality of population counts in the Census, and enable the necessary adjustment or correction to be made to the raw Census counts.

In addition, for some people, the Indigenous status reported in the PES is different to the Indigenous status recorded in the Census. Accordingly, estimates from the PES include an adjustment for misclassification error.

The net undercount rate in the 2006 Census was estimated at 11.5% for the Indigenous population, compared to an undercount of 2.7% for the total Australian population. However, these estimates are not directly comparable, as Indigenous undercount includes persons who did not have an Indigenous status reported on the Census form or who had a mis-stated response—both of these groups of persons would have been counted in the total Australian population. Corresponding estimates for the 2001 Census were 6.1% for the Indigenous population and 1.8% for the total Australian population.

The undercount estimates for the 2001 and 2006 Censuses should be compared with caution for the following reasons:

- the 2006 PES included remote areas and discrete Indigenous communities, whereas the 2001 and earlier Post Enumeration Surveys did not;
- a new and improved method of estimation was used in the 2006 PES; and
- high sampling errors are associated with the undercount estimates.

For more details on the PES and Indigenous undercount, see:

- *Information Paper: Measuring Net Undercount in the 2006 Population Census, Australia, 2006* (cat. no. 2940.0.55.001);
- *Census of Population and Housing - Undercount, 2006* (cat. no. 2940.0)
- *Census of Population and Housing - Details of Undercount, Australia, August 2006* (cat. no. 2940.0);
- *Australian Demographic Statistics, March Quarter 2007* (cat. no. 3101.0);
- *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, June 2006* (cat. no. 3238.0.55.001);
- *Research Paper: An Estimating Equation Approach to Census Coverage Adjustment, May 2007* (cat. no. 1351.0.55.019); and
- *Population Distribution, Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 4705.0).

NON-RESPONSE TO INDIGENOUS STATUS QUESTION ON THE CENSUS FORM

Indigenous status is not recorded for all people counted in the Census. While some of the people with unknown Indigenous status will be of Indigenous origin and some will be non-Indigenous, it is not possible to determine the exact proportions from Census data. There are two situations which result in Indigenous status being unknown:

*Census of Population and
Housing continued*

NON-RESPONSE TO INDIGENOUS STATUS QUESTION ON THE CENSUS
FORM *continued*

- incomplete Census forms, with no answer to the Indigenous status question, are returned to the ABS (item non-response); and
- the ABS is unable to obtain Census forms from people or dwellings (both private and non-private) believed to be occupied on Census night, and as a consequence imputes basic demographic information (but not Indigenous status) for these (imputed) records.

While the non-response rate to the Indigenous status question remained relatively constant at around 1.7% in the 1996 and 2006 Censuses and 2.0% in the 2001 Census, the proportion of imputed records increased from 1.3% of the total Census count in 1996 to 4.1% in 2006 [see *Population Distribution, Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 4705.0)].

As a result, in the 2006 Census there were 1,133,400 records with unknown Indigenous status (5.7% of the total Census count), compared with 767,800 records in 2001 (4.1%). Of these, around 29% were due to incomplete Census forms and the remaining 71% were due to ABS imputation procedures described above.

While some of these records will be for people of Indigenous origin and the others for non-Indigenous origin, no imputation was made for Indigenous status in the Census file. However, for compiling Indigenous ERP they are allocated as either Indigenous or non-Indigenous according to the distribution of stated responses within each geographic area, age group, sex and Census form type. For more details on not stated Indigenous status and how Indigenous ERP are derived, see *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, Jun 2006* (cat. no. 3238.0.55.001) and *Population Distribution, Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 4705.0).

UNEXPLAINED GROWTH IN INDIGENOUS CENSUS COUNTS

The way the Indigenous status of a person is recorded in the Census can change over time and in different situations. The recorded status of an individual may move between any of the categories of Indigenous status, including between Indigenous and non-Indigenous.

Over the past 35 years, there has been a clear upward trend in Indigenous Census counts, beginning with the 1971 Census and continuing to the 2006 Census. During this time, large increases in Indigenous Census counts have occurred on several occasions. The excess of births over deaths (natural increase) can account for a proportion, but not all, of these increases, while overseas migration has had an insignificant effect on the size of the Indigenous population. It therefore appears that a further component of growth exists in regard to Indigenous Census counts, referred to as 'unexplained growth'.

Between 1991 and 1996, the Census count of Indigenous people increased by 88,000 (33%). The components of this increase were estimated to be 14% due to natural increase, and a further 19% due to other factors, including changes in Census procedures and a difference in the identification of people in the Census as being of Indigenous origin. Comparable figures for 1996 to 2001 were: 16% (57,000) total increase, 12% due

*Census of Population and
Housing continued*

UNEXPLAINED GROWTH IN INDIGENOUS CENSUS COUNTS *continued*

to natural increase, and a further 4% due to other factors. These large increases are also reflected in the respective Census-based Indigenous ERP.

Between 2001 and 2006, the Census count of Indigenous people increased by 45,000 (11%). This increase is considerably lower than that experienced during the periods 1991–1996 and 1996–2001. Registration data show that natural increase accounted for an increase of about 49,000 Indigenous people during the intercensal period. This suggests there was no unexplained growth in the Indigenous population during 2001–2006, as natural increase fully explained the increase in Indigenous Census counts.

Changes in the way some Indigenous people answer the Indigenous status question on the Census may account for the smaller increase between the 2001 and 2006 Censuses. Many people who did not identify themselves or were not identified as Indigenous during earlier Censuses may have done so in the 2001 Census.

*Changes in Indigenous
population, 1996–2001
and 2001–2006*

As discussed above, ABS derives Indigenous population estimates by making various adjustments to Indigenous Census counts. The complexities associated with this process are illustrated by analysis of average annual growth rates for 1996–2001 and 2001–2006 (table 2.4). Some important results to note from this table are:

- For Australia, annual growth rates for males and females for 2001–2006 were around one percentage point lower than for 1996–2001. This is a significant change for a time span of five years. This suggests there was an increasing propensity to identify as Indigenous in the 1996–2001 period.
- All states and territories experienced lower growth rates for 2001–2006 than for 1996–2001, with the exception of the Northern Territory. The male population of the Northern Territory increased at the same rate in 2001–2006 as in 1996–2001 (2.0% per year) while the female population increased at a much higher rate (2.7% per year compared to 1.7% per year, respectively).
- There are significant variations in growth rates amongst the states and territories, with Victoria having the highest growth rate (3.7%) and Tasmania the lowest (1.1%) during 2001–2006.
- The 2001–2006 growth rates for South Australia, Western Australia and Tasmania were half those for 1996–2001.
- The growth rate for New South Wales decreased to 2.5% in 2001–2006 from around 4% in 1996–2001. The growth rate for Queensland females decreased to 2.5% in 2001–2006 from 3.8% in 1996–2001. The growth rate for the Australian Capital Territory decreased significantly over the same period.

2.4 INDIGENOUS ERP AND GROWTH RATES—30 June 2001 and 30 June 2006

	MALES				FEMALES			
	2001	2006	Annual growth rate, 2001–2006	Annual growth rate, 1996–2001	2001	2006	Annual growth rate, 2001–2006	Annual growth rate, 1996–2001
State/territory	no.	no.	%	%	no.	no.	%	%
NSW	67 432	76 229	2.5	4.4	67 456	76 456	2.5	3.8
Vic.	13 799	16 581	3.7	4.3	14 047	16 936	3.7	4.1
Qld	61 526	71 950	3.1	3.6	64 384	72 935	2.5	3.8
SA	12 604	13 790	1.8	3.1	12 940	14 265	1.9	2.8
WA	32 881	35 775	1.7	3.4	33 050	35 191	1.3	3.0
Tas.	8 718	9 204	1.1	2.7	8 666	9 211	1.2	2.4
NT	28 492	31 514	2.0	2.0	28 383	32 491	2.7	1.7
ACT	1 963	2 147	1.8	5.1	1 946	2 135	1.9	4.7
Aust.(a)	227 526	257 309	2.5	3.6	230 994	259 734	2.3	3.3

(a) Includes Other Territories.

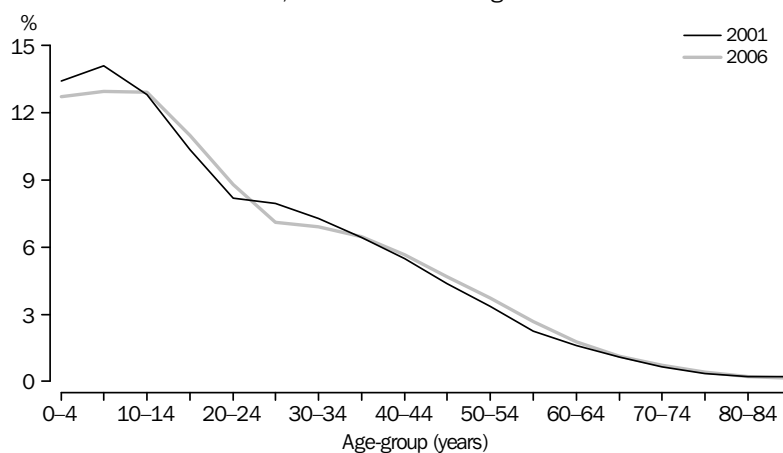
Changes in Indigenous population, 1996–2001 and 2001–2006 *continued*

The large variations in growth rates over the two periods could reflect a number of factors including changes in the 2006 Post Enumeration Survey coverage and estimation methodology or changes in the way some Indigenous people answer the Indigenous status question on Census forms. Nevertheless, it is clear that Indigenous ERP estimates are volatile and the estimates need to be used with caution.

AGE/SEX STRUCTURE

For the purposes of compiling life tables it is necessary to have accurate measures of the population according to their age and sex. It is therefore important to make some assessment of the quality of the age/sex structure of Indigenous ERP for Australia and the states and territories. The age distributions of the 30 June 2001 and 30 June 2006 Indigenous ERP have remained more or less the same (graphs 2.5 and 2.6).

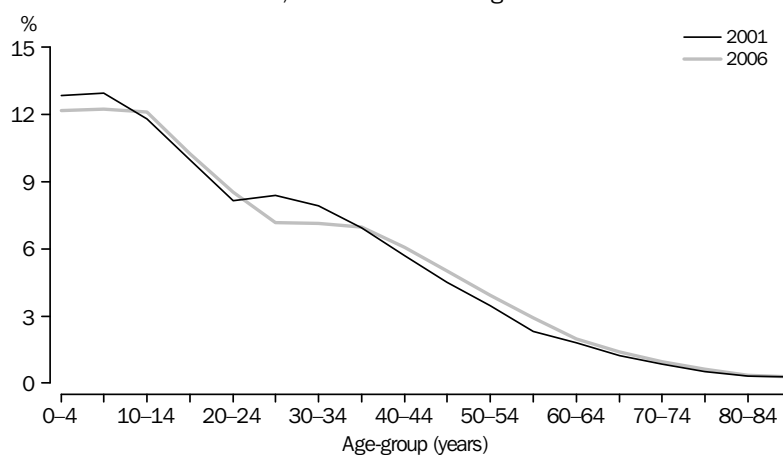
2.5 AGE STRUCTURE, Australia—Indigenous males



*Changes in Indigenous
population, 1996–2001
and 2001–2006
continued*

AGE/SEX STRUCTURE *continued*

2.6 AGE STRUCTURE, Australia—Indigenous females



In terms of the variation in the age distribution between successive Census year ERPs, the index of dissimilarity (Shryock et al., 1976:131) showed quite low values in comparison to its theoretical range of 0 to 100. The smaller the value of index of dissimilarity, the more similar are the two age distributions. For the states and territories, most values of index of dissimilarity fall around or below 5 except for the Australian Capital Territory, where the index value could be unreliable due to the small size of the Indigenous population (table 2.7).

