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# WEIGHTING THE 81, 86, 91 & 96 CENSUS-MORTALITY COHORTS TO ADJUST FOR LINKAGE BIAS

## NZCMS Technical Report No. 5

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# *Statistic New Zealand's Security Statement*

The New Zealand Census-Mortality Study was initiated by Dr Tony Blakely and his co-researchers from the Wellington School of Medicine, University of Otago. It was approved by the Government Statistician as a Data Laboratory project under the Microdata Access Protocols.

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Under the Statistics Act 1975 the Government Statistician has legal authority to collect and hold information about people, households and businesses, as well as the responsibility of protecting individual information and limits to the use to which such information can be put. The obligations of the Statistics Act 1975 on data collected under the Act are summarised below.

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**Census data**

The Population Census is the most important stocktake of the population that is carried out. The statistics that are produced provide a regular picture of society. Results are used widely in making decisions affecting every neighbourhood. They are used in planning essential local services, and they also help to monitor social programmes ranging from housing to health.

Traditionally census data is published by Statistics New Zealand in aggregated tables and graphs for use throughout schools, business and homes. Recently Statistics New Zealand has sought to increase the benefits that can obtained from its data by providing access to approved researchers to carry out research projects. Microdata access is provided, at the discretion of the Government Statistician, to allow authoritative statistical research of benefit to the public of New Zealand.

This project used anonymous census data and mortality data which were integrated using a probabilistic linking methodology to create a single data-set that allows the researchers to undertake a statistical study of the association of mortality and socio-economic factors. This is the first time that the census has been linked to an administrative data-set for purposes apart from improving the quality of Statistics New Zealand surveys. The project has been closely monitored to ensure it complies with Statistics New Zealand's strict confidentiality requirements.

**Further information**

For further information about confidentiality matters in regard to this study please contact either:

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# Chapter 1: Introduction

This technical report describes the calculation of weighting factors to adjust for *linkage bias* in the New Zealand Census-Mortality Study (NZCMS). The NZCMS used anonymous and probabilistic record linkage of census records with mortality records to create cohort studies of the entire New Zealand population. Each of four censuses (1981, 1986, 1991 and 1996) is followed-up for three years for mortality. The census population is restricted to 0-74 year olds at census night. Linkage bias (to be described in more detail subsequently) occurs when the probability of a mortality record being linked back to a census record varies by factors of interest (e.g. age, ethnicity, socio-economic position).

The methods for linking the census and mortality records are described in detail elsewhere (Blakely et al. 1999; Blakely 2001; Hill et al. 2002). The record linkage process was successful in linking approximately 75% of the eligible mortality records from three years after each census back to a census record. Incomplete linkage between census and mortality files means that the vital status of some members of the census cohort is misclassified as not dead when in reality they have died. Furthermore when the mortality and census records were stratified by demographic characteristics (age, sex and ethnicity), geographical distribution (rural/urban and Regional Health Authority), socioeconomic measures (NZ Deprivation Index) and time following census, the proportion of mortality records linked varied by strata (i.e. linkage bias). Consequently measures of association between socioeconomic factors and mortality in the cohort analyses using NZCMS data may be biased, as the linkage bias manifests as 'differential misclassification bias of the mortality outcome'.

In order to compensate for linkage bias the records in each of the four cohort data-sets have been weighted. The weighting adjusts for misclassification of the mortality outcome in subsequent cohort analyses. The method used to calculate the weighting factors is described in this document.

Previous extensive analyses of the 1991 census record linkage project demonstrated linkage bias by (Blakely et al. 1999):

- *Age*: mortality records for youths (15-24 year olds) followed by young adults (25-44 year olds) were the least likely to be linked to a census record
- *Rurality*: mortality records for rural decedents were less likely to be linked, almost certainly a consequence of poorer quality meshblock data
- *Ethnicity*: mortality records for Maori and Pacific decedents were less likely to be linked than non-Maori non-Pacific
- *Small area socio-economic deprivation*: mortality records for decedents from more deprived small areas were less likely to be linked than those from less deprived areas, although the amount of this bias was modest (5-10%) within strata of age by sex by ethnic group (Blakely et al. 2000).

There was little linkage bias by sex, except among 25-44 year olds where males were less likely to be linked than females. There was also a definite trend for decreasing record linkage success with increasing time between census night and death in the 1991 census record linkage project (Blakely et al. 1999). 79.3% of mortality records for deaths in the first six months after 1991 census were linked to a census record compared to 72.8% of death in the last six months of the three-year follow-up. (As no detailed time-series analyses *within* the three-year follow-up period was planned, we have not included follow-up period as a variable for calculating weights in this report).

Analyses of the 1991 cohort applied a post-hoc weighting to adjust for linkage bias in the odds ratio estimates for all cohort analyses (Blakely 2001). This involved adjusting the odds ratios (OR) associated with socioeconomic position by the risk ratio for linkage. (The odds ratio in the cohort analyses is a close approximation of the relative risk of mortality due to death being a rare outcome. However, we directly calculated risk ratios for the linkage, as linkage was a very common outcome, meaning the odds ratios did not approximate the risk ratio.) For example if the OR in cohort analyses for all cause mortality was 1.5 for high compared to low deprivation areas, and the risk ratio (RR) for linkage for all cause mortality for high compared to low deprivation was 0.91, then the linkage adjusted odds ratio for low to high deprivation would be 1.5 / 0.91 = 1.65. Such adjustment could only be done using socioeconomic variables available on the mortality data-set – that is occupational class and area based measures such as the NZ deprivation index.

The weights described in this report avoid the need for post-hoc weighting to adjust for linkage bias. Rather, using weighted analyses of NZCMS cohort data will mean that:

- absolute rates of mortality by strata of demographic and socio-economic factors should be little affected by linkage bias
- both rate ratios and rate differences of mortality by demographic and socio-economic factors should be little affected by linkage bias.

# Chapter 2: Linkage by social and demographic variables

The overall percentage of deaths linked for each cohort was 71% for 1981-84, 74% for 1986-89, 77% for 1991-94, and 78% for 1996-99 (Hill et al. 2002).

The total number of deaths and proportion of mortality records linked by Sex, Age, Ethnicity, NZ Deprivation Index, Rurality, Regional Health Authority, Broad Cause of Death Categories and time lapsed after census for each of the four mortality data-sets are shown in Table 1 to Table 4. The total number of deaths and proportion of mortality records linked by Territorial Local Authority and by detailed cause of death categories are given in Table 23 to Table 30 (pages 46-51) in the Appendix.

Table 5 to Table 9 give the proportion linked by combined strata of sex by age by ethnicity. For 1996-1999 three tables are given using strata based on sole, prioritised and sole or multiple prioritised ethnicity. Equivalent tables for strata based on age at death (the above tables use age on census night) are included in the appendices Table 31 to Table 35.

These tables all show a lower rate of linkage for:

- Maori, Pacific Island and Asian (1996 only) ethnic groups;
- young adults aged 15-24 years;
- death due to accidental injury and suicide;
- people living in rural areas at the time of death;
- people living in the Northern and Mid-Central Regional Health Authority areas;
- for people living in areas with higher New Zealand Deprivation Index scores (i.e. living in more deprived small areas); and
- increasing time lapsed since the census.

**Much of the difference in linkage by geographical variables and New Zealand Deprivation Index was due to differences in population distribution by age, sex and ethnicity.** This finding is consistent with results reported for the 1991 census mortality cohort (Blakely et al. 1999; Blakely et al. 2000; Blakely 2001). Rurality was however an important independent risk factor for linkage (results not shown).

**Table 1: 1981-1984 Number of deaths and percentage of mortality records linked to a census record by various socioeconomic and demographic variables**

| 1981 – 84 | | Actual Deaths | % Linked |
|---|---|---|---|
| **Age at Census** | | | |
| | 0 - 14 yrs | 1,092 | (66%) |
| | 15 - 24 yrs | 1,875 | (52%) |
| | 25 - 44 yrs | 3,777 | (62%) |
| | 45 - 64 yrs | 17,244 | (72%) |
| | 65 - 74 yrs | 20,709 | (73%) |
| **Age at Death** | | | |
| | 0 - 14 yrs | 888 | (68%) |
| | 15 - 24 yrs | 1,878 | (54%) |
| | 25 - 44 yrs | 3,528 | (61%) |
| | 45 - 64 yrs | 15,459 | (72%) |
| | 65 - 78 yrs | 22,950 | (73%) |
| **Age at Census** | | | |
| | 0- 4 yrs | 492 | (67%) |
| | 5- 9 yrs | 216 | (64%) |
| | 10-14 yrs | 387 | (67%) |
| | 15-19 yrs | 1,029 | (56%) |
| | 20-24 yrs | 849 | (49%) |
| | 25-29 yrs | 684 | (52%) |
| | 30-34 yrs | 813 | (63%) |
| | 35-39 yrs | 912 | (64%) |
| | 40-44 yrs | 1,368 | (66%) |
| | 45-49 yrs | 1,989 | (70%) |
| | 50-54 yrs | 3,252 | (71%) |
| | 55-59 yrs | 5,232 | (73%) |
| | 60-64 yrs | 6,774 | (73%) |
| | 65-69 yrs | 9,603 | (74%) |
| | 70-74 yrs | 11,103 | (73%) |
| **Sex** | | | |
| | Males | 27,570 | (71%) |
| | Females | 17,130 | (71%) |
| **Ethnicity** | | | |
| | Maori | 3,108 | (53%) |
| | Pacific People | 354 | (59%) |
| | NonMaori NonPacific | 41,238 | (73%) |