2.7 INDEX OF DISSIMILARITY BETWEEN INDIGENOUS AGE STRUCTURES—30 June 2001 and 30 June 2006

	Males	Females
State/territory	index	index
NSW	4.0	4.5
Vic.	4.2	3.6
Qld	3.3	3.2
SA	3.5	4.1
WA	3.5	3.6
Tas.	5.0	4.7
NT	2.9	2.4
ACT	9.4	5.6
Aust.(a)	3.4	3.4

(a) Includes Other Territories.

CONCLUSION

As discussed above, the required inputs for compiling Indigenous life tables (that is, numbers of Indigenous deaths and estimates of the Indigenous population) are subject to a range of data quality issues.

In the main, Indigenous ERP compiled from the five-yearly Census provide a sound benchmark. However, improvements in methodologies for the Post Enumeration Survey and changing propensities to identify as Indigenous make interpretation of changes over time in the Indigenous population problematic.

In relation to Indigenous death statistics, the non-reporting and/or incorrect reporting of a person's Indigenous status on the death registration form means that death rates calculated using the number of registered Indigenous deaths are underestimates of the true death rates prevalent among Indigenous Australians. Application of these death rates in a standard life table would result in an overestimate of Indigenous life expectancy.

For the purposes of compiling Indigenous life tables, some method of adjustment is therefore required to inflate the registered number of Indigenous deaths for potential under-identification in registration data. The method used by ABS to do so for the 2005–2007 experimental Indigenous life tables is described in detail in *Chapter 3: Data linkage to derive Indigenous deaths identification rates*.

CHAPTER 3

DATA LINKAGE TO DERIVE INDIGENOUS DEATHS IDENTIFICATION RATES

INTRODUCTION

Chapter 2 described the data required for producing Indigenous life tables and life expectancy estimates, and quality issues associated with these data. This chapter considers the use of data linkage techniques to derive Indigenous deaths identification rates. Specifically, it describes the Census Data Enhancement Indigenous Mortality Quality Study, discusses the analyses undertaken and presents the results. To calculate estimates of life expectancy using direct methods, it is important to ensure that the classification of records as Indigenous occurs in a consistent manner in both the numerator (deaths) and the denominator (population).

CDE INDIGENOUS MORTALITY QUALITY STUDY

The Indigenous Mortality Quality Study was conducted as part of the ABS Census Data Enhancement (CDE) project. The CDE project consisted of a number of quality studies which brought together data from the 2006 Census of Population and Housing and other specified datasets.

For more information on the CDE project, see the following papers:

- *Research Paper: Methodology of Evaluating the Quality of Probabilistic Linking, Apr 2007* (cat. no. 1351.0.55.018);
- *Research Paper: Exploring Methods for Creating a Longitudinal Census Dataset, Nov 2005* (cat. no. 1352.0.55.076);
- *Discussion Paper: Enhancing the Population Census: Developing a Longitudinal View, 2006* (cat. no. 2060.0); and
- *Information Paper: Census Data Enhancement Project: An Update, Australia, Jun 2006* (cat. no. 2062.0).

The aims of the CDE Indigenous Mortality Quality Study were to:

- assist in understanding the differences in recording of Indigenous status between death registrations and Census data; and
- assess the under-identification of Indigenous deaths in death registrations records.

The CDE Indigenous Mortality Quality Study involved linking Census records with death registration records to examine differences in the reporting of Indigenous status across the two datasets. Specifically the study linked 2006 Census records with all registered deaths that occurred from 9 August 2006 to 30 June 2007, for all states and territories except Victoria, where death records were only available to mid-March 2007.

In the absence of any unique identifier in the Census and deaths datasets, linking was performed using probabilistic methods. Three groups of variables, name (first name and surname), personal characteristics (date of birth, age, sex, place of birth, year of arrival and marital status), and geographic information (meshblock, statistical local area, street number, street name, suburb and postcode) were used to link death records to Census records. To ensure comparability, variables common to both datasets were coded and

CDE INDIGENOUS
MORTALITY QUALITY
STUDY *continued*

formatted consistently. The two datasets were linked in a way that was independent of reported Indigenous status so that any future analysis would not be affected by bias introduced in the linking process. For this reason, Indigenous status was not used as a linking variable.

After Census processing was completed, all names and addresses held by the ABS on Census records were destroyed. The linked file did not contain names and addresses and was also destroyed after the analysis was completed.

Internationally, similar record linkage studies have been conducted in New Zealand where the 1981, 1986, 1991 and 1996 Censuses were each anonymously and probabilistically linked to three years of subsequent deaths data, allowing a comparison of ethnicity recording (Ajwani et al., 2003; Blakely et al., 2002a; Blakely et al., 2002b). Large nationally representative studies based on linked Census and deaths data have also been conducted in the United Kingdom, France, Sweden and Netherlands. The results from these studies have been used in various ways including the provision of evidence for policy decisions and the setting of policy targets for special intervention programs.

SUMMARY RESULTS OF
THE CDE STUDY

The number of Census and death registration records eligible for linking and percentage of death records linked are presented in Table 3.1. The linking process used 106,945 death records and 19,046,302 Census records. These Census counts are different from estimated resident population, as discussed in Chapter 2.

Of the 106,945 death records, 98,898 (92.5%) records were linked to one of 19,046,302 eligible Census records. Of the total linked death records, about 1,200 records (1.2%) were estimated to be false links (that is, record pairs do not belong to the same person). This estimate of false links was obtained by clerically reviewing a sample of linked record pairs and observing the percentage of presumed false links. However, given the small level of potential false links no attempt was made to adjust the results.

SUMMARY RESULTS OF
THE CDE STUDY*continued***3.1** CENSUS AND DEATH RECORDS, Australia

<i>Description</i>	<i>Records</i>
Number	
Census records eligible for linking(a)	19 046 302
Indigenous Census records	454 993
Records on death file(b)	106 945
Death records linked	98 898
Death records not linked	8 047
Estimated false links(c)	1 202
Indigenous records on death file(d)	1 800
Indigenous death records linked(d)	1 327
Per cent	
All death records linked	92.5
Indigenous death records linked	73.7
False links	1.2
True links	98.8

- (a) Excludes residents temporarily overseas on Census night, imputed records and Census net undercount adjustment.
- (b) Deaths which occurred between 9 August 2006 and 30 June 2007. For Victoria, deaths which occurred between 9 August 2006 and 15 March 2007.
- (c) With a 95% upper confidence level of 1,617.
- (d) According to Indigenous status reported on death registration form.

The number and percentage of death records linked to Census records by selected characteristics of deceased persons are presented in Table 3.2. A slightly higher linkage was achieved for females (93.8%) compared with males (91.2%). The linkage rate varied considerably by age, being lowest for 25–44 year old decedents (76.5%). This may be due to the relatively high Census undercount rate in this age group. The linkage rate was highest for 75 years and older decedents (94.5%). Age and sex interacted as predictors of linkage such that 25–64 year old male decedents were less likely to be linked than 25–64 year old female decedents, whereas there was little difference by sex for other age groups.

SUMMARY RESULTS OF
THE CDE STUDY*continued***3.2** DEATH RECORDS LINKED TO CENSUS RECORDS BY SELECTED
CHARACTERISTICS, Australia

<i>Reported characteristics in death registration</i>	<i>Total death records</i>	<i>Linked records</i>	<i>Linked records</i>
	no.	no.	%
Sex			
Males	54 904	50 075	91.2
Females	52 041	48 823	93.8
Age (years)			
0–14	539	450	83.5
15–24	1 053	835	79.3
25–44	4 153	3 176	76.5
45–64	15 626	13 810	88.4
65–74	16 578	15 402	92.9
75 and over	68 996	65 225	94.5
Indigenous status			
Indigenous	1 800	1 327	73.7
Non-Indigenous	103 987	96 531	92.8
Not stated	1 158	1 040	89.8
State of usual residence			
NSW	40 116	37 064	92.4
Vic.	19 351	17 940	92.7
Qld	20 915	19 346	92.5
SA	10 409	9 768	93.8
WA	10 467	9 628	92.0
Tas.	3 534	3 314	93.8
NT	797	589	73.9
ACT	1 350	1 245	92.2
Aust.(a)	106 945	98 898	92.5
Marital status			
Never married	10 536	8 898	84.5
Married	44 331	41 845	94.4
Widow	39 819	37 552	94.3
Divorced	8 792	7 736	88.0
Not applicable (<15 years)	2 899	2 390	82.4
Elapsed time between Census and death			
Within 6 months of Census	63 747	58 767	92.2
Within 7–11 months of Census	43 198	40 131	92.9

(a) Includes Other Territories.

The linkage success varied by Indigenous status recorded on the death registration form. People of non-Indigenous origin on the death registration form had a considerably increased linkage success (92.8%) compared with people of Indigenous origin (73.7%). The linkage success also varied by state of usual residence as reported on the death registration form. Rates were highest for Tasmania and South Australia (93.8%) and lowest for the Northern Territory (73.9%). All other states and the Australian Capital Territory had a linkage rate of about 92%. The low linkage rate for the Northern Territory reflects the relatively high proportion of Indigenous Australians in the Territory's population. The linkage rate was similar for married and widowed persons (about 94%). The linkage rate was slightly lower for deaths which occurred within six months of the Census (92.2%) than those which occurred within 7–11 months after the Census (92.9%).

Other aspects of the CDE Indigenous Mortality Quality Study data were analysed by the ABS and results released in *Information Paper: Census Data Enhancement - Indigenous Mortality Quality Study, 2006–07* (cat. no. 4723.0) on 17 November 2008.

USE OF THE CDE STUDY TO DERIVE INDIGENOUS DEATHS IDENTIFICATION RATES

The CDE study allows a direct comparison of Indigenous status recorded on the death registration and the Census data for what is highly likely to be the same individual, and enables estimation of the undercoverage of Indigenous deaths in the death registration system. Table 3.3 presents the outcomes of the CDE study for Indigenous deaths in NSW. It provides a cross-classification of the linked death registrations and Census records by the Indigenous status recorded in the respective records. Similar tables for other states and territories where there are sufficient deaths are available in datacube Table 2: *Summary of Indigenous deaths by Indigenous status, states and territories, 2006–2007* (cat. no. 3302.0.55.003).

3.3 SUMMARY OF LINKED DEATHS BY INDIGENOUS STATUS, New South Wales—2006–2007

DEATH REGISTRATION CLASSIFICATION				
Census classification	Indigenous	Non-Indigenous	Not stated	Total
	no.	no.	no.	no.
Indigenous	273	131	12	416
Non-Indigenous	87	34 460	196	34 743
Not stated	12	1 881	12	1 905
Total	372	36 472	220	37 064

The table highlights a number of features:

- of the 416 records identified as Indigenous in the Census, only 273 (66%) were identified as Indigenous on the death registration;
- the 273 records identified as Indigenous in both datasets represented 73% of linked deaths identified as Indigenous in death registrations;
- there is considerable misidentification of Indigenous status between the Census and death registrations (for example, Indigenous in death registrations but non-Indigenous in Census, and vice versa);
- the overall Indigenous deaths identification rate, indicated by these statistics, is 89% (that is, $372 / 416 * 100$).

The above suggests that while there appears to be considerable misidentification of Indigenous status between the Census and death registrations, the overall identification rate in the death registrations collection is quite high for New South Wales (89%).

At the same time, it needs to be recognised that at the national level, 26% of Indigenous deaths as recorded on the death registration form could not be linked to a Census record. This would occur due to failures in the linking process (that is, inadequate name and/or address information to enable a link) and also under-enumeration of the Indigenous population in the Census counts, which at the national level was estimated to be 11.5%. Despite these issues, it is considered that the linked data provide reasonable estimates of the identification rate of Indigenous deaths.

For the purpose of compiling Indigenous life tables, the experimental Indigenous ERP used was derived from Census counts adjusted by results of the Post Enumeration Survey (PES). The PES provides an independent check on Census coverage and also identifies key demographic characteristics of the population that have been missed or overcounted in the Census. In compiling experimental Indigenous ERP, Indigenous

USE OF THE CDE STUDY
TO DERIVE INDIGENOUS
DEATHS IDENTIFICATION
RATES *continued*

status reported in the PES was considered more reliable than that recorded in the Census.

Therefore, to be consistent with Indigenous ERP calculations, the number of deaths reported as Indigenous in Census in the CDE linked data were adjusted to a PES basis. It should be noted that these adjustments were only in respect of misclassifications of Indigenous status in the linked file. No attempt was, or could be, made for undercount identified in the PES; this is reflected in the non-matched death registrations.

Thus, the Indigenous deaths identification rate using the linked data was derived by:

- calculating the propensities, from PES, of being Indigenous in PES given Census Indigenous status (to align the Census Indigenous status with the PES Indigenous status);
- applying the propensities to counts from the CDE linked data to obtain the expected number of deaths in Census on a PES basis; and
- taking the ratio of the number of deaths reported as Indigenous in death registrations to that reported in Census on a PES basis to calculate the Indigenous deaths identification rate.

The following step by step example illustrates the calculation of the identification rate of Indigenous deaths for NSW:

*Step 1: Calculation of
propensities from PES
data given in table 3.4*

The propensities are calculated for persons who matched to Census and responded as Indigenous in the PES to the Census Indigenous question. They were estimated by the three response classes for the Census Indigenous question: Indigenous, non-Indigenous and not stated.

3.4 INDIGENOUS STATUS AS REPORTED IN 2006 CENSUS AND 2006
POST ENUMERATION SURVEY, New South Wales

	PES RESPONSE		
	Indigenous	Non-Indigenous	Total
Census response	no.	no.	no.
Indigenous	275	75	350
Non-Indigenous	31	17 160	17 191
Not stated	5	278	283
Total	311	17 513	17 824

Data in table 3.4 gives:

- $P(I/I)$ = propensity of being Indigenous in PES given
Census Indigenous status = 'Indigenous' is $275 / 350 = 0.7857$
- $P(I/NI)$ = propensity of being Indigenous in PES given
Census Indigenous status = 'non-Indigenous' is $31 / 17,191 = 0.0018$
- $P(I/NS)$ = propensity of being Indigenous in PES given
Census Indigenous status = 'not stated' is $5 / 283 = 0.0177$

Step 1: Calculation of propensities from PES data given in table 3.4 continued

The propensities $P(I/NI)$ and $P(I/NS)$ calculated above for New South Wales are based on small numbers of PES responses (31 and 5 respectively in this example) and hence could be unreliable. To overcome this problem, $P(I/NI)$ and $P(I/NS)$ are estimated from the Australian level PES data which gives $P(I/NI) = 0.0015$ and $P(I/NS) = 0.0303$.

These propensities are based on the unweighted PES data. In calculating Indigenous ERP, weighted PES information was used. Therefore, to be consistent with Indigenous ERP calculations, the propensities were calculated using the weighted PES data. This gives $P(I/I) = 0.8079$, $P(I/NI) = 0.0015$ and $P(I/NS) = 0.0205$.

Step 2: Estimation of expected number of deaths in Census in linked data given in table 3.3 using PES Indigenous propensities

The expected number of deaths in Census in CDE linked data using PES Indigenous propensities is:

$$\begin{aligned} &= 416 * P(I/I) + 34,743 * P(I/NI) + 1,905 * P(I/NS), \text{ where } P(I/I) \text{ is based on} \\ &\quad \text{weighted New South Wales PES data, and } P(I/NI) \text{ and } P(I/NS) \text{ are based on weighted} \\ &\quad \text{Australia-level PES data} \\ &= 416 * 0.8079 + 34,743 * 0.0015 + 1,905 * 0.0205 \\ &= 427 \end{aligned}$$

Step 3: Calculation of identification rate of Indigenous deaths

The estimate of the Indigenous deaths identification rate is then calculated by taking the ratio of the number of deaths reported as Indigenous in death registrations to the number of deaths expected to be recorded as Indigenous in Census using the PES Indigenous propensities:

$$\begin{aligned} &= 372 / 427 \\ &= 0.87 \end{aligned}$$

Step 4: Calculation of adjustment factor

The adjustment factor is taken to be the reciprocal of the identification rate of Indigenous deaths:

$$\begin{aligned} &= 1 / 0.87 \\ &= 1.15 \end{aligned}$$

In the linked data, 372 records were reported as Indigenous on the death registration form (table 3.3). Of deaths linked to the Census, 427 were recorded as Indigenous, after adjustment for classifying Indigenous status in the way that PES does. This means that fewer deaths were identified as Indigenous in death registrations than were expected in Census on a PES basis. Therefore, the number of Indigenous deaths according to death registrations needed multiplying by an adjustment factor of $1 / 0.87 = 1.15$ to be comparable to the Indigenous deaths expected to be recorded as such in the Census on a PES basis.

The procedure described above was used to derive Indigenous deaths identification rates for New South Wales, Queensland, Western Australia and the Northern Territory, with the $P(I/NI)$ and $P(I/NS)$ based on the weighted Australian propensities. Due to small numbers of Indigenous deaths in Victoria, South Australia, Tasmania and the Australian Capital Territory, it was not feasible to derive separate Indigenous deaths identification rates for these jurisdictions. Therefore, a single Indigenous deaths identification rate was derived by grouping these together.

*Step 4: Calculation of
adjustment factor
continued*

This method was not used to derive expected number of deaths for Australia. Instead, these were obtained by summing the expected number of deaths for New South Wales, Queensland, Western Australia, the Northern Territory, and the Victoria/South Australia/Tasmania/Australian Capital Territory grouping. This ensured the consistency of estimating expected deaths and hence Indigenous deaths identification rates between the states and territories and Australia.

There is considerable variation in the identification rates at the state/territory level (table 3.5). The estimate is less than 1.0 for New South Wales, Queensland and the Victoria/South Australia/Tasmania/Australian Capital Territory grouping, which indicates a level of under-identification of Indigenous deaths in death registrations relative to the Census for linked records. The situation is the opposite for Western Australia and the Northern Territory, indicating an over-representation of Indigenous deaths in death registrations relative to the Census for linked records; that is, persons who are identified as Indigenous in the death registrations collection exceed those identified as Indigenous in the Census on a PES basis. There is no clear reason as to why this might be the case, although there is evidence that some Indigenous deaths have a state of usual residence on the death registration that is different to the Census. It should be noted that both Western Australia and the Northern Territory had high levels of unlinked Indigenous death records (35% and 40% respectively) which in part is a reflection of the high Census undercount for those jurisdictions. This may indicate that the linked records may not be representative of all death records.

3.5 INDIGENOUS DEATHS IDENTIFICATION RATES, State/territory and Australia—2006–2007

	<i>Number of Indigenous deaths according to death registrations</i>	<i>Expected number of Indigenous deaths(a)</i>	<i>Identification rate</i>	<i>Adjustment factor(b)</i>
<i>State/territory</i>	<i>no.</i>	<i>no.</i>	<i>no.</i>	<i>no.</i>
NSW	372	427	0.87	1.15
Qld	351	372	0.94	1.06
WA	254	228	1.11	0.90
NT	204	188	1.09	0.92
Vic./SA/Tas./ACT/OT combined	146	226	0.65	1.55
Aust.(c)	1 327	1 441	0.92	1.09

(a) In Census if weighted PES Indigenous propensities are used.

(b) Calculated as the reciprocal of the identification rate.

(c) Includes all states and territories.

DISCUSSION

The use of the CDE Indigenous Mortality Quality Study to assess the identification rate of Indigenous deaths in death registration data has a number of benefits but at the same time it has limitations. First, the obvious and most substantial benefit is that it enables, for the first time, direct calculation of identification rates. That is, they are derived by directly comparing Indigenous status as reported according to death registrations and Census data for linked records, as opposed to indirect and modelled estimates that have been used previously. No other identification rates derived by the ABS in the past were produced by a direct comparison of an individual's Indigenous status as reported in two separate collections.

Second, no assumptions were necessary to derive the identification rates from the CDE study, whereas a number of subjective judgements and assumptions were necessary to produce the ABS' previously published identification rates.

The limitations of the CDE Indigenous Mortality Quality Study relate to three main factors. First, the derived Indigenous deaths identification rates relate to a very restricted time frame—the 11 months from early August 2006 to the end of June 2007 that the study was conducted. It is not possible to accurately judge the appropriateness or otherwise of the derived Indigenous deaths identification rates for past or future periods. In that regard it should be noted that the number of Indigenous deaths recorded in 2006–07 represented a 4% increase over 2005–06 indicating a possible improvement in identification rates in 2006–07.

Second, there remains a relatively high level (26%) of unlinked Indigenous death records, particularly in Western Australia (35%) and the Northern Territory (40%). While not unexpected given the relatively high Census undercount for Indigenous Australians, there may be features or characteristics of the unlinked records that are quite different to the linked records and therefore may introduce some bias to the results. Sensitivity analysis (see Appendix 1) indicates this is likely to be small.