| 1981 - 84 | | Actual Deaths | % Linked |
|---|---|---|---|
| **NZ Deprivation Index** | | | |
| | Dep 1 | 2,988 | (77%) |
| | Dep 2 | 3,489 | (71%) |
| | Dep 3 | 3,705 | (72%) |
| | Dep 4 | 4,038 | (72%) |
| | Dep 5 | 4,452 | (71%) |
| | Dep 6 | 4,695 | (72%) |
| | Dep 7 | 4,641 | (71%) |
| | Dep 8 | 5,376 | (70%) |
| | Dep 9 | 5,523 | (71%) |
| | Dep10 | 5,766 | (68%) |
| | Miss Dep | 30 | (60%) |
| **Regional Health Authority** | | | |
| | Northern | 12,819 | (69%) |
| | Midland | 8,844 | (68%) |
| | Central | 11,826 | (73%) |
| | Southern | 11,208 | (74%) |
| | RHA Missing | 6 | (60%) |
| **Rurality** | | | |
| | Urban | 34,275 | (73%) |
| | Minor Urban | 4,956 | (73%) |
| | Rural & Other | 5,472 | (57%) |
| **Follow-Up (Months)** | | | |
| | 0- 5 months | 6,681 | (74%) |
| | 6-11 months | 6,900 | (73%) |
| | 12-17 months | 7,566 | (72%) |
| | 18-23 months | 7,314 | (71%) |
| | 24-29 months | 8,103 | (70%) |
| | 30-36 months | 8,139 | (68%) |
| **Cause of Death** | | | |
| | Cancer | 12,732 | (74%) |
| | Cardiovascular disease | 19,701 | (73%) |
| | Injury/ suicide | 4,332 | (60%) |
| | Other causes | 7,935 | (67%) |

**Table 2 1986-1989 Number of deaths and percentage of mortality records linked to a census record by various socioeconomic and demographic variables**

| 1986 - 89 | | Actual Deaths | % Linked |
|---|---|---|---|
| **Age at Census** | | | |
| | 0 - 14 yrs | 1,020 | (71%) |
| | 15 - 24 yrs | 2,088 | (56%) |
| | 25 - 44 yrs | 4,017 | (64%) |
| | 45 - 64 yrs | 16,758 | (75%) |
| | 65 - 74 yrs | 20,622 | (77%) |
| **Age at Death** | | | |
| | 0 - 14 yrs | 807 | (71%) |
| | 15 - 24 yrs | 1,989 | (59%) |
| | 25 - 44 yrs | 3,894 | (62%) |
| | 45 - 64 yrs | 14,781 | (75%) |
| | 65 - 78 yrs | 23,034 | (77%) |
| **Age at Census** | | | |
| | 0- 4 yrs | 444 | (70%) |
| | 5- 9 yrs | 171 | (71%) |
| | 10-14 yrs | 408 | (72%) |
| | 15-19 yrs | 1,062 | (61%) |
| | 20-24 yrs | 1,029 | (51%) |
| | 25-29 yrs | 816 | (54%) |
| | 30-34 yrs | 861 | (60%) |
| | 35-39 yrs | 1,044 | (68%) |
| | 40-44 yrs | 1,293 | (70%) |
| | 45-49 yrs | 1,968 | (72%) |
| | 50-54 yrs | 2,952 | (73%) |
| | 55-59 yrs | 4,758 | (75%) |
| | 60-64 yrs | 7,080 | (77%) |
| | 65-69 yrs | 8,841 | (77%) |
| | 70-74 yrs | 11,784 | (76%) |
| **Sex** | | | |
| | Males | 27,276 | (74%) |
| | Females | 17,229 | (74%) |
| **Ethnicity** | | | |
| | Maori | 2,958 | (59%) |
| | Pacific People | 444 | (72%) |
| | NonMaoriNonPacNonAs | 41,103 | (75%) |

| 1986 - 89 | | Actual Deaths | % Linked |
|---|---|---|---|
| **NZ Deprivation Index** | | | |
| | Dep 1 | 2,973 | (77%) |
| | Dep 2 | 3,471 | (77%) |
| | Dep 3 | 3,690 | (77%) |
| | Dep 4 | 4,056 | (76%) |
| | Dep 5 | 4,335 | (74%) |
| | Dep 6 | 4,587 | (75%) |
| | Dep 7 | 4,866 | (75%) |
| | Dep 8 | 5,247 | (74%) |
| | Dep 9 | 5,391 | (71%) |
| | Dep10 | 5,853 | (68%) |
| | Miss Dep | 39 | (45%) |
| **Regional Health Authority** | | | |
| | Northern | 13,239 | (72%) |
| | Midland | 8,826 | (72%) |
| | Central | 11,637 | (75%) |
| | Southern | 10,797 | (76%) |
| | RHA Missing | 6 | (33%) |
| **Rurality** | | | |
| | Urban | 34,266 | (75%) |
| | Minor Urban | 4,989 | (75%) |
| | Rural & Other | 5,250 | (66%) |
| **Follow-Up (Months)** | | | |
| | 0- 5 months | 6543 | (77%) |
| | 6-11 months | 7080 | (75%) |
| | 12-17 months | 7569 | (74%) |
| | 18-23 months | 7362 | (74%) |
| | 24-29 months | 7731 | (72%) |
| | 30-36 months | 8223 | (72%) |
| **Cause of Death** | | | |
| | Cancer | 13,464 | (78%) |
| | Cardiovascular disease | 18,036 | (75%) |
| | Injury/ suicide | 4,920 | (61%) |
| | Other causes | 8,088 | (71%) |

**Table 3 1991-1994 Number of deaths and percentage of mortality records linked to a census record by various socioeconomic and demographic variables**

| 1991 - 94 | | Actual Deaths | % Linked |
|---|---|---|---|
| **Age at Census** | | | |
| | 0 - 14 yrs | 831 | (69%) |
| | 15 - 24 yrs | 1,767 | (54%) |
| | 25 - 44 yrs | 4,209 | (65%) |
| | 45 - 64 yrs | 14,919 | (78%) |
| | 65 - 74 yrs | 19,584 | (81%) |
| **Age at Death** | | | |
| | 0 - 14 yrs | 696 | (69%) |
| | 15 - 24 yrs | 1,695 | (56%) |
| | 25 - 44 yrs | 3,939 | (63%) |
| | 45 - 64 yrs | 13,218 | (77%) |
| | 65 - 78 yrs | 21,762 | (80%) |
| **Age at Census** | | | |
| | 0- 4 yrs | 387 | (68%) |
| | 5- 9 yrs | 165 | (72%) |
| | 10-14 yrs | 282 | (68%) |
| | 15-19 yrs | 903 | (58%) |
| | 20-24 yrs | 864 | (49%) |
| | 25-29 yrs | 804 | (52%) |
| | 30-34 yrs | 861 | (60%) |
| | 35-39 yrs | 1,083 | (69%) |
| | 40-44 yrs | 1,461 | (73%) |
| | 45-49 yrs | 1,881 | (75%) |
| | 50-54 yrs | 2,787 | (75%) |
| | 55-59 yrs | 3,924 | (78%) |
| | 60-64 yrs | 6,327 | (79%) |
| | 65-69 yrs | 8,889 | (81%) |
| | 70-74 yrs | 10,698 | (80%) |
| **Sex** | | | |
| | Males | 25,224 | (76%) |
| | Females | 16,089 | (78%) |
| **Ethnicity** | | | |
| | Maori | 3,471 | (62%) |
| | Pacific People | 657 | (57%) |
| | NonMaoriNonPac | 37,182 | (78%) |

| 1991 - 94 | | Actual Deaths | % Linked |
|---|---|---|---|
| **NZ Deprivation Index** | | | |
| | Dep 1 | 3,069 | (82%) |
| | Dep 2 | 3,291 | (79%) |
| | Dep 3 | 3,606 | (80%) |
| | Dep 4 | 3,723 | (78%) |
| | Dep 5 | 3,978 | (78%) |
| | Dep 6 | 4,041 | (78%) |
| | Dep 7 | 4,542 | (76%) |
| | Dep 8 | 4,623 | (76%) |
| | Dep 9 | 4,995 | (75%) |
| | Dep10 | 5,355 | (70%) |
| | Miss Dep | 84 | (49%) |
| **Regional Health Authority** | | | |
| | Northern | 12,375 | (73%) |
| | Midland | 8,766 | (75%) |
| | Central | 10,494 | (79%) |
| | Southern | 9,618 | (80%) |
| | Missing RHA | 54 | (33%) |
| **Rurality** | | | |
| | Urban | 31,122 | (78%) |
| | Minor Urban | 4,977 | (79%) |
| | Rural & Other | 5,211 | (68%) |
| **Follow-Up (Months)** | | | |
| | 0- 5 months | 6060 | (79%) |
| | 6-11 months | 6495 | (79%) |
| | 12-17 months | 7020 | (78%) |
| | 18-23 months | 6867 | (77%) |
| | 24-29 months | 7191 | (74%) |
| | 30-36 months | 7674 | (73%) |
| **Cause of Death** | | | |
| | Cancer | 13,959 | (81%) |
| | Cardiovascular disease | 15,450 | (78%) |
| | Injury/ suicide | 4,377 | (61%) |
| | Other causes | 7,524 | (74%) |