Third, as stated above, the propensities of Indigenous identification as reported in the 2006 Census and 2006 PES are calculated for persons who matched to Census in PES. While PES is a sample representing the whole population, the current methodology implicitly assumes that the propensities based on the Census-PES match will apply for the death registrations linked to the Census. Appendix 1 provides some indication of the sensitivity of the estimates of Indigenous life expectancy at birth to assumptions made when calculating it.

A further assumption relates to the application of identification rates, which were calculated at the total population level (for each jurisdiction) but were applied to registered deaths uniformly across age and sex.

DISCUSSION *continued*

In spite of these limitations, the CDE Indigenous Mortality Quality Study clearly indicates that identification rates of Indigenous deaths in death registrations data are markedly higher, at least in 2006–07, than previous estimates. In particular, the ABS has previously published identification rates (called implied coverage rates) in *Deaths, Australia, 2006* (cat. no. 3302.0) which indicated a rate of 55% nationally. The identification rates for New South Wales (45%) and Queensland (51%) were the significant contributors to this low identification rate.

The previously published identification rates were derived using Indigenous population projections based on assumptions regarding future fertility, mortality, migration and unexplained growth. However, there was a significant degree of circularity in the way the identification rates were derived; see *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002). Therefore, the accuracy of the projected number of Indigenous deaths and the identification rates obtained was dependent on the accuracy of the Indigenous life tables this method produced in the first place. To the extent that method and the resulting life expectancies were flawed, then the identification rates would have been highly unreliable.

CHAPTER 4

LIFE TABLES

LIFE TABLES

EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS, New South Wales—2005–2007

4.1

	MALES				FEMALES			
	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>
	no.	rate	no.	years	no.	rate	no.	years
0	100 000	0.00965	99 151	69.9	100 000	0.00768	99 324	75.0
1–4	99 035	0.00158	395 727	69.6	99 232	0.00126	396 606	74.6
5–9	98 879	0.00078	494 193	65.7	99 107	0.00063	495 368	70.7
10–14	98 802	0.00077	493 846	60.7	99 045	0.00039	495 132	65.7
15–19	98 726	0.00268	493 089	55.8	99 006	0.00073	494 867	60.8
20–24	98 461	0.00616	490 903	50.9	98 934	0.00157	494 374	55.8
25–29	97 854	0.00806	487 362	46.2	98 779	0.00572	492 637	50.9
30–34	97 065	0.01189	482 752	41.6	98 214	0.00764	489 243	46.2
35–39	95 911	0.02230	474 432	37.1	97 464	0.00946	485 112	41.5
40–44	93 772	0.02374	463 435	32.8	96 542	0.01249	479 829	36.9
45–49	91 546	0.03286	450 617	28.6	95 336	0.01758	472 721	32.3
50–54	88 538	0.04731	432 762	24.5	93 660	0.02512	462 736	27.8
55–59	84 349	0.06903	408 036	20.5	91 307	0.03783	448 627	23.5
60–64	78 526	0.11001	372 198	16.9	87 853	0.06975	424 995	19.3
65–69	69 887	0.16336	321 990	13.6	81 725	0.11028	387 384	15.5
70–74	58 470	0.22846	259 340	10.8	72 712	0.18411	330 754	12.1
75–79	45 112	0.32809	188 990	8.2	59 325	0.26367	258 618	9.3
80–84	30 311	0.47451	114 747	6.0	43 683	0.39846	175 047	6.7
85 years and over	15 928	1.00000	67 041	4.2	26 277	1.00000	118 909	4.5

- (a) *lx*—number of persons surviving to exact age *x*.
 (b) *qx*—proportion of persons dying between exact age *x* and exact age *x*+*n*, where *n* is the width of the age interval.
 (c) *Lx*—number of person years lived within the age interval *x* to *x*+*n*.
 (d) *ex*—expectation of life at exact age *x*. Age *x* refers to the first age listed in the five year age group.

LIFE TABLES *continued***4.2** EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS, Queensland—2005–2007

	MALES				FEMALES			
	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>
	no.	rate	no.	years	no.	rate	no.	years
0	100 000	0.01195	98 948	68.3	100 000	0.00746	99 344	73.6
1–4	98 805	0.00296	394 500	68.1	99 254	0.00135	396 666	73.2
5–9	98 513	0.00131	492 215	64.3	99 120	0.00059	495 455	69.2
10–14	98 384	0.00166	491 566	59.4	99 062	0.00100	495 097	64.3
15–19	98 221	0.00433	490 195	54.5	98 963	0.00266	494 270	59.3
20–24	97 796	0.00857	487 025	49.7	98 700	0.00608	492 090	54.5
25–29	96 958	0.01061	482 244	45.1	98 100	0.00617	488 950	49.8
30–34	95 929	0.01296	476 813	40.5	97 495	0.00638	486 034	45.1
35–39	94 686	0.02409	468 036	36.0	96 873	0.01256	481 618	40.4
40–44	92 405	0.02796	455 740	31.9	95 656	0.01961	473 797	35.9
45–49	89 821	0.03900	440 827	27.7	93 780	0.02585	463 080	31.5
50–54	86 318	0.05652	420 018	23.7	91 356	0.03389	449 340	27.3
55–59	81 439	0.07876	391 548	20.0	88 260	0.04523	431 810	23.2
60–64	75 025	0.10083	357 467	16.5	84 268	0.07273	407 167	19.1
65–69	67 460	0.17790	309 404	13.0	78 139	0.11911	368 859	15.4
70–74	55 459	0.25410	242 104	10.3	68 832	0.17039	315 882	12.2
75–79	41 367	0.35282	170 348	7.9	57 104	0.26961	248 537	9.1
80–84	26 772	0.49227	99 748	5.9	41 708	0.42548	164 354	6.5
85 years and over	13 593	1.00000	57 070	4.2	23 962	1.00000	107 561	4.5

- (a) *lx*—number of persons surviving to exact age *x*.
 (b) *qx*—proportion of persons dying between exact age *x* and exact age *x*+*n*, where *n* is the width of the age interval.
 (c) *Lx*—number of person years lived within the age interval *x* to *x*+*n*.
 (d) *ex*—expectation of life at exact age *x*. Age *x* refers to the first age listed in the five year age group.

LIFE TABLES *continued*EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES
STRAIT ISLANDER AUSTRALIANS, Western Australia—2005–
2007**4.3**

	MALES				FEMALES			
	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>
	no.	rate	no.	years	no.	rate	no.	years
0	100 000	0.01062	99 065	65.0	100 000	0.00945	99 168	70.4
1–4	98 938	0.00391	394 849	64.7	99 055	0.00253	395 622	70.1
5–9	98 551	0.00192	492 194	60.9	98 804	0.00138	493 624	66.2
10–14	98 362	0.00104	491 633	56.1	98 668	0.00069	493 226	61.3
15–19	98 260	0.00823	489 602	51.1	98 600	0.00537	491 812	56.4
20–24	97 451	0.01228	484 287	46.5	98 071	0.00558	489 054	51.7
25–29	96 254	0.01341	478 231	42.1	97 524	0.01019	485 289	46.9
30–34	94 963	0.02346	469 679	37.6	96 530	0.01195	479 829	42.4
35–39	92 735	0.03426	456 071	33.4	95 376	0.01662	473 257	37.9
40–44	89 558	0.04424	438 203	29.5	93 791	0.02833	462 670	33.5
45–49	85 596	0.05741	416 115	25.8	91 134	0.03845	447 269	29.4
50–54	80 682	0.07475	388 805	22.2	87 630	0.05136	427 337	25.4
55–59	74 651	0.09883	355 522	18.8	83 129	0.06875	401 899	21.7
60–64	67 273	0.13598	314 095	15.5	77 414	0.08868	370 568	18.1
65–69	58 125	0.18512	264 333	12.6	70 549	0.13168	330 644	14.6
70–74	47 365	0.27565	204 263	9.9	61 259	0.20890	275 087	11.4
75–79	34 309	0.36964	139 482	7.7	48 462	0.30007	206 541	8.7
80–84	21 627	0.49891	79 996	5.7	33 920	0.43579	132 154	6.4
85 years and over	10 837	1.00000	43 732	4.0	19 138	1.00000	84 314	4.4

- (a) *lx*—number of persons surviving to exact age *x*.
 (b) *qx*—proportion of persons dying between exact age *x* and exact age *x*+*n*, where *n* is the width of the age interval.
 (c) *Lx*—number of person years lived within the age interval *x* to *x*+*n*.
 (d) *ex*—expectation of life at exact age *x*. Age *x* refers to the first age listed in the five year age group.

LIFE TABLES *continued*EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES
STRAIT ISLANDER AUSTRALIANS, Northern Territory—2005–
2007**4.4**

	MALES				FEMALES			
	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>
	no.	rate	no.	years	no.	rate	no.	years
0	100 000	0.01783	98 431	61.5	100 000	0.01081	99 049	69.2
1–4	98 217	0.00401	391 927	61.6	98 919	0.00322	394 926	69.0
5–9	97 823	0.00303	488 359	57.9	98 600	0.00208	492 469	65.2
10–14	97 527	0.00401	486 820	53.0	98 395	0.00264	491 381	60.3
15–19	97 136	0.01221	483 081	48.2	98 135	0.00475	489 620	55.5
20–24	95 950	0.01931	475 263	43.8	97 669	0.00741	486 584	50.7
25–29	94 097	0.02206	465 433	39.6	96 945	0.00882	482 782	46.1
30–34	92 021	0.03173	453 418	35.4	96 090	0.01725	476 545	41.5
35–39	89 101	0.05320	434 171	31.5	94 432	0.02224	467 317	37.2
40–44	84 361	0.06268	408 759	28.1	92 332	0.03947	452 989	33.0
45–49	79 073	0.07310	381 115	24.8	88 688	0.04932	432 761	29.2
50–54	73 293	0.08541	351 001	21.6	84 314	0.05968	409 262	25.6
55–59	67 033	0.09883	318 657	18.4	79 282	0.07220	382 384	22.0
60–64	60 408	0.12695	284 204	15.1	73 558	0.09085	351 539	18.6
65–69	52 739	0.22422	235 959	11.9	66 875	0.12051	314 810	15.2
70–74	40 914	0.28215	175 116	9.6	58 816	0.18328	268 223	11.9
75–79	29 370	0.38498	118 357	7.4	48 036	0.28060	207 472	9.0
80–84	18 063	0.52976	65 235	5.5	34 557	0.42677	135 807	6.5
85 years and over	8 494	1.00000	34 639	4.1	19 809	1.00000	87 794	4.4

- (a) *lx*—number of persons surviving to exact age *x*.
 (b) *qx*—proportion of persons dying between exact age *x* and exact age *x*+*n*, where *n* is the width of the age interval.
 (c) *Lx*—number of person years lived within the age interval *x* to *x*+*n*.
 (d) *ex*—expectation of life at exact age *x*. Age *x* refers to the first age listed in the five year age group.

LIFE TABLES *continued***4.5** EXPERIMENTAL LIFE TABLES FOR ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS, Australia—2005–2007

	MALES				FEMALES			
	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>	<i>lx(a)</i>	<i>qx(b)</i>	<i>Lx(c)</i>	<i>ex(d)</i>
	no.	rate	no.	years	no.	rate	no.	years
0	100 000	0.01171	98 970	67.2	100 000	0.00828	99 272	72.9
1–4	98 829	0.00258	394 647	67.0	99 172	0.00190	396 193	72.5
5–9	98 574	0.00138	492 531	63.2	98 984	0.00094	494 686	68.6
10–14	98 438	0.00137	491 852	58.3	98 891	0.00087	494 237	63.7
15–19	98 303	0.00575	490 102	53.4	98 804	0.00274	493 346	58.7
20–24	97 738	0.01019	486 200	48.7	98 534	0.00485	491 476	53.9
25–29	96 742	0.01364	480 411	44.1	98 056	0.00821	488 269	49.1
30–34	95 422	0.01874	472 640	39.7	97 251	0.00956	483 933	44.5
35–39	93 634	0.03057	461 012	35.4	96 322	0.01399	478 239	39.9
40–44	90 771	0.03750	445 346	31.5	94 974	0.02104	469 873	35.5
45–49	87 367	0.04462	427 092	27.6	92 975	0.02876	458 190	31.2
50–54	83 469	0.05923	404 988	23.8	90 301	0.03658	443 247	27.0
55–59	78 526	0.07879	377 162	20.1	86 998	0.05037	424 035	22.9
60–64	72 339	0.11465	340 960	16.6	82 616	0.08212	396 119	19.0
65–69	64 045	0.17290	292 542	13.4	75 831	0.11167	357 986	15.5
70–74	52 972	0.24206	232 803	10.7	67 363	0.18539	305 593	12.1
75–79	40 149	0.32834	167 790	8.3	54 874	0.25645	239 191	9.3
80–84	26 967	0.44671	104 717	6.2	40 802	0.39057	164 169	6.7
85 years and over	14 920	1.00000	62 274	4.2	24 866	1.00000	109 300	4.4

- (a) *lx*—number of persons surviving to exact age *x*.
 (b) *qx*—proportion of persons dying between exact age *x* and exact age *x*+*n*, where *n* is the width of the age interval.
 (c) *Lx*—number of person years lived within the age interval *x* to *x*+*n*.
 (d) *ex*—expectation of life at exact age *x*. Age *x* refers to the first age listed in the five year age group.

EXPLANATORY NOTES

INTRODUCTION

Use of experimental Indigenous life tables

- 1** This publication contains abridged experimental life tables for male and female Aboriginal and Torres Strait Islander (Indigenous) Australians for the reference period 2005–2007.
- 2** The life tables in this publication have been produced to enable the construction of ABS estimates and projections of the Aboriginal and Torres Strait Islander population of Australia for the period 1991 to 2021. These data are produced using the cohort-component method, in which assumptions made about levels of mortality, fertility and migration are iteratively applied to a base population to obtain past and/or future populations.
- 3** Estimates of life expectancy at birth for Indigenous Australians are commonly used as a measure for assessing Indigenous population health and disadvantage. Due to significant changes in methodology, *ABS strongly advises that comparisons between the estimates presented here and previously published estimates should not be made. Differences should not be interpreted as measuring changes in Indigenous life expectancy over time.*

SCOPE

- 4** Life tables in this publication relate to the resident populations of New South Wales, Queensland, Western Australia, Northern Territory and Australia (which includes all states and territories). Due to the small number of Indigenous deaths in Victoria, South Australia, Tasmania and the Australian Capital Territory, it is not possible to construct life tables for these jurisdictions (see paragraphs 10–12 and 24–26).

CLASSIFICATIONS

Indigenous status

- 5** The term Indigenous is used in this publication to refer to Australian Aboriginal and Torres Strait Islander peoples. ABS Indigenous population statistics are based on responses to the ABS standard question for Indigenous identification (Question 7 of the 2006 Census), as below:

7 Is the person of Aboriginal or Torres Strait Islander origin? • For persons of both Aboriginal and Torres Strait Islander origin, mark both 'Yes' boxes.	<input type="radio"/> No <input type="radio"/> Yes, Aboriginal <input type="radio"/> Yes, Torres Strait Islander
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Australian Standard Geographical Classification

- 6** The Australian Standard Geographical Classification (ASGC) is a hierarchical classification system consisting of six interrelated classification structures. The ASGC provides a common framework of statistical geography and thereby enables the production of statistics which are comparable and can be spatially integrated.
- 7** For further information refer to *Australian Standard Geographical Classification (ASGC)* (cat. no. 1216.0).

METHOD FOR PRODUCING
LIFE TABLES

8 A life table is a statistical model used to represent mortality of a population. In its simplest form, a life table is generated from age-specific death rates and the resulting values are used to measure mortality, survivorship and life expectancy.

9 A life table may be complete or abridged, depending on the age intervals used in their compilation. Life tables in this publication are abridged life tables – they contain data for five-year age groups – and are presented separately for males and females. Abridged life tables were chosen as age-specific death rates for 5-year age groups were considered more reliable than those for single years of age due to the small annual numbers of Indigenous deaths in the states and territories.

10 To construct a life table, data on deaths that occur in a period and estimates of the population (at the mid-point of the period) exposed to the risk of dying are required, disaggregated by age and sex.

11 The first step in the compilation of a life table involves the calculation of age-specific death rates (ASDRs) for the population of interest. ASDRs are calculated as:

- $ASDR_{a,s} = \text{Deaths}_{a,s} / \text{Population}_{a,s}$ where
 - $ASDR_{a,s}$ is the age-specific death rate for age group a and sex s ;
 - $\text{Deaths}_{a,s}$ is the number of deaths for age group a and sex s over a specified period of time; and
 - $\text{Population}_{a,s}$ is the population of the age group a and sex s at the mid-point of the specified period.

12 The next step is to derive mortality rates (the proportion of people of a given age who die within one year, denoted by qx) from ASDRs. The mortality rates are then applied to a hypothetical group of newborn babies (typically 100,000 in size) until the population has died out. This results in a range of related functions, of which the life tables in this publication include:

- lx —the number of persons surviving to exact age x ;
- qx —the proportion of persons dying between exact age x and exact age $x+n$ (where n is the width of the age interval). It is the mortality rate, from which all other functions of the life table are derived;
- Lx —the number of person years lived within the age interval x to $x+n$; and
- ex —life expectancy at exact age x .

13 The life tables in this publication are period life tables, based on mortality rates for 2005–2007. Period life tables assume that as a group of new-born babies pass through life it will experience the mortality rates of the specific period which do not change from year to year. Period life tables thus constitute a hypothetical model of mortality, and, although based upon mortality rates from a real population during a particular period of time, do not describe the future mortality of this group.

*Life tables for the Indigenous
population*

14 To produce life tables for the Indigenous population of Australia, information on the number of Indigenous deaths and the Indigenous population are required. Data quality issues are discussed in *Chapter 2: Quality issues with Indigenous deaths and population data*.

15 The life tables in this publication are based on the number of Indigenous deaths registered in 2005–2007 and Indigenous population estimates for 30 June 2006 from *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, Jun 2006* (cat. no. 3238.0.55.001).

16 To account for under-identification of Indigenous deaths in death registrations, the numbers of Indigenous deaths were adjusted according to the adjustment factors derived from the Census Data Enhancement Indigenous Mortality Quality Study (see table 3.5). This is described in *Chapter 3: Data linkage to derive Indigenous deaths identification rates*.

Life tables for the Indigenous population continued

17 The adjusted numbers of Indigenous deaths were divided by three to obtain the average annual number of Indigenous deaths over the period 2005–2007, and in conjunction with 30 June 2006 Indigenous population estimates were used to calculate age-specific death rates for the Indigenous population. Life tables were then derived as described in paragraphs 11 and 12 above.

Life tables for the non-Indigenous population

18 Life tables for the non-Indigenous population were produced to enable a comparison of life expectancy at birth and other ages between the Indigenous and non-Indigenous populations of Australia.

19 Numbers of non-Indigenous deaths were obtained by subtracting the adjusted numbers of Indigenous deaths from the total number of deaths registered in 2005–2007 and dividing by three to obtain the average annual number of non-Indigenous deaths.

20 Estimates of the non-Indigenous population for 30 June 2006 from *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, Jun 2006* (cat. no. 3238.0.55.001) were used as denominators in the calculation of age-specific death rates for the non-Indigenous population, and life tables derived from these.

Graduation of life tables

21 Graduation refers to a standard demographic technique of smoothing to remove the effect of year to year volatility in numbers of deaths (by age and sex) on mortality rates (qx). This ensures that implausible results do not occur in the life tables, such as female mortality rates exceeding male mortality rates.

22 Life tables were first produced for the Indigenous and non-Indigenous populations as described above. While numbers of deaths were averaged for 2005–2007, the resulting mortality rates still contained some volatility across age groups. Mortality rates were therefore adjusted so that the rates were smooth across age groups. This was done for both Indigenous and non-Indigenous life tables, for all states and territories and both sexes.

23 The graduation of life tables was performed so that life expectancy at birth estimates were unaffected, but minor changes to life expectancy at other ages occurred.

Victoria, South Australia, Tasmania and Australian Capital Territory

24 The compilation of life tables requires sufficient numbers of deaths to allow the calculation of reliable ASDRs for each age group. With small numbers of deaths the resulting ASDRs are likely to be volatile, and, particularly at younger ages, may be zero.

25 Due to the small Indigenous populations of Victoria, South Australia, Tasmania and the Australian Capital Territory, these jurisdictions record very small numbers of Indigenous deaths annually (around 90, 135, 25 and 10 Indigenous deaths per year on average for 2005–2007 respectively).

26 For abridged life tables with an upper age group of 85 years and over, there are 19 age groups in total. Disaggregating the numbers of Indigenous deaths in these jurisdictions by age and sex results in extremely small numbers of deaths for any age group and sex, from which it is not possible to calculate reliable age-specific death rates. For this reason it is not possible to produce life tables for the Indigenous populations of these jurisdictions.

*Life expectancy in Deaths,
Australia (cat. no. 3302.0)*

27 Estimates of life expectancy at birth for the total population presented in this publication differ from estimates published in *Deaths, Australia, 2006* (cat. no. 3302.0). Estimates presented in this publication are derived from abridged life tables with an upper age limit of 85 years and over, using numbers of deaths registered in 2005–2007 and the population as at 30 June 2006, while life expectancy estimates in *Deaths, Australia, 2006* (cat. no. 3302.0) are based on complete life tables with an upper age group of 115 years and over, using deaths according to month of occurrence in 2005–2007 and quarterly population estimates. In addition, graduation processes applied to both sets of life tables differ.

CONFIDENTIALITY

28 The *Census and Statistics Act 1905* provides the authority for the ABS to collect statistical information, and requires that statistical output shall not be published or disseminated in a manner that is likely to enable the identification of a particular person or organisation. This requirement means that the ABS must take care and make assurances that any statistical information about individual respondents cannot be derived from published data.