**Table 4 1996-1999 Number of deaths and percentage of mortality records linked to a census record by various socioeconomic and demographic variables**

| 1996 - 99 | Actual Deaths | % Linked |
|---|---|---|
| **Age at Census** | | |
| 0 - 14 yrs | 810 | (69%) |
| 15 - 24 yrs | 1,482 | (56%) |
| 25 - 44 yrs | 4,209 | (65%) |
| 45 - 64 yrs | 14,031 | (79%) |
| 65 - 74 yrs | 18,996 | (83%) |
| **Age at Death** | | |
| 0 - 14 yrs | 645 | (72%) |
| 15 - 24 yrs | 1,413 | (57%) |
| 25 - 44 yrs | 3,975 | (63%) |
| 45 - 64 yrs | 12,663 | (78%) |
| 65 - 78 yrs | 20,826 | (83%) |
| **Age at Census** | | |
| 0- 4 yrs | 351 | (71%) |
| 5- 9 yrs | 141 | (77%) |
| 10-14 yrs | 318 | (64%) |
| 15-19 yrs | 744 | (59%) |
| 20-24 yrs | 738 | (52%) |
| 25-29 yrs | 777 | (52%) |
| 30-34 yrs | 930 | (61%) |
| 35-39 yrs | 1,137 | (69%) |
| 40-44 yrs | 1,362 | (71%) |
| 45-49 yrs | 2,103 | (76%) |
| 50-54 yrs | 2,703 | (77%) |
| 55-59 yrs | 3,873 | (79%) |
| 60-64 yrs | 5,346 | (81%) |
| 65-69 yrs | 8,238 | (83%) |
| 70-74 yrs | 10,758 | (83%) |
| **Sex** | | |
| Males | 24,021 | (77%) |
| Females | 15,504 | (80%) |
| **Sole Ethnicity** | | |
| Maori | 5,646 | (65%) |
| Pacific People | 1,539 | (64%) |
| Asian | 561 | (67%) |
| NonMaori NonPacificNonAsian | 31,782 | (81%) |
| **Prioritised Ethnicity** | | |
| Maori | 6,105 | (65%) |
| Pacific People | 1,638 | (64%) |
| Asian | 597 | (67%) |
| NonMaori NonPacificNonAsian | 31,185 | (82%) |

| 1996 - 99 | Actual Deaths | % Linked |
|---|---|---|
| **Sole & Multiple-Prioritised Ethnicity** | | |
| Sole Maori | 5,643 | (65%) |
| Multiple Maori | 462 | (66%) |
| Sole Pacific | 1,539 | (64%) |
| Multiple Pacific | 96 | (63%) |
| Sole Asian | 561 | (67%) |
| Multiple Asian | 33 | (71%) |
| NonMaori NonPacificNonAsian | 31,185 | (82%) |
| **NZ Deprivation Index** | | |
| Dep 1 | 2,829 | (81%) |
| Dep 2 | 3,117 | (82%) |
| Dep 3 | 3,237 | (80%) |
| Dep 4 | 3,543 | (81%) |
| Dep 5 | 3,678 | (81%) |
| Dep 6 | 3,930 | (79%) |
| Dep 7 | 4,236 | (78%) |
| Dep 8 | 4,671 | (78%) |
| Dep 9 | 4,884 | (76%) |
| Dep10 | 5,256 | (72%) |
| Miss Dep | 147 | (52%) |
| **Regional Health Authority** | | |
| Northern | 12,045 | (75%) |
| Midland | 8,586 | (76%) |
| Central | 9,903 | (79%) |
| Southern | 8,877 | (83%) |
| missing RHA | 114 | (48%) |
| **Rurality** | | |
| Urban | 29,622 | (79%) |
| Minor Urban | 5,031 | (79%) |
| Rural & Other | 4,872 | (73%) |
| **Follow-Up (Months)** | | |
| 0- 5 months | 6,105 | (81%) |
| 6-11 months | 6,270 | (80%) |
| 12-17 months | 6,537 | (78%) |
| 18-23 months | 6,630 | (78%) |
| 24-29 months | 6,738 | (77%) |
| 30-36 months | 7,242 | (76%) |
| **Cause of Death** | | |
| Cancer | 14,499 | (82%) |
| Cardiovascular Diseases | 12,888 | (80%) |
| Injury / Suicide | 4,200 | (61%) |
| Other Causes | 7,938 | (78%) |

**Table 5 1981-1984 Number of deaths and percentage linked by strata of Age-at-Census, sex and Ethnicity**

| 1981 – 84 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Census** | **Sex** | **Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 78 | (63%) |
| | | Pacific People | 15 | (80%) |
| | | NonMaori NonPacific | 570 | (66%) |
| | *Females* | Maori | 54 | (71%) |
| | | Pacific People | 12 | (71%) |
| | | NonMaori NonPacific | 360 | (66%) |
| *15 - 24 yrs* | *Males* | Maori | 162 | (50%) |
| | | Pacific People | 27 | (35%) |
| | | NonMaori NonPacific | 1,200 | (53%) |
| | *Females* | Maori | 72 | (47%) |
| | | Pacific People | 15 | (73%) |
| | | NonMaori NonPacific | 396 | (52%) |
| *25 - 44 yrs* | *Males* | Maori | 330 | (51%) |
| | | Pacific People | 48 | (52%) |
| | | NonMaori NonPacific | 1,950 | (63%) |
| | *Females* | Maori | 231 | (58%) |
| | | Pacific People | 30 | (57%) |
| | | NonMaori NonPacific | 1,194 | (67%) |
| *45 - 64 yrs* | *Males* | Maori | 816 | (53%) |
| | | Pacific People | 87 | (63%) |
| | | NonMaori NonPacific | 9,978 | (74%) |
| | *Females* | Maori | 603 | (58%) |
| | | Pacific People | 45 | (63%) |
| | | NonMaori NonPacific | 5,712 | (75%) |
| *65 - 74 yrs* | *Males* | Maori | 435 | (48%) |
| | | Pacific People | 48 | (59%) |
| | | NonMaori NonPacific | 11,826 | (76%) |
| | *Females* | Maori | 324 | (48%) |
| | | Pacific People | 27 | (54%) |
| | | NonMaori NonPacific | 8,049 | (73%) |

**Table 6: 1986-1989 Number of deaths and percentage linked by strata of Age-at-Census, sex and Ethnicity**

| 1986 – 89 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Census** | **Sex** | **Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 72 | (71%) |
| | | Pacific People | 18 | (77%) |
| | | NonMaori NonPacific | 525 | (70%) |
| | *Females* | Maori | 45 | (61%) |
| | | Pacific People | 18 | (75%) |
| | | NonMaori NonPacific | 345 | (73%) |
| *15 - 24 yrs* | *Males* | Maori | 162 | (50%) |
| | | Pacific People | 21 | (50%) |
| | | NonMaori NonPacific | 1,386 | (58%) |
| | *Females* | Maori | 66 | (45%) |
| | | Pacific People | 15 | (73%) |
| | | NonMaori NonPacific | 438 | (53%) |
| *25 - 44 yrs* | *Males* | Maori | 294 | (51%) |
| | | Pacific People | 72 | (70%) |
| | | NonMaori NonPacific | 2,196 | (63%) |
| | *Females* | Maori | 171 | (60%) |
| | | Pacific People | 39 | (76%) |
| | | NonMaori NonPacific | 1,245 | (69%) |
| *45 - 64 yrs* | *Males* | Maori | 807 | (63%) |
| | | Pacific People | 108 | (74%) |
| | | NonMaori NonPacific | 9,588 | (76%) |
| | *Females* | Maori | 621 | (64%) |
| | | Pacific People | 54 | (85%) |
| | | NonMaori NonPacific | 5,580 | (77%) |
| *65 - 74 yrs* | *Males* | Maori | 393 | (58%) |
| | | Pacific People | 63 | (66%) |
| | | NonMaori NonPacific | 11,577 | (78%) |
| | *Females* | Maori | 324 | (56%) |
| | | Pacific People | 45 | (66%) |
| | | NonMaori NonPacific | 8,226 | (76%) |

**Table 7: 1991-1994 Number of deaths and percentage linked by strata of Age-at-Census, sex and Ethnicity**

| 1991 – 94 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Census** | **Sex** | **Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 57 | (59%) |
| | | Pacific People | 30 | (63%) |
| | | NonMaori NonPacific | 411 | (70%) |
| | *Females* | Maori | 39 | (63%) |
| | | Pacific People | 15 | (73%) |
| | | NonMaori NonPacific | 279 | (70%) |
| *15 - 24 yrs* | *Males* | Maori | 162 | (50%) |
| | | Pacific People | 30 | (33%) |
| | | NonMaori NonPacific | 1,143 | (53%) |
| | *Females* | Maori | 45 | (59%) |
| | | Pacific People | 15 | (73%) |
| | | NonMaori NonPacific | 369 | (58%) |
| *25 - 44 yrs* | *Males* | Maori | 366 | (52%) |
| | | Pacific People | 75 | (47%) |
| | | NonMaori NonPacific | 2,229 | (63%) |
| | *Females* | Maori | 216 | (62%) |
| | | Pacific People | 45 | (51%) |
| | | NonMaori NonPacific | 1,278 | (74%) |
| *45 - 64 yrs* | *Males* | Maori | 957 | (63%) |
| | | Pacific People | 171 | (66%) |
| | | NonMaori NonPacific | 8,034 | (79%) |
| | *Females* | Maori | 759 | (70%) |
| | | Pacific People | 102 | (56%) |
| | | NonMaori NonPacific | 4,899 | (81%) |
| *65 – 74 yrs* | *Males* | Maori | 495 | (60%) |
| | | Pacific People | 108 | (52%) |
| | | NonMaori NonPacific | 10,953 | (83%) |
| | *Females* | Maori | 378 | (60%) |
| | | Pacific People | 66 | (63%) |
| | | NonMaori NonPacific | 7,587 | (81%) |

**Table 8: 1996-1999 Number of deaths and percentage linked by strata of Age-at-Census, sex and Sole Ethnicity**

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Census** | **Sex** | **Sole Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 141 | (61%) |
| | | Pacific | 30 | (67%) |
| | | Asian | 9 | (55%) |
| | | NonMaori NonPacific NonAsian | 294 | (73%) |
| | *Females* | Maori | 90 | (60%) |
| | | Pacific | 21 | (55%) |
| | | Asian | 6 | (67%) |
| | | NonMaori NonPacific NonAsian | 219 | (76%) |
| *15 - 24 yrs* | *Males* | Maori | 252 | (42%) |
| | | Pacific | 54 | (56%) |
| | | Asian | 27 | (60%) |
| | | NonMaori NonPacific NonAsian | 753 | (57%) |
| | *Females* | Maori | 96 | (52%) |
| | | Pacific | 18 | (67%) |
| | | Asian | 15 | (67%) |
| | | NonMaori NonPacific NonAsian | 264 | (63%) |
| *25 - 44 yrs* | *Males* | Maori | 615 | (50%) |
| | | Pacific | 171 | (60%) |
| | | Asian | 69 | (60%) |
| | | NonMaori NonPacific NonAsian | 1,833 | (63%) |
| | *Females* | Maori | 348 | (64%) |
| | | Pacific | 126 | (70%) |
| | | Asian | 54 | (74%) |
| | | NonMaori NonPacific NonAsian | 996 | (77%) |
| *45 - 64 yrs* | *Males* | Maori | 1,512 | (69%) |
| | | Pacific | 405 | (66%) |
| | | Asian | 135 | (65%) |
| | | NonMaori NonPacific NonAsian | 6,369 | (81%) |
| | *Females* | Maori | 1,131 | (70%) |
| | | Pacific | 252 | (66%) |
| | | Asian | 75 | (75%) |
| | | NonMaori NonPacific NonAsian | 4,152 | (84%) |
| *65 - 74 yrs* | *Males* | Maori | 768 | (74%) |
| | | Pacific | 264 | (64%) |
| | | Asian | 90 | (67%) |
| | | NonMaori NonPacific NonAsian | 10,230 | (84%) |
| | *Females* | Maori | 687 | (66%) |
| | | Pacific | 198 | (64%) |
| | | Asian | 81 | (67%) |
| | | NonMaori NonPacific NonAsian | 6,675 | (85%) |

**Table 9: 1996-1999 Number of deaths and percentage linked by strata of Age-at-Census, sex and Prioritised Ethnicity**

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Census** | **Sex** | **Prioritised Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 174 | (62%) |
| | | Pacific | 39 | (65%) |
| | | Asian | 12 | (58%) |
| | | NonMaori NonPacific NonAsian | 246 | (75%) |
| | *Females* | Maori | 117 | (64%) |
| | | Pacific | 24 | (52%) |
| | | Asian | 9 | (67%) |
| | | NonMaori NonPacific NonAsian | 186 | (76%) |
| *15 - 24 yrs* | *Males* | Maori | 291 | (44%) |
| | | Pacific | 66 | (55%) |
| | | Asian | 24 | (62%) |
| | | NonMaori NonPacific NonAsian | 702 | (58%) |
| | *Females* | Maori | 114 | (53%) |
| | | Pacific | 21 | (68%) |
| | | Asian | 18 | (67%) |
| | | NonMaori NonPacific NonAsian | 240 | (63%) |
| *25 - 44 yrs* | *Males* | Maori | 660 | (50%) |
| | | Pacific | 183 | (58%) |
| | | Asian | 72 | (60%) |
| | | NonMaori NonPacific NonAsian | 1,770 | (63%) |
| | *Females* | Maori | 375 | (66%) |
| | | Pacific | 144 | (68%) |
| | | Asian | 57 | (75%) |
| | | NonMaori NonPacific NonAsian | 954 | (77%) |
| *45 - 64 yrs* | *Males* | Maori | 1,617 | (69%) |
| | | Pacific | 420 | (66%) |
| | | Asian | 144 | (64%) |
| | | NonMaori NonPacific NonAsian | 6,237 | (81%) |
| | *Females* | Maori | 1,179 | (70%) |
| | | Pacific | 255 | (66%) |
| | | Asian | 78 | (75%) |
| | | NonMaori NonPacific NonAsian | 4,098 | (85%) |

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| *65 - 74 yrs* | *Males* | Maori | 840 | (73%) |
| | | Pacific | 279 | (64%) |
| | | Asian | 96 | (66%) |
| | | NonMaori NonPacific NonAsian | 10,143 | (85%) |
| | *Females* | Maori | 738 | (66%) |
| | | Pacific | 204 | (65%) |
| | | Asian | 84 | (69%) |
| | | NonMaori NonPacific NonAsian | 6,612 | (85%) |

# Chapter 3: Methods

## 3.1 Summary

A two step process was used to create the weights to adjust for linkage bias.

Firstly the linked mortality records were weighted up to represent the full mortality records. This entailed two weighting processes.

A. Creation of a base weight (W_Base) for strata of [Age] x [Sex] x [Ethnicity] x [NZDep] x [Rurality] x [ICD Group].

We used broad age (e.g. 25-44 yrs), deprivation (e.g. NZDep deciles 1 to 4) and cause of death (e.g. cardiovascular disease) groupings to ensure adequate numbers for calculation of weights. These broad groupings meant that for fine strata of say, five-year age groups the weighted number of linked deaths did not always accurately predict the known number of actual deaths. Therefore, a second step was required as described next.

B. Scaling of the base weighted number or linked deaths to produce accurate numbers of deaths for strata of [five-year age groups] x [sex]. Three adjusted weights were created.

→ W_AgEthAdj — Scaled to give accurate numbers for strata of [five-year age groups] x [sex] x [ethnicity]

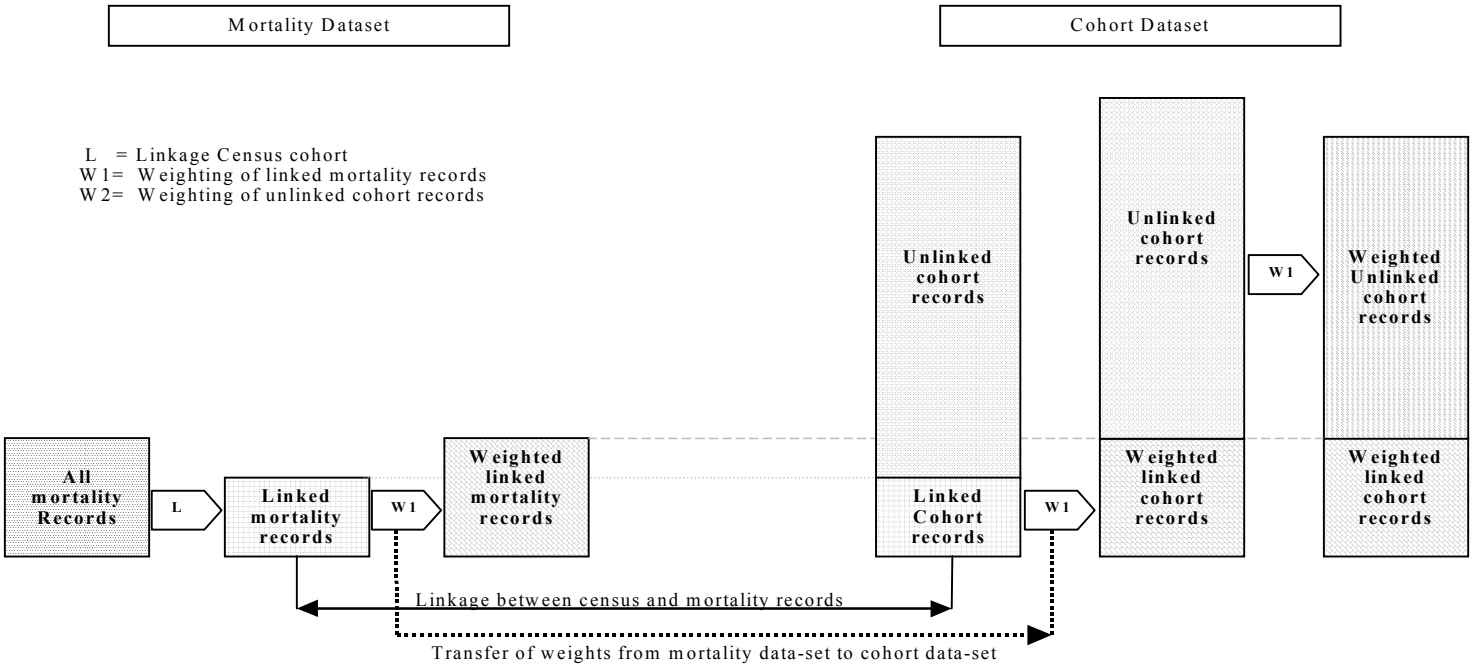
→ W_AgDepAdj — Scaled to give accurate numbers for strata of [five-year age groups] x [sex] x [quintiles of deprivation].

→ W_AgICDAdj — Scaled to give accurate numbers for strata of [five-year age groups] x [sex] x [cause of death categories] – using 18 cause of death categories.

The second step was to weight the unlinked cohort records to adjust for the non-linkage of some mortality records.