29 Where necessary, tables in this publication have had small values suppressed or randomised to protect confidentiality. As a result, sums of components may not add exactly to totals.

ROUNDING

30 Calculations as shown in the commentary sections of this publication are based on unrounded figures. Calculations using rounded figures may differ from those published. Where figures have been rounded in tables, discrepancies may occur between sums of component items and totals.

ACKNOWLEDGEMENTS

31 The ABS publications draw extensively on information provided freely by individuals, business, governments and other organisations. Their continued cooperation is very much appreciated; without it, the wide range of statistics published by the ABS would not be available. Information received by the ABS is treated in strict confidence as required by the *Census and Statistics Act 1905*.

RELATED PRODUCTS

32 Other ABS products which may be of interest to users include:

- *Research Paper: Methodology of Evaluating the Quality of Probabilistic Linking* (cat. no. 1351.0.55.018)
- *Research Paper: An Estimating Equation Approach to Census Coverage Adjustment* (cat. no. 1351.0.55.019)
- *Research Paper: Exploring Methods for Creating a Longitudinal Census Dataset* (cat. no. 1352.0.55.076)
- *Discussion Paper: Enhancing the Population Census: Developing a Longitudinal View* (cat. no. 2060.0)
- *Information Paper: Census Data Enhancement Project: An Update, Australia, June 2006* (cat. no. 2062.0)
- *Census of Population and Housing - Details of Undercount, Australia, August 2006* (cat. no. 2940.0)
- *Census of Population and Housing - Undercount, Australia, 2006* (cat. no. 2940.0)
- *Information Paper: Measuring Net Undercount in the 2006 Population Census, Australia, 2006* (cat. no. 2940.0.55.001)
- *Demography Working Paper 2004/3 - Calculating Experimental Life Tables for Use in Population Estimates and Projections of Aboriginal and Torres Strait Islander Australians, 1991 to 2001* (cat. no. 3106.0.55.003)
- *Experimental Estimates and Projections of Aboriginal and Torres Strait Islander Australians, 1991–2009* (cat. no. 3238.0)
- *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, Jun 2006* (cat. no. 3238.0.55.001)

RELATED PRODUCTS *continued*

- *Deaths, Australia* (cat. no. 3302.0)
- *Life Tables, States and Territories* (cat. nos. 3302.0.55.001–3302.8.55.001)
- *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002)
- *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, 2008* (cat. no. 4704.0)
- *Population Distribution, Aboriginal and Torres Strait Islander Australians, Australia, 2006* (cat. no. 4705.0)
- *Information Paper: Census Data Enhancement - Indigenous Mortality Quality Study, 2006–07* (cat. no. 4723.0)

ADDITIONAL STATISTICS
AVAILABLE

33 The abridged life tables in chapter 4 are also available as a data cube (in Microsoft Excel format) available for download from the ABS website in *Experimental Life Tables for Aboriginal and Torres Strait Islander Australians, 2005–2007* (cat. no. 3302.0.55.003):

- Table 1: *Experimental Life Tables for Aboriginal and Torres Strait Islander Australians, State/Territory and Australia—2005–2007*
- Table 2: *Summary of Linked Deaths by Indigenous Status, State/Territory and Australia—2006–2007*

34 Additional demographic information is available on the ABS website <<http://www.abs.gov.au>>; click Themes, then under People click on Demography. Users can also access the full range of electronic ABS data from the ABS website.

35 As well as the statistics included in this and related publications, the ABS may have other relevant data available on request. Inquiries should be made to the National Information and Referral Service on 1300 135 070.

36 The ABS also issues a daily Release Advice on the website which details the products to be released in the week ahead.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AIHW	Australian Institute of Health and Welfare
Aust.	Australia
cat. no.	Catalogue number
CDE	Census data enhancement
ERP	estimated resident population
no.	number
NSW	New South Wales
NT	Northern Territory
OT	Other Territories
PES	Post Enumeration Survey
Qld	Queensland
RTO	resident temporarily overseas
SA	South Australia
SE	standard error
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia

ESTIMATING SAMPLE ERROR

This appendix describes the basis for estimating the sample error of estimates of Indigenous life expectancy at birth and for assessing the sensitivity of this life expectancy to assumptions made when calculating it. Broadly, a process of replication was used where the inputs to the Indigenous life expectancy calculations were replicated based on sample error information obtained from the Post Enumeration Survey (PES) and on plausible deviations from the assumptions. Variation between the replicate estimates of Indigenous life expectancy corresponding to replicate estimates from PES gave estimates of the sample error of life expectancy and the additional variation from deviations from the assumptions measured the sensitivity of the method to the assumptions.

The immediate inputs to Indigenous life expectancy are:

- Indigenous estimated resident population (ERP) at 30 June 2006 by 5-year age groups; and
- Indigenous deaths for 2005–2007 adjusted for differences in reporting Indigenous status.

The method of calculating Indigenous ERP is described in *Experimental Estimates of Aboriginal and Torres Strait Islander Australians, Jun 2006* (cat. no. 3238.0.55.001). The method of adjusting Indigenous deaths for differential identification is given in *Chapter 3: Data linkage to derive Indigenous deaths identification rates*.

The inputs to the calculation of Indigenous ERP are:

- Census counts at fine levels;
- estimates of total population (both Indigenous and non-Indigenous) at intermediate levels; and
- estimates of Indigenous population at broad levels.

The main input for adjusted Indigenous deaths are Indigenous deaths registered during 2005–2007, modified using the Indigenous deaths identification rate [previously referred to as the coverage rate in *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002)]. This adjusts the Indigenous status of death registrations to correspond to the Indigenous status in ERP, which is as reported in PES. The identification rate is calculated from a probabilistic linking of death registrations between August 2006 and June 2007 to the 2006 Census and from PES data. The inputs are:

- number of deaths in linked records reported as Indigenous in death registrations, by state/territory;
- number of deaths in linked records by Census Indigenous status, by state/territory;
- propensity of being Indigenous in PES given Census Indigenous status = 'Indigenous', by state/territory; and
- propensities of being Indigenous in PES given Census Indigenous status = 'non-Indigenous' and 'not stated'.

Estimates of the total and Indigenous populations incorporate components of PES undercount adjustment and the propensities are calculated from PES, and so the sample error in PES generates sample error in Indigenous life expectancy. Standard errors (SEs) were calculated by replication of PES inputs, based on estimated PES sampling error.

Note that PES data are weighted to estimate the propensities but unweighted data were used in the discussion paper.

ESTIMATING SENSITIVITY
ERROR

In calculating and applying the identification rate the following assumptions were made:

- identification rates for unlinked deaths were assumed to be the same as those for linked deaths;
- identification rates for 2005–2007 were assumed to be the same as those observed for August 2006 to June 2007;
- identification rates were assumed to apply uniformly across age and sex;
- propensities for Indigenous identification in the Census and PES were assumed to be applicable to death registrations, in spite of the different age distributions; and
- Census/PES non-Indigenous and not stated propensities for Australia were assumed to apply uniformly across states/territories.

There was no direct information on possible deviation from the first two assumptions, but deviations within plus or minus five percentage points of identification rate for each state were used for the first assumption, and within plus or minus two percentage points for each age, sex and state for the second assumption. Data from the linked file and PES were analysed to give ranges of deviations in identification rates for the last three assumptions.

RESULTS

The 95% confidence intervals for Indigenous life expectancy at birth estimates from the sensitivity analysis and sample error are given in Table A1.1 below.

A1.1 CONFIDENCE INTERVALS FOR INDIGENOUS LIFE EXPECTANCY AT BIRTH—2005–2007

		95% CONFIDENCE INTERVALS	
	<i>Life expectancy at birth</i>	<i>Sensitivity error(a)</i>	<i>Sample error</i>
<i>State/territory</i>	years	years	years
Males			
NSW	69.9	67.9–71.9	68.6–71.2
Qld	68.3	66.8–69.8	67.3–69.3
WA	65.0	63.4–66.6	63.8–66.2
NT	61.5	60.1–62.9	60.5–62.5
Aust.(b)	67.2	65.8–68.6	66.3–68.1
Females			
NSW	75.0	73.3–76.7	73.9–76.1
Qld	73.6	72.3–74.9	72.8–74.4
WA	70.4	68.9–71.9	69.4–71.4
NT	69.2	67.9–70.5	68.4–70.0
Aust.(b)	72.9	71.7–74.1	72.1–73.7

(a) Sensitivity to assumptions. Includes sample error.

(b) Includes all states and territories.

RESULTS *continued*

The 95% confidence intervals for Indigenous deaths identification rates from the sensitivity analysis and sample error are given in Table A1.2 below.

These errors are produced during the process of calculating the errors for life expectancy, but because the sensitivity errors are applied at a finer level than the sample errors, the process for aggregating them to state level was slightly different.

A1.2 CONFIDENCE INTERVALS FOR INDIGENOUS DEATHS
IDENTIFICATION RATES—2005–2007

95% CONFIDENCE INTERVALS			
	Identification rate	Sensitivity error(a)	Sample error
State/territory	no.	no.	no.
NSW	0.87	0.73–1.01	0.80–0.95
Qld	0.94	0.84–1.05	0.89–1.00
WA	1.11	1.01–1.22	1.06–1.16
NT	1.09	1.01–1.16	1.07–1.10
Aust.(b)	0.92	0.83–1.01	0.87–0.97

(a) Sensitivity to assumptions. Includes sample error.

(b) Includes all states and territories.

INTRODUCTION

The method adopted by the ABS to compile Indigenous life tables has two key features. First, the use of the CDE Indigenous Mortality Quality Study enables direct calculation of identification rates. Second, by aligning the deaths data to the population estimates derived from the 2006 Census and Post Enumeration Survey the methodology assures consistency between the numerator (that is, estimates of deaths) and the denominator (estimates of population at risk).

This appendix presents Indigenous life expectancy estimates using a range of alternative approaches for adjusting deaths data as input to compilation of life tables using the direct demographic method.

ALTERNATIVE APPROACHES
TO ADJUST DEATHS

Six alternative approaches were considered:

1. using deaths identified as Indigenous in either the Census or death registrations in the CDE linked data only;
2. using deaths identified as Indigenous in either the Census or death registrations in the CDE linked and unlinked data;
3. using the Chandra Sekar and Deming 'Capture/Recapture' approach;
4. using Indigenous identification based on the 2006 Census;
5. using CDE-adjusted Indigenous deaths, with further adjustments to the age and sex structure of deaths according to preliminary results from the Australian Institute of Health and Welfare Indigenous Mortality Data Linkage Study; and
6. using deaths identified as Indigenous in the Australian Institute of Health and Welfare Indigenous Mortality Data Linkage Study.