This overall process is summarised diagrammatically in Figure 1.

**Figure 1 Diagrammatic summary of linkage weighting process**



## 3.2 Derivation of the linkage weighting values

The incomplete linkage process means that, when considering all the mortality records for the three years after each census, the number of mortality records linked to a census record in any sociodemographic strata is a proportion of the total number of deaths in that strata. However by multiplying the number of linked mortality records in each strata by a weighting factor ($W_L^i$) we can estimate the number of deaths in that strata had all the records been successfully linked.

Hence (1) $N_D^i = W_L^i . N_L^i$ and thus

(2) $W_L^i = N_D^i / N_L^i$

Where $N_D^i$ is the total number of death records in ***mortality data-based*** strata *i* and $N_L^i$ is the number of death records in strata *i linked* to a census record.

*For example if 126 of 200 mortality records for Maori men aged 25-44 were linked to a census record then applying a weight of 200/126 = 1.587 to all linked mortality records for Maori men aged 25-44 years will weight up the linked deaths to approximate the known actual number of deaths. That is 1.587 x 126 = 200.*

For each of the four cohorts the associated total mortality data-set was stratified according to ethnic group, sex, age on census night, New Zealand Deprivation Index and Rurality of residence. These strata are all based on information contained within the mortality data-set, which was derived originally from the Death Registration form. The value of $W_L^i$ was then calculated for each strata.

The weights are calculated from the data-set of eligible mortality records, which includes a field indicating whether the mortality record was successfully linked to a census record. This data-set is called the ***Bias*** data-set. The calculated weights were then transferred to the ***Cohort*** data-set (which includes all eligible census records) by linkage between individual ID numbers in the Bias and Cohort data-sets. Statistics New Zealand staff carried out the transfer of weights. Further details about the structure of the data-sets is given is the technical report describing the linkage process and construction of the data-sets (Hill et al. 2002).

### 3.2.1 Stratification of the data by demographic variables

To correctly weight each linked record on the census-mortality data-sets requires applying weights that vary by demographic strata. The strata that we used for the initial weighting were:

- sex
- age group (5 groups according to age at census night; 0-14, 15-29, 30-44, 45-64 and 65-74 years)
- ethnic group (3 groups for the 1981,1986 and 1991 mortality records only one ethnic group was available. For the 1996 bias data-set up to three ethnic groups were recorded. Prioritised ethnicity was used for the stratification).

- NZDep groupings (5 groups; deciles 1-4, 5-6, 7-8, 9-10 and missing).
- Rurality (rural, urban).

Stratification by socio-demographic variables without reference to cause of death would produce weighted counts of linked deaths that were different to the known numbers of deaths by cause. In analyses of the association between socioeconomic variables and specific mortality outcomes the effect of this would be similar to the effect of a biased misclassification of outcome. It was therefore desirable to include cause of death categories in the stratification regime. Eighteen groupings of cause of death were used.

The age and NZ Deprivation groupings are based on previous experience with linkage bias (Blakely 2001) and numerator-denominator bias adjustment weights (Blakely et al. 2002a; Blakely et al. 2002b) that suggest we could not stratify any more thinly (e.g. NZDep deciles 1-4 had to be pooled given few Maori and Pacific people in the least deprived small areas).

Potentially this stratification regime could result in 5760 separate strata (7200 for the 1996 census cohort): (18 [Cause of death] × 4 [ethnicity] × 5 [Age] × 2 [Sex] × 5 [Deprivation] × 2 [Rural]). In practice not all cause of death categories were relevant to all age groups. To avoid weights of zero (no deaths in strata) or undefined weights (no linked mortality records in strata) it was necessary to group strata to obtain a minimum strata size. Decisions about how to group the data were made after examination of the numbers and proportion linked in each stratum. Ethnic groups and the broad age groups were never combined and sex groups were combined only when absolutely necessary to ensure cells of adequate size. The decision as to whether to combine strata by cause of death, deprivation index or rurality was based on the examination of the numbers and linkage rates within the ethnic and age specific cells. In practice stratification by rurality could only be done for major causes of death among the older age groups.

The stratification of the 1991 Bias data-set is illustrated in tabular form in the appendix (Table 36, page 57). Similar stratification regimes were used for all four censuses. The SAS codes used to regroup each bias data-set are given in the Appendix (page 76). After combining strata there were 651, 674, 665, and 862 strata for the 1981, 1986, 1991 and 1996 Bias data-sets respectively.

A Linkage Weight (W_Base) was calculated for each of the strata using the formula $W_L^i = N_D / N_L^i$ (Chapter 3, page 22) The success of the initial weighting was investigated by comparing the weighted number of linked deaths and the known number of actual deaths, by strata age groups (broad groupings and five year age groupings, sex, ethnicity, RHA, rurality, cause of death (18 small Groups and four broad groups) and TLA. The weighted numbers were found to be very accurate for the broad groupings of variables but less so for the detailed groupings. The difference between weighted linked deaths and actual deaths was of particular concern with regard to five-year age groups and detailed cause of death groups (as described above). In order to produce weights that ensured weighted numbers of linked deaths were the same as the known number of actual deaths a secondary adjustment to the original weightings was done.

Three adjustment factors were calculated each using strata of 5-year age groupings by sex and one other variables – ethnicity or deprivation index or cause of death. Linkage weights were calculated for each strata and an adjusted weighting was created by multiplying the original weighting by the second weighting. Hence for each linked

mortality record the adjusted weighting W_AgEthAdj was calculated by multiplying W_Base by a second weight based on strata of age, sex and ethnicity. Similarly, the adjusted weighting W_AgDepAdj was calculated by multiplying W_Base by a second weight based on strata of age, sex and NZ deprivation index; and the adjusted weighting W_AgICDAdj was calculated by multiplying W_Base by as second weight based on strata of age, sex and detailed cause of death groupings.

Hence $W\_AgEthAdj = N_A^{\,i} / N_W^{\,i}$

Where $N_A^{\,i}$ = The total number of deaths in strata *i*

And $N_W$ = The weighted number of linked deaths in strata *i*

$= N_L^{\,i} \times W\_Base^{i}$

Where $N_L^{\,i}$ = The number of linked deaths in strata *i*

The weighted numbers of linked deaths and known number of actual deaths were then compared for each of the four weights. Table 10 to Table 13 shows the weighted numbers of linked deaths produced using each of the four weights as well as the actual and linked deaths by strata of age and sex.

Table 37 to Table 40 (pages 60 to 72) in the appendix give the weighted and actual number of deaths by ethnicity, Regional Health Authority, rurality, New Zealand Deprivation Index and Territorial Local Authority.

The weighted number of linked deaths varied slightly dependant on the type of weighting used. The agreement between weighted numbers of linked deaths and actual total numbers of deaths was high for strata of age, sex and ethnicity and cause of death but none of the weights produce consistently good agreement between weighted linked deaths and actual deaths for the geographical variables (RHA and TLA). The choice of weighting used in any cohort will depend on the analyses being done. *Any future analyses of geographical variables would need to create a new adjusted weighting using strata of derived from the regions of interest.*

**Table 10 1981-1984 Weighted numbers of linked deaths and actual deaths on Bias data-set by age and sex**

| 1981 – 84 | | Linked Deaths[11] | Actual Deaths[1] | W_Base Adjusted Deaths[2] | W_AgEthAdj Adjusted Deaths[2] | W_AgDepAdj Adjusted Deaths[2] | W_AgICDAdj Adjusted Deaths[2] |
|---|---|---|---|---|---|---|---|
| **Sex** | **Age at Census** | | | | | | |
| *Males* | 0 - 14 yrs | 435 | 663 | 663 | 663 | 663 | 660 |
| | 15 - 24 yrs | 732 | 1,389 | 1,389 | 1,389 | 1,388 | 1,387 |
| | 25 - 44 yrs | 1,413 | 2,325 | 2,325 | 2,325 | 2,324 | 2,322 |
| | 45 - 64 yrs | 7,848 | 10,881 | 10,881 | 10,881 | 10,881 | 10,881 |
| | 65 - 74 yrs | 9,165 | 12,306 | 12,307 | 12,306 | 12,306 | 12,304 |
| *Females* | 0 - 14 yrs | 288 | 429 | 429 | 429 | 429 | 422 |
| | 15 - 24 yrs | 252 | 486 | 486 | 486 | 485 | 482 |
| | 25 - 44 yrs | 945 | 1,449 | 1,449 | 1,449 | 1,448 | 1,444 |
| | 45 - 64 yrs | 4,638 | 6,360 | 6,360 | 6,360 | 6,360 | 6,359 |
| | 65 - 74 yrs | 6,027 | 8,400 | 8,399 | 8,400 | 8,400 | 8,400 |

**Table 11 1986-1989 Weighted numbers of linked deaths and actual deaths on Bias data-set by age and sex**

| 1986-89 | | Linked Deaths[1] | Actual Deaths[1] | W_Base Adjusted Deaths[2] | W_AgEthAdj Adjusted Deaths[2] | W_AgDepAdj Adjusted Deaths[2] | W_AgICDAdj Adjusted Deaths[2] |
|---|---|---|---|---|---|---|---|
| **Sex** | **Age at Census** | | | | | | |
| *Males* | 0 - 14 yrs | 435 | 615 | 615 | 615 | 613 | 615 |
| | 15 - 24 yrs | 897 | 1,569 | 1,569 | 1,569 | 1,568 | 1,569 |
| | 25 - 44 yrs | 1,584 | 2,562 | 2,562 | 2,562 | 2,562 | 2,557 |
| | 45 - 64 yrs | 7,836 | 10,503 | 10,503 | 10,503 | 10,503 | 10,503 |
| | 65 - 74 yrs | 9,330 | 12,030 | 12,030 | 12,030 | 12,030 | 12,030 |
| *Females* | 0 - 14 yrs | 291 | 405 | 405 | 405 | 405 | 403 |
| | 15 - 24 yrs | 273 | 519 | 519 | 519 | 519 | 513 |
| | 25 - 44 yrs | 987 | 1,455 | 1,455 | 1,455 | 1,455 | 1,449 |
| | 45 - 64 yrs | 4,755 | 6,255 | 6,255 | 6,255 | 6,251 | 6,255 |
| | 65 - 74 yrs | 6,447 | 8,595 | 8,595 | 8,595 | 8,590 | 8,595 |

[1] Random rounded to base three according to Statistics New Zealand Protocol
[1] Calculated as the ratio of the weighted linked deaths to the actual deaths multiplied by the random rounded number of actual deaths.

**Table 12 1991-1994 Weighted numbers of linked deaths and actual deaths on Bias data-set by age and sex**

| 1991 – 94 | | Linked Deaths[1] | Actual Deaths[1] | W_Base Adjusted Deaths[2] | W_AgEthAdj Adjusted Deaths[2] | W_AgDepAdj Adjusted Deaths[2] | W_AgICDAdj Adjusted Deaths[2] |
|---|---|---|---|---|---|---|---|
| **Sex** | **Age at Census** | | | | | | |
| *Males* | 0 – 14 yrs | 342 | 498 | 498 | 498 | 496 | 497 |
| | 15 – 24 yrs | 696 | 1,335 | 1,335 | 1,335 | 1,335 | 1,330 |
| | 25 – 44 yrs | 1,635 | 2,670 | 2,670 | 2,670 | 2,669 | 2,659 |
| | 45 – 64 yrs | 7,032 | 9,162 | 9,162 | 9,162 | 9,162 | 9,162 |
| | 65 – 74 yrs | 9,393 | 11,559 | 11,559 | 11,559 | 11,559 | 11,559 |
| *Females* | 0 – 14 yrs | 231 | 333 | 333 | 333 | 333 | 330 |
| | 15 – 24 yrs | 255 | 429 | 429 | 429 | 429 | 428 |
| | 25 – 44 yrs | 1,101 | 1,536 | 1,536 | 1,532 | 1,534 | 1,536 |
| | 45 – 64 yrs | 4,551 | 5,760 | 5,760 | 5,760 | 5,759 | 5,760 |
| | 65 – 74 yrs | 6,399 | 8,031 | 8,031 | 8,031 | 8,028 | 8,030 |

**Table 13 1996-1999 Weighted numbers of linked deaths and actual deaths on Bias data-set by age and sex**

| 1996 – 99 | | Linked Deaths[1] | Actual Deaths[1] | W_Base Adjusted Deaths[2] | W_AgEthAdj Adjusted Deaths[2] | W_AgDepAdj Adjusted Deaths[2] | W_AgICDAdj Adjusted Deaths[2] |
|---|---|---|---|---|---|---|---|
| **Sex** | **Age at Census** | | | | | | |
| *Males* | 0 - 14 yrs | 324 | 474 | 474 | 474 | 472 | 472 |
| | 15 - 24 yrs | 585 | 1,086 | 1,086 | 1,086 | 1,086 | 1,085 |
| | 25 - 44 yrs | 1,599 | 2,685 | 2,685 | 2,685 | 2,683 | 2,682 |
| | 45 - 64 yrs | 6,537 | 8,421 | 8,421 | 8,421 | 8,421 | 8,421 |
| | 65 - 74 yrs | 9,426 | 11,355 | 11,355 | 11,355 | 11,355 | 11,355 |
| *Females* | 0 - 14 yrs | 234 | 336 | 336 | 335 | 335 | 335 |
| | 15 - 24 yrs | 237 | 396 | 396 | 396 | 396 | 391 |
| | 25 - 44 yrs | 1,122 | 1,524 | 1,524 | 1,522 | 1,524 | 1,522 |
| | 45 - 64 yrs | 4,515 | 5,607 | 5,607 | 5,607 | 5,607 | 5,605 |
| | 65 - 74 yrs | 6,306 | 7,641 | 7,641 | 7,641 | 7,641 | 7,641 |

## 3.3 Weighting of non-linked census records

Linked cohort members represent a person who was alive at the time of the census but died in the subsequent three years. Applying weights to the linked cohort members compensates for the incomplete linkage of the mortality data-set back to the census and allows the calculation of mortality rates for the total population. It is however also necessary to weight down the unlinked cohort members to allow for the fact that some of the unlinked census records actually did die during follow-up.

The weighting thus far has addressed only the linked census-mortality records, which account for approximately one percent of the total number of census records in each cohort. In order for the weighted sum of *all* census records in each cohort to still equal the total number of census records, each *un*linked census record must also be assigned a weight of (usually) just less than 1.0. The unlinked mortality records represent a census record for which the mortality outcome is misclassified as not dead. The true number of cohort members not dead at the end of the follow-up period can be estimated by subtracting the number weighted number of deaths on the census data from the total number of census cohort records.

The unlinked census records must be adjusted by a weighting factor ($W_u^I$)

This can be expressed mathematically

$$N_C^i = N_{LINKED(ADJUSTED)} + N_{UNLINKED\ (ADJUSTED)}$$

$$= N_L^i \times W_L^I + N_U^i \times W_U^I$$

where $N_C^I$ = total number of cohort members in strata *i*.

$N_L^i \times W_L^I = N_{LINKED(ADJUSTED)}$

= the weighted number of linked cohort members

$N_U^i \times W_U^I = N_{UNLINKED\ (ADJUSTED)}$

= the weighted number of unlinked cohort members

and hence $W_U^i = (N_C^i - N_L^i \times W_L^i) / N_U^I$ (equation 2)

*For example, assume that there were 10,000 Maori male census respondents aged 0-14 years living in urban areas with an NZDep decile score of 9 or 10 ($N_C^i$ = 10,000). Of these, assume 50 ($N_L^I$= 50) were linked to a mortality record and 9950 ($N_U^i$ = 9,950) were unlinked. If each of the 50 linked records had a $W_L^i$ value of 2.0 the adjusted number of deaths $N_L^i \times W_L^I$ would be 2.0 x 50 = 100. The estimated true number (adjusted unlinked) of respondents who were not dead would therefore be 10,000-100 = 9,900.*

*Using equation 2 to calculate the weighting for the unlinked census cohort records*

$$W_U^i = (10{,}000 - 2.0 \times 50)/9950$$

$$= 0.994975$$

*and the number of adjusted number of unlinked cohort members is thus*

*0.994975 x 9950 = 9900.*

The cohort weights were calculated for strata of 5-year age groups, sex, ethnicity, Deprivation index and rurality. No stratification by rurality was done for Pacific and Asian (1996 only) ethnic groups. The ethnic groupings were based on prioritised ethnicity further subdivided into those with one or multiple ethnicities stated on their census record. For the 1981 census cohort three ethnic strata were used – Maori, Pacific and nonMaori nonPacific.

It was necessary to create a separate weight for each of the four linkage weights. Any other linkage weights produced in the future for specific analyses will also require separate weighting of the unlinked cohort records. By way of illustration Table 14 gives the mean weighting of unlinked census cohort records by broad age bands, sex and prioritised ethnicity for the 1996 census cohort.

**Table 14 Mean weighting of unlinked census cohort members by sex, age and prioritised ethnicity. 1981 Census Cohort.**

| | | | Mean weighting | | | |
|---|---|---|---|---|---|---|
| **Sex** | **AgeAtCensus** | **Ethnicity** | **W_B**[ϕ] | **W_E**[γ] | **W_D**[η] | **W_C**[ι] |
| Males | 0-14 yrs | Maori | 0.9994 | 0.9994 | 0.9994 | 0.9994 |
| | | People | 0.9994 | 0.9994 | 0.9994 | 0.9994 |
| | | nonMaori nonPacfic | 0.9995 | 0.9995 | 0.9995 | 0.9995 |
| | 15-24 yrs | Maori | 0.9968 | 0.9969 | 0.9969 | 0.9967 |
| | | Pacific | 0.9981 | 0.9974 | 0.9982 | 0.9983 |
| | | nonMaori nonPacfic | 0.9979 | 0.9979 | 0.9979 | 0.9979 |
| | 25-44 yrs | Maori | 0.9951 | 0.9950 | 0.9951 | 0.9952 |
| | | Pacific | 0.9975 | 0.9976 | 0.9975 | 0.9973 |
| | | nonMaori nonPacfic | 0.9982 | 0.9982 | 0.9982 | 0.9982 |
| | 45-64 yrs | Maori | 0.9733 | 0.9733 | 0.9734 | 0.9737 |
| | | Pacific | 0.9876 | 0.9876 | 0.9876 | 0.9869 |
| | | nonMaori nonPacfic | 0.9902 | 0.9902 | 0.9902 | 0.9902 |
| | 65-74 yrs | Maori | 0.9086 | 0.9084 | 0.9087 | 0.9093 |
| | | Pacific | 0.9454 | 0.9459 | 0.9450 | 0.9460 |
| | | nonMaori nonPacfic | 0.9633 | 0.9633 | 0.9633 | 0.9633 |
| Females | 0-14 yrs | Maori | 0.9996 | 0.9996 | 0.9995 | 0.9996 |
| | | Pacific | 0.9996 | 0.9996 | 0.9996 | 0.9997 |
| | | nonMaori nonPacfic | 0.9997 | 0.9997 | 0.9997 | 0.9997 |
| | 15-24 yrs | Maori | 0.9988 | 0.9987 | 0.9988 | 0.9988 |
| | | Pacific | 0.9989 | 0.9991 | 0.9989 | 0.9987 |
| | | nonMaori nonPacfic | 0.9993 | 0.9993 | 0.9993 | 0.9993 |
| | 25-44 yrs | Maori | 0.9973 | 0.9972 | 0.9972 | 0.9975 |
| | | People | 0.9984 | 0.9983 | 0.9982 | 0.9983 |
| | | nonMaori nonPacfic | 0.9990 | 0.9990 | 0.9990 | 0.9990 |
| | 45-64 yrs | Maori | 0.9833 | 0.9833 | 0.9833 | 0.9836 |
| | | Pacific | 0.9914 | 0.9913 | 0.9914 | 0.9916 |
| | | nonMaori nonPacfic | 0.9947 | 0.9947 | 0.9947 | 0.9947 |
| | 65-74 yrs | Maori | 0.9324 | 0.9321 | 0.9333 | 0.9341 |
| | | Pacific | 0.9674 | 0.9676 | 0.9679 | 0.9678 |
| | | nonMaori nonPacfic | 0.9783 | 0.9783 | 0.9783 | 0.9783 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