The first three approaches were suggested in feedback on the *Discussion Paper: Assessment of Methods for Developing Life Tables for Aboriginal and Torres Strait Islander Australians, 2006* (cat. no. 3302.0.55.002). ABS subsequently explored these approaches but considered them to be unsuitable for estimating Indigenous mortality. The main reason for this is that the identification of Indigenous status in the numerator (deaths) and the denominator (population estimates) are inconsistent with each other, thus introducing bias to life expectancy estimates.

The fourth approach was explored by ABS before releasing the discussion paper, but the resultant life expectancy at birth estimates were not published as they were considerably higher than the estimates released in the discussion paper.

The fifth and sixth approaches were explored as a result of discussions with the Australian Institute of Health and Welfare (AIHW) following the release of the discussion paper.

A brief discussion of each of the different approaches and the results obtained are presented below.

1. Deaths identified as Indigenous in either Census or death registrations in the CDE linked data only

ABS explored this option to derive identification rates for Indigenous deaths and life expectancy estimates using the CDE linked data.

As shown in Table A2.1, in the linked file there were 1,327 deaths identified as Indigenous in death registrations in Australia. An additional 323 deaths were identified as Indigenous in the Census only (these deaths were not identified as Indigenous in death registrations). This gives a total of 1,650 Indigenous deaths in the linked file, and an identification rate of $1,327 / 1,650 * 100 = 80\%$ for Australia.

This lowers the identification rate and results in lower life expectancy at birth estimates.

This approach uses a concept of Indigenous status which is different from that used for the denominator for death rates; that is, population estimates where Indigenous status is as reported in PES only but not augmented by other sources of information. In calculating life expectancy estimates, it is important to ensure that the classification of records as Indigenous occurs in a consistent manner in the numerator (deaths) and the denominator (population estimates) as different population scopes feed directly into bias in death rates.

A2.1 CDE LINKED DATA(a), Identification rates and life expectancy estimates based on Indigenous deaths—2005–2007

	Indigenous deaths in death registrations	Additional Indigenous deaths identified in Census only	Total Indigenous deaths by death registrations and Census	Indigenous deaths identification rate(b)	LIFE EXPECTANCY AT BIRTH ESTIMATES	
					Males	Females
State/territory	no.	no.	no.	no.	years	years
NSW	372	143	515	0.72	67.5	73.0
Qld	351	62	413	0.85	66.9	72.4
WA	254	34	288	0.88	61.7	67.3
NT	204	5	209	0.98	59.7	67.7
Aust.(c)	1 327	323	1 650	0.80	65.5	71.4

(a) Deaths identified in either Census or registration in the CDE linked data.

(b) Ratio of Indigenous deaths identified in death registrations to the total Indigenous deaths identified in both registration and Census.

(c) Includes all states and territories.

2. Deaths identified as Indigenous in either Census or death registrations in the CDE linked and unlinked data

This approach, like the previous approach, is based on Indigenous deaths identified in either the Census or death registrations, but uses the Indigenous deaths identified in the CDE linked file plus those Indigenous deaths which were unable to be linked to a Census record.

At the national level, there were 1,800 Indigenous death records available from death registrations for linking in the CDE study. This approach uses all of these Indigenous death records in the numerator to estimate the identification rate, as opposed to 1,327 linked records used by the approach above. Of the 1,800 records, there were 1,650 records on the linked file where the deceased was assumed to be Indigenous based on information from their death registration or Census records (table A2.1 above). The 473 (that is, 1,800 minus 1,327) Indigenous death records which were unable to be linked to Census records were then added to the 1,650 Indigenous death records to get the total number of Indigenous deaths available for analysis after linkage. The identification rate was then calculated as the ratio of Indigenous deaths prior to linkage to Indigenous deaths after linkage; that is, $1,800 / 2,123 * 100 = 85\%$ for Australia.

A2.2 CDE LINKED AND UNLINKED DATA(a), Identification rates and life expectancy estimates based on Indigenous deaths—2005–2007

	<i>Indigenous deaths prior to linkage</i>	<i>Indigenous deaths after linkage</i>	<i>Indigenous deaths identification rate(b)</i>	LIFE EXPECTANCY AT BIRTH ESTIMATES	
				Males	Females
<i>State/territory</i>	no.	no.	no.	years	years
NSW	453	594	0.76	68.3	73.6
Qld	429	493	0.87	67.2	72.7
WA	387	422	0.92	62.3	67.9
NT	341	345	0.99	59.9	67.9
Aust.(c)	1 800	2 123	0.85	66.0	71.9

(a) Deaths identified in either Census or registration in the CDE linked and unlinked data.

(b) Ratio of Indigenous deaths prior to linkage to Indigenous deaths after linkage.

(c) Includes all states and territories.

Like the previous approach, this approach also produces life expectancy estimates which are biased as the identification of Indigenous status in the numerator and the denominator are inconsistent.

3. Chandra Sekar and Deming 'Capture/Recapture' model

The ABS has explored the Chandra Sekar and Deming 'Capture/Recapture' approach to deriving identification rates based on the CDE Indigenous Mortality Quality Study data. The logic of this approach is that when a vital registration is incomplete, data obtained from an independent collection can be used in conjunction with the registrar's list to estimate (1) the total number of births and deaths in an area over a specified period, and (2) the completeness of registration. This method was originally applied in a health centre area near Calcutta, India to estimate total numbers of births and deaths and registration completeness for the years 1945 and 1946. The study used data collected from a registration system and an enquiry in the form of a house-to-house canvass (Sekar and Deming, 1949). This approach was also applied to data from a registration system and a survey in conjunction with the 1940 and 1950 Censuses of the United States and the Population Survey in 1969–70 to measure completeness of birth registration (Shryock et al., 1970).

This approach was explored using the CDE linked file of the form:

A2.3 INDIGENOUS STATUS CLASSIFICATION

Census classification	DEATH REGISTRATION CLASSIFICATION		
	Indigenous	Non-Indigenous(a)	Total
Census			
Indigenous	a	b	S
Non-Indigenous(a)	c	d	..
Total	R	..	N

(a) Includes records where Indigenous status was not stated.

where:

- a = number of deaths recorded as Indigenous in both death registrations and Census;
- b = number of deaths recorded as Indigenous in Census only, but recorded as non-Indigenous in death registrations;
- c = number of deaths recorded as Indigenous in death registrations only, but recorded as non-Indigenous in Census, and;
- d = Indigenous deaths missed by both death registrations and Census.

The values a, b and c are observed and d is estimated as $b * c / a$ on the assumption that the process of contributing to the rows is independent of contributing to the columns.

An estimate of the total number of Indigenous deaths can be obtained as:

- $N = a + b + c + d$

The identification rate for Indigenous deaths can then be estimated as:

- identification rate = total number of Indigenous deaths captured in death registrations / estimated total number of Indigenous deaths captured in death registrations and Census
- $= R / N$

where R denotes the total number of Indigenous deaths captured in death registrations and S denotes the total number of Indigenous deaths captured in Census.

Identification rates and life expectancy at birth estimates based on this method are presented in table A2.4.

3. Chandra Sekar and Deming
'Capture/Recapture' model
continued

A2.4 CHANDRA SEKAR AND DEMING 'CAPTURE/RECAPTURE' METHOD, Indigenous deaths identification rates and life expectancy at birth estimates —2005–2007

State/territory	Indigenous deaths captured in registration no.	Indigenous deaths captured in registrations and census no.	Identification rate no.	LIFE EXPECTANCY AT BIRTH	
				Males	Females
				years	years
NSW	372	567	0.66	66.3	71.9
Qld	351	423	0.83	66.6	72.1
WA	254	300	0.85	61.1	66.8
NT	204	209	0.98	59.7	67.7
Aust.(a)	1 327	1 755	0.76	64.6	70.6

(a) Includes all states and territories.

The underlying model is based on the following assumptions:

- (i) the data collections are independent of each other;
- (ii) some Indigenous records are classified as non-Indigenous in both data collections;
- (iii) the population of deaths is divided into 'underlying Indigenous status'; and
- (iv) non-Indigenous deaths are never reported as Indigenous.

Assumption (i) is valid in this case though it is likely that the same family member could have provided information for some of the linked deaths/Census records. Virtually all deaths that occur in Australia are registered, but not all Indigenous deaths are registered as such. Similarly, some Indigenous deaths are misclassified as non-Indigenous in Census. Therefore, assumption (ii) may be applicable.

The key problem for using this method to derive identification rates for Indigenous deaths based on the CDE linked data relates to the assumption (iv). As can be seen in table 3.3 of *Chapter 3: Data linkage to derive Indigenous deaths identification rates*, a significant number of deaths were identified as Indigenous in death registrations but were classified as non-Indigenous in the Census, and vice versa. Like the previous two methods, the 'Capture/Recapture' method maximises the number of Indigenous deaths identified by two sources, but disregards the misclassification of Indigenous status reported in Census and registration data. Thus Indigenous classification used in the numerator (deaths) and denominator (population estimates) are again inconsistent.

4. Direct method using
identification based on the
2006 Census

The CDE linked dataset was used to derive direct estimates of mortality of the Indigenous population counted in the 2006 Census. The method of estimation was a three stage process.

Firstly, people who identified themselves as Indigenous in the 2006 Census were selected from the Census. There were 455,028 such people, comprising the denominator of age-specific death rates used for life table calculations.

Secondly, only those death records for which Indigenous status was reported as Indigenous in the Census were taken from the linked file. There were 1,379 such records. The CDE study linked 2006 Census records with deaths that occurred from 9 August 2006 to 30 June 2007 for all states/territories (except for Victoria where death records were only available to mid-March 2007). As one full year of deaths are required to derive life tables, deaths were adjusted to account for this part year reference period before using them to compile life tables.

4. *Direct method using
identification based on the
2006 Census continued*

Thirdly, age-specific death rates were calculated by dividing the Indigenous deaths by the Indigenous Census counts. These rates were then used to derive Indigenous life tables. No adjustments were made to the death rates to account for potential undercoverage of deaths, hence the method is referred to as 'direct'.

At the Australia level, this approach produced life expectancy at birth estimates of 71.9 years for Indigenous males and 76.4 years for Indigenous females. These estimates are much higher than those derived after adjusting Indigenous deaths by the undercoverage figures obtained from the CDE study. No life tables were produced at the state/territory level as the number of deaths involved were small.

This approach was intended to make Indigenous counts for deaths and for the population at risk (that is, Indigenous usual residents of Australians) consistent. However, this is not the case. Because of undercount in Census a proportion of death records could not be linked, as there was no corresponding Census record to link with. Such people are removed from the counts of deaths and from the counts of the population at risk. However, people whose information from death registrations or Census is not accurate enough to make a link are not included in the death counts, but it is not possible to remove from the Census count the corresponding count of people with unlinkable information in Census or what would have been unlinkable information from death registrations, had they died.