# Chapter 4: Validation of weighting

## 4.1 Correcting for linkage bias by sex and age

Assuming that age and sex are recorded accurately on both mortality and census data, then we have no reason to believe that the weights are not accurate for sex and age specific analyses of the cohort data.

## 4.2 Comparison of weighted number of Maori and Pacific deaths on the census cohorts with the numbers predicted by the numerator-denominator bias adjustment ratios

Unlike sex and age, it is not reasonable to assume that ethnicity is recorded accurately and comparably on both mortality and census data.(Ajwani et al. 2002; Blakely and Atkinson 2001; Blakely et al. 2002a; Blakely et al. 2002b) As part of the NZCMS programme of work the recording of ethnicity on mortality and on census records were compared for those mortality records that were linked to a census record. A subset of linked records with high levels of agreement on date of birth date of death and area of residence (meshblock or census area unit) were used for this work. The data-set is called the Highly Probable Links (HPL) data-set. This subset was weighted up to the total mortality data-set using strata based on age at death, sex, ethnicity, NZ Deprivation index, Regional Health Authority and rurality of residence at death. These analyses are described in detail in Ajwani et al (Ajwani et al. 2002).

One check on the validity of the weighting ratios produced by the linkage weighting described in this report is to compare the weighted number of cohort deaths (by age-at-death, sex and ethnicity) with the weighted number of census deaths in the subset of highly probable links used to compare census and mortality recording of ethnicity.

Table 15 to Table 18 compare the weighted number of deaths on the cohort data-set with the weighted number of deaths on the HPL data-set by strata of age at death, sex and Census *Sole* Ethnicity. Table 19 to Table 21 gives similar information by strata of age at death, sex and Census *Prioritised* Ethnicity. The percentage difference between the two weights is shown in each table with strata with greater than two percent difference, and an absolute difference of greater than six, between the weighted numbers indicated with a hash. *Note that the percentage difference in the tables have been calculated using the random rounded numbers and so may be inaccurate for strata with small numbers*. For example for Pacific females aged 15-24 years at death the random rounded weighted

numbers of 21 from the cohort data-set and 18 from the HPL data-set could be from 19-23 and 16-20 respectively with the true percentage difference between the numbers ranging from –0.05% to +30.00%. *When only strata with weighted numbers of more than 200 are considered the degree of agreement between the weighted numbers is high*. Furthermore there is no consistent pattern by strata for under or over weighting of the cohort compared to HPL data-set.

Therefore, and importantly, we conclude that the linkage bias weights have reasonable accuracy for estimating the number of deaths by ethnic group *when the census-based ethnicity coding is used.* This is despite the linkage bias weights being (necessarily) calculated using mortality data ethnicity.

### 4.2.1 Sole ethnicity

**Table 15 Comparison of number of weighted deaths on cohort data-set and number of weighted deaths on the HPL data-set - 1981-1984 - by Age at *Death* Sex and Ethnicity**

| Age At Death | Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set[2] | Weighted Number of deaths - HPL data-set | % Difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 84 | 132 | 126 | 5% |
| | Pacific | 27 | 36 | 36 | 0% |
| | nonMaori nonPacific | 243 | 372 | 360 | 3% # |
| 15-24 years | Maori | 144 | 264 | 279 | 6% # |
| | Pacific | 18 | 45 | 36 | 20% # |
| | nonMaori nonPacific | 576 | 1,053 | 1,053 | 0% |
| 25-44 years | Maori | 219 | 420 | 414 | 1% |
| | Pacific | 36 | 63 | 63 | 0% |
| | nonMaori nonPacific | 1,035 | 1,683 | 1,734 | 3% # |
| 45-64 years | Maori | 657 | 1,128 | 1,098 | 3% # |
| | Pacific | 93 | 141 | 129 | 9% # |
| | nonMaori nonPacific | 6,297 | 8,556 | 8,550 | 0% |
| 65-77 years | Maori | 360 | 657 | 651 | 1% |
| | Pacific | 60 | 93 | 90 | 3% |
| | nonMaori nonPacific | 9,744 | 12,930 | 12,954 | 0% |
| *Female* | | | | | |
| 0-14 years | Maori | 66 | 96 | 93 | 3% |
| | Pacific | 15 | 24 | 18 | 25% |
| | nonMaori nonPacific | 168 | 255 | 252 | 1% |
| 15-24 years | Maori | 63 | 123 | 117 | 5% |
| | Pacific | 21 | 27 | 27 | 0% |
| | nonMaori nonPacific | 186 | 351 | 360 | 3% # |
| 25-44 years | Maori | 171 | 288 | 270 | 6% # |

[2] Calculated using the Weight `W_AgEthAdj`

| | | | | | |
|---|---|---|---|---|---|
| | Pacific | 33 | 54 | 48 | 11% |
| | nonMaori nonPacific | 642 | 984 | 993 | 1% |
| 45-64 years | Maori | 453 | 735 | 732 | 0% |
| | Pacific | 63 | 93 | 84 | 10% # |
| | nonMaori nonPacific | 3,621 | 4,857 | 4,869 | 0% |
| 65-77 years | Maori | 306 | 543 | 531 | 2% # |
| | Pacific | 42 | 66 | 54 | 18% # |
| | nonMaori nonPacific | 6,294 | 8,631 | 8,673 | 1% |

**Table 16 Comparison of number of weighted deaths on cohort data-set and number of weighted deaths on the HPL data-set - 1986-1989 - by Age at *Death* Sex and Sole Ethnicity**

| Age At Death | Sole Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set3 | Weighted Number of deaths - HPL data-set | % Difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 54 | 84 | 84 | 0% |
| | Pacific | 27 | 42 | 45 | 7% |
| | nonMaori nonPacific | 198 | 276 | 279 | 1% |
| 15-24 years | Maori | 111 | 222 | 222 | 0% |
| | Pacific | 24 | 48 | 51 | 6% |
| | nonMaori nonPacific | 546 | 999 | 984 | 2% |
| 25-44 years | Maori | 270 | 504 | 489 | 3% |
| | Pacific | 60 | 114 | 111 | 3% |
| | nonMaori nonPacific | 1206 | 1947 | 1968 | 1% |
| 45-64 years | Maori | 795 | 1200 | 1185 | 1% |
| | Pacific | 201 | 279 | 282 | 1% |
| | nonMaori nonPacific | 5151 | 6588 | 6588 | 0% |
| 65-77 years | Maori | 477 | 717 | 720 | 0% |
| | Pacific | 114 | 180 | 183 | 2% |
| | nonMaori nonPacific | 9870 | 12006 | 12033 | 0% |
| *Female* | | | | | |
| 0-14 years | Maori | 33 | 54 | 51 | 6% |
| | Pacific | 18 | 24 | 24 | 0% |
| | nonMaori nonPacific | 186 | 252 | 249 | 1% |
| 15-24 years | Maori | 51 | 102 | 102 | 0% |

[3] Calculated using the Weight `W_AgEthAdj`

| | | | | | |
|---|---|---|---|---|---|
| | Pacific | 15 | 21 | 18 | 14% |
| | nonMaori nonPacific | 219 | 390 | 387 | 1% |
| 25-44 years | Maori | 150 | 243 | 246 | 1% |
| | Pacific | 45 | 63 | 54 | 14% # |
| | nonMaori nonPacific | 696 | 1041 | 1068 | 3% |
| 45-64 years | Maori | 513 | 774 | 753 | 3% |
| | Pacific | 102 | 126 | 117 | 7% # |
| | nonMaori nonPacific | 3570 | 4632 | 4638 | 0% |
| 65-77 years | Maori | 288 | 471 | 468 | 1% |
| | Pacific | 57 | 81 | 66 | 19% # |
| | nonMaori nonPacific | 6816 | 8967 | 8982 | 0% |