5. *CDE-adjusted Indigenous
deaths with further
adjustments to age structure
of deaths according to AIHW
Indigenous Mortality Data
Linkage Study*

Following the release of the discussion paper, the Australian Institute of Health and Welfare provided preliminary results from the Indigenous Mortality Data Linkage Study to ABS. The study has linked deaths from the AIHW National Mortality Database to the AIHW National Hospital Morbidity Database, the AIHW National Perinatal Data Collection, the Aboriginal Health Liaison Officer Dataset and to the Australian Government Department of Health and Ageing Residential Aged Care Dataset for 2001–2006 to enhance identification of Indigenous deaths.

From these data, estimates of Indigenous life expectancy at birth taking into account differential identification of Indigenous deaths according to age and sex were derived.

ABS calculated age-specific Indigenous deaths identification rates for Australia directly from the AIHW data, which were applied to the number of CDE-adjusted deaths (these are the numbers of Indigenous deaths used to produce the ABS estimates in this publication) to obtain age-adjusted numbers of Indigenous deaths. These deaths were then used as numerators in the calculation of abridged life tables.

For Australia, this approach resulted in life expectancy at birth estimates of 67.1 years for Indigenous males and 72.7 years for Indigenous females (table A2.5).

It should be noted that the identification rates from the AIHW study relate to the period 2001–2006 while the number of CDE-adjusted deaths relate to 2005–2007. Nevertheless, the estimates derived from this approach are very similar to the ABS estimates for 2005–2007 (67.2 years for Indigenous males and 72.9 years for Indigenous females; table 1.1).

A2.5 LIFE EXPECTANCY AT BIRTH OF INDIGENOUS AUSTRALIANS,
Incorporating results of the AIHW Indigenous Mortality Data
Linkage Study—2005–2007

	LIFE EXPECTANCY AT BIRTH	
	Males	Females
	years	years
CDE-adjusted deaths with AIHW age adjustments	67.1	72.7

6. Direct method using deaths identified as Indigenous in AIHW Indigenous Mortality Data Linkage Study

The AIHW provided estimates of Indigenous life expectancy at birth based on complete life tables using the average yearly number of deaths for 2001–2006 identified as Indigenous in the Indigenous Mortality Data Linkage Study. For Australia, this resulted in life expectancy at birth estimates of 67.1 years for Indigenous males and 73.1 years for Indigenous females (table A2.6).

ABS also calculated Indigenous life expectancy at birth from these data, using abridged life tables, consistent with the methodology used to produce the ABS life expectancy estimates presented in this publication (abridged life tables were chosen as age-specific death rates for 5-year age groups were considered more reliable than those for single years of age due to the small annual numbers of Indigenous deaths in the states and territories). For Australia, this approach resulted in life expectancy at birth estimates of 66.7 years for Indigenous males and 72.6 years for Indigenous females (table A2.6). The small differences between these and the AIHW estimates derived from complete life tables may be due to the choice of method for approximating mortality for 85 years and over.

Both of the above estimates derived from the AIHW Indigenous Mortality Data Linkage Study are consistent with ABS Indigenous life expectancy estimates presented in this publication.

A2.6 LIFE EXPECTANCY AT BIRTH OF INDIGENOUS AUSTRALIANS(a), AIHW Indigenous Mortality Data Linkage Study—2001–2006

	LIFE EXPECTANCY AT BIRTH		95% CONFIDENCE INTERVALS	
	Males	Females	Males	Females
	years	years	years	years
Complete life table(b)	67.1	73.1	66.7–67.4	72.7–73.5
Abridged life table(c)	66.7	72.6

- (a) Direct method using deaths identified as Indigenous in AIHW Indigenous Mortality Data Linkage Study, and an average of 30 June 2001 and 30 June 2006 Experimental Estimates of Aboriginal and Torres Strait Islander Australians.
- (b) Calculated by AIHW.
- (c) Calculated by ABS.

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APPENDIX 3

ILLUSTRATIVE LIFE EXPECTANCY ESTIMATES FOR 2000–2002 BASED ON ASSUMED IDENTIFICATION RATES

ILLUSTRATIVE LIFE EXPECTANCY AT BIRTH ESTIMATES FOR 2000–2002 USING ASSUMPTIONS BASED ON 2006 CDE RESULTS

The 2006 Census Data Enhancement (CDE) Indigenous Mortality Quality Study related to deaths which occurred from 9 August 2006 to 30 June 2007. While Indigenous deaths identification rates and adjustment factors derived from the study were assumed to be applicable to Indigenous deaths registered during 2005–2007, they cannot be applied to Indigenous deaths for more distant periods for use in estimating Indigenous life expectancy for these periods.

However, assumptions can be made about the level of identification of Indigenous deaths for other periods, using the CDE-derived identification rates as a reference point. Using these assumptions, illustrative life expectancy estimates using direct demographic methods can be derived.

A range of illustrative life expectancy estimates for 2000–2002 is presented in Table A3.1, based on three assumptions on the level of identification of Indigenous deaths during this period.

As the estimates are only illustrative and based on assumptions regarding improvements in identification of Indigenous deaths over time, *they cannot be considered to be true estimates of life expectancy at birth for 2000–2002. Nor should differences between these estimates and estimates for 2005–2007 be interpreted as measuring changes in Indigenous life expectancy at birth over time.* However it is worth noting that the estimates for each scenario are considerably higher than the previously published ABS Indigenous life expectancy estimates for 1996–2001.

A3.1 INDIGENOUS LIFE EXPECTANCY, Assumed Indigenous deaths identification rates—2000–2002

State/territory	ASSUMPTION		
	If death identification rate was 20% less	If death identification rate was 10% less	If death identification rate was unchanged
	years	years	years
Males			
NSW	65.1	66.6	67.9
Qld	62.7	64.4	65.9
WA	62.0	63.7	65.3
NT	56.2	58.1	59.8
Aust. (a)	62.4	64.1	65.6
Females			
NSW	70.9	72.3	73.5
Qld	68.4	69.9	71.2
WA	67.8	69.4	70.8
NT	62.8	64.5	66.1
Aust. (a)	68.2	69.8	71.1

(a) Includes all states/territories.

ILLUSTRATIVE LIFE
EXPECTANCY AT BIRTH
ESTIMATES FOR 2000–2002
USING ASSUMPTIONS BASED
ON 2006 CDE RESULTS

continued

The ABS and AIHW continue to work with key stakeholders such as state and territory Registrars of Births, Deaths and Marriages, funeral directors, medical officers and hospital staff to improve Indigenous identification in administrative collections, including death registrations. The larger numbers of Indigenous deaths recorded in Australia in recent years than those recorded in earlier years are due to improvements in the reporting of Indigenous status in death registrations.

GLOSSARY

Age-specific death rates	Age-specific death rates are the number of deaths (occurred or registered) during the calendar year at a specified age per 1,000 of the estimated resident population of the same age at the mid-point of the year (30 June). Pro rata adjustment is made in respect of deaths for which the age of the deceased is not given.
Census	The complete enumeration of a population or groups at a point in time with respect to well-defined characteristics (eg Population, Manufacturing, etc.). In this paper the word 'Census' refers to the ABS Census of Population and Housing.
Death	Death is the permanent disappearance of all evidence of life after birth has taken place. The definition excludes deaths prior to live birth. For the purposes of the Deaths and Causes of Death collections conducted by the Australian Bureau of Statistics, a death refers to any death which occurs in, or en route to Australia and is registered with a state or territory Registry of Births, Deaths and Marriages.
Estimated Resident Population (ERP)	<p>The official measure of the population of Australia is based on the concept of usual residence. It refers to all people, regardless of nationality or citizenship, who usually live in Australia, with the exception of foreign diplomatic personnel and their families. It includes usual residents who are overseas for less than 12 months. It excludes overseas visitors who are in Australia for less than 12 months.</p> <p>Estimates of the Australian resident population are generated on a quarterly basis by adding natural increase (the excess of births over deaths) and net overseas migration (NOM) occurring during the period to the population at the beginning of each period. For state and territory population estimates, an additional term is added to the equation representing net interstate migration.</p>
Identification rate	The ratio of observed to expected deaths.
Imputation	A statistical process for predicting values where no response was provided to a question and a response could not be derived.
Indigenous death	The death of a person who is identified as being of Aboriginal or Torres Strait Islander origin on the death registration form.
Indigenous people	People who identified themselves, or were identified by another household member, as being of Aboriginal and/or Torres Strait Islander origin.
Life table	A life table is a statistical model used to show the levels of mortality and life expectancy at different ages. It depicts the mortality experience of a hypothetical group of newborn babies throughout their lifetimes. Life tables may be complete or abridged, depending on the age interval used in their compilation. Complete life tables such as those for the Australian population contain data by single years of age, while abridged life tables, such as those for the Indigenous population, contain data for five-year age groups. Life tables are presented separately for males and females.
Life expectancy	Life expectancy refers to the average number of additional years a person of a given age and sex might expect to live if the age-specific death rates of the given period continued throughout his/her lifetime.
Natural increase	Excess of births over deaths.

Net undercount	The difference between the actual Census count (including imputations) and an estimate of the number of people who should have been counted in the Census. This estimate is based on the PES conducted after each Census. For a category of person (e.g. based on age, sex and state of usual residence), net undercount is the resultant of Census undercount, overcount, misclassification and imputation error.
Non-sampling error	Non-sampling error arises from inaccuracies in collecting, recording and processing the data. Every effort is made to minimise non-sampling error by the careful design of questionnaires, intensive training and supervision of interviewers, and efficient data processing procedures. Non-sampling error also arises because information cannot be obtained from all people selected in the survey.
Other Territories	Following the 1992 amendments to the Acts Interpretation Act to include the Indian Ocean Territories of Christmas Island and the Cocos (Keeling) Islands as part of geographic Australia, another category of the state and territory level has been created, known as Other Territories. Other Territories include Jervis Bay Territory, previously included with the Australian Capital Territory, as well as Christmas Island and the Cocos (Keeling) Islands.
Post Enumeration Survey	The Census Post Enumeration Survey (PES) is a household survey conducted three to four weeks after the Census. The PES allows the ABS to estimate the number of people missed in the Census and the number counted more than once. Usually more people are missed than counted more than once in Australia, leading to a net undercount. Results from the PES contribute to a more accurate calculation of the estimated resident population (ERP) for Australia and the states and territories which is then backdated to 30 June of the Census year.
Sampling error	Sampling error occurs because a sample, rather than the entire population, is surveyed. One measure of the likely difference resulting from not including all dwellings in the survey is given by the standard error.
Standard error	A measure of the spread of the difference between the true value and an estimate. There are about two chances in three that a sample estimate will differ by less than one standard error from the figure that would have been obtained if all dwellings had been included in the survey, and about nineteen chances in twenty that the difference will be less than two standard errors.
Undercount	The number of people who should have been counted in the Census but were not.
Unexplained growth	The intercensal growth in the Indigenous population counts cannot be fully explained by births, deaths and migration. One way to measure this unexplained growth is for an earlier census date population estimate to be survived to the next census date and the difference between the next census date population estimate and the survived estimate remains unexplained.
Year of occurrence	Data presented on year of occurrence basis relate to the date the death occurred.
Year of registration	Data presented on year of registration basis relate to the date the death was registered.

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