**Table 17 Comparison of number of weighted deaths on cohort data-set and number of weighted deaths on the HPL data-set - 1991-1994 - by Age at *Death* Sex and Ethnicity**

| Age At Death | Sole Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set[4] | Weighted Number of deaths - HPL data-set | % Difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 54 | 84 | 84 | 0% |
| | Pacific | 27 | 39 | 45 | 15% |
| | nonMaori nonPacific | 198 | 279 | 279 | 0% |
| 15-24 years | Maori | 111 | 219 | 222 | 1% |
| | Pacific | 24 | 51 | 51 | 0% |
| | nonMaori nonPacific | 549 | 1,002 | 984 | 2% |
| 25-44 years | Maori | 273 | 501 | 489 | 2% # |
| | Pacific | 60 | 114 | 111 | 3% |
| | nonMaori nonPacific | 1,209 | 1,962 | 1,968 | 0% |
| 45-64 years | Maori | 795 | 1,194 | 1,185 | 1% |
| | Pacific | 198 | 282 | 282 | 0% |
| | nonMaori nonPacific | 5,151 | 6,597 | 6,588 | 0% |
| 65-77 years | Maori | 474 | 726 | 720 | 1% |
| | Pacific | 117 | 183 | 183 | 0% |
| | nonMaori nonPacific | 9,870 | 11,994 | 12,033 | 0% |
| *Female* | | | | | |
| 0-14 years | Maori | 42 | 60 | 63 | 5% |
| | Pacific | 18 | 21 | 21 | 0% |
| | nonMaori nonPacific | 141 | 204 | 201 | 2% |
| 15-24 years | Maori | 48 | 78 | 75 | 4% |
| | Pacific | 9 | 12 | 15 | 25% |
| | nonMaori nonPacific | 207 | 342 | 339 | 1% |
| 25-44 years | Maori | 168 | 258 | 261 | 1% |
| | Pacific | 54 | 84 | 93 | 11% # |
| | nonMaori nonPacific | 744 | 1,026 | 1,017 | 1% |
| 45-64 years | Maori | 675 | 936 | 930 | 1% |
| | Pacific | 93 | 144 | 144 | 0% |
| | nonMaori nonPacific | 3,297 | 4,077 | 4,095 | 0% |
| 65-77 years | Maori | 354 | 534 | 540 | 1% |
| | Pacific | 108 | 156 | 150 | 4% |
| | nonMaori nonPacific | 6,567 | 8,130 | 8,139 | 0% |

[4] Calculated using the Weight `W_AgEthAdj`

**Table 18 Comparison of number of weighted deaths on cohort data-set and number of weighted deaths on the HPL data-set 1996-1999 – by Age at *Death* Sex and Sole Ethnicity**

| Age At Death | Sole Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set[5] | Weighted Number of deaths - HPL data-set | % difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 66 | 105 | 93 | 13% # |
| | Pacific | 12 | 15 | 15 | 0% |
| | Asian | 6 | 12 | 9 | 33% |
| | nonMaori nonPacific nonAsian | 183 | 252 | 249 | 1% |
| 15-24 years | Maori | 78 | 174 | 171 | 2% |
| | Pacific | 30 | 54 | 54 | 0% |
| | Asian | 15 | 24 | 24 | 0% |
| | nonMaori nonPacific nonAsian | 432 | 762 | 774 | 2% |
| 25-44 years | Maori | 240 | 468 | 492 | 5% # |
| | Pacific | 84 | 150 | 144 | 4% |
| | Asian | 36 | 60 | 60 | 0% |
| | nonMaori nonPacific nonAsian | 1,134 | 1,878 | 1,878 | 0% |
| 45-64 years | Maori | 891 | 1,311 | 1,299 | 1% |
| | Pacific | 243 | 363 | 354 | 3% # |
| | Asian | 90 | 138 | 135 | 2% |
| | nonMaori nonPacific nonAsian | 4,581 | 5,751 | 5,781 | 1% |
| 65-77years | Maori | 585 | 792 | 780 | 2% |
| | Pacific | 168 | 261 | 270 | 3% # |
| | Asian | 66 | 99 | 102 | 3% |
| | nonMaori nonPacific nonAsian | 9,513 | 11,322 | 11,337 | 0% |
| *Females* | | | | | |
| 0-14 years | Maori | 39 | 57 | 60 | 5% |
| | Pacific | 12 | 18 | 18 | 0% |
| | Asian | 6 | 6 | 9 | 33% |
| | nonMaori nonPacific nonAsian | 141 | 192 | 189 | 2% |
| 15-24 years | Maori | 48 | 84 | 72 | 17% |
| | Pacific | 15 | 21 | 15 | 40% |
| | Asian | 9 | 15 | 15 | 0% |
| | nonMaori nonPacific nonAsian | 186 | 297 | 285 | 4% # |
| 25-44 years | Maori | 159 | 249 | 234 | 6% # |
| | Pacific | 69 | 102 | 105 | 3% |
| | Asian | 33 | 42 | 48 | 13% |
| | nonMaori nonPacific nonAsian | 756 | 1,011 | 1,014 | 0% |
| 45-64 years | Maori | 624 | 894 | 879 | 2% |
| | Pacific | 141 | 210 | 210 | 0% |
| | Asian | 63 | 87 | 84 | 4% |
| | nonMaori nonPacific nonAsian | 3,267 | 3,918 | 3,924 | 0% |
| 65-77years | Maori | 495 | 726 | 726 | 0% |
| | Pacific | 141 | 213 | 198 | 7% # |
| | Asian | 57 | 84 | 78 | 8% |
| | nonMaori nonPacific nonAsian | 6,183 | 7,317 | 7,338 | 0% |

[5] Calculated using the Weight `W_AgEthAdj`

### 4.2.2 Prioritised ethnicity

**Table 19 Comparison of number of weighted deaths on cohort data-set and number of weighted deaths on the HPL data-set 1986-1989 – by Age at *Death* Sex and Prioritized Ethnicity**

| Age At Death | Prioritised Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set[6] | Weighted Number of deaths - HPL data-set | % difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 93 | 135 | 138 | 2% |
| | Pacific | 24 | 36 | 39 | 8% |
| | NonMaori nonPacific | 219 | 309 | 312 | 1% |
| 15-24 years | Maori | 171 | 315 | 306 | 3% # |
| | Pacific | 36 | 72 | 63 | 13% # |
| | NonMaori nonPacific | 669 | 1,098 | 1,110 | 1% |
| 25-44 years | Maori | 261 | 477 | 477 | 0% |
| | Pacific | 93 | 138 | 132 | 4% |
| | NonMaori nonPacific | 1,161 | 1,890 | 1,923 | 2% |
| 45-64 years | Maori | 762 | 1,161 | 1,152 | 1% |
| | Pacific | 174 | 240 | 219 | 9% # |
| | NonMaori nonPacific | 5,931 | 7,887 | 7,902 | 0% |
| 65-77 years | Maori | 402 | 627 | 618 | 1% |
| | Pacific | 96 | 132 | 126 | 5% |
| | NonMaori nonPacific | 9,975 | 12,747 | 12,777 | 0% |
| *Females* | | | | | |
| 0-14 years | Maori | 57 | 84 | 81 | 4% |
| | Pacific | 18 | 24 | 24 | 0% |
| | NonMaori nonPacific | 165 | 219 | 219 | 0% |
| 15-24 years | Maori | 63 | 126 | 132 | 5% |
| | Pacific | 18 | 27 | 21 | 22% |
| | nonMaori nonPacific | 207 | 360 | 354 | 2% |
| 25-44 years | Maori | 174 | 282 | 291 | 3% # |
| | Pacific | 51 | 72 | 66 | 8% |
| | nonMaori nonPacific | 663 | 990 | 1,011 | 2% |
| 45-64 years | Maori | 579 | 861 | 846 | 2% |
| | Pacific | 105 | 135 | 123 | 9% # |
| | nonMaori nonPacific | 3,501 | 4,542 | 4,536 | 0% |
| 65-77 years | Maori | 339 | 540 | 549 | 2% |
| | Pacific | 63 | 87 | 81 | 7% |
| | nonMaori nonPacific | 6,759 | 8,892 | 8,892 | 0% |

[6] Calculated using the Weight `W_AgEthAdj`

**Table 20 Comparison of number of weighed deaths on cohort data-set and number of weighted deaths on the HPL data-set 1991-1994 – by Age at *Death,* Sex and Prioritized Ethnicity**

| Age At Death | Prioritised Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set7 | Weighted Number of deaths - HPL data-set | % Difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 72 | 108 | 108 | 0% |
| | Pacific | 30 | 45 | 45 | 0% |
| | nonMaori nonPacific | 180 | 252 | 255 | 1% |
| 15-24 years | Maori | 147 | 294 | 294 | 0% |
| | Pacific | 24 | 54 | 60 | 11% |
| | nonMaori nonPacific | 507 | 921 | 906 | 2% |
| 25-44 years | Maori | 309 | 570 | 552 | 3% # |
| | Pacific | 60 | 114 | 114 | 0% |
| | nonMaori nonPacific | 1,173 | 1,884 | 1,902 | 1% |
| 45-64 years | Maori | 870 | 1,308 | 1,290 | 1% |
| | Pacific | 204 | 288 | 288 | 0% |
| | nonMaori nonPacific | 5,070 | 6,474 | 6,477 | 0% |
| 65-77 years | Maori | 531 | 789 | 792 | 0% |
| | Pacific | 123 | 192 | 195 | 2% |
| | nonMaori nonPacific | 9,810 | 11,925 | 11,946 | 0% |
| *Female* | | | | | |
| 0-14 years | Maori | 57 | 84 | 84 | 0% |
| | Pacific | 21 | 30 | 30 | 0% |
| | nonMaori nonPacific | 123 | 177 | 171 | 3% |
| 15-24 years | Maori | 63 | 99 | 96 | 3% |
| | Pacific | 12 | 18 | 21 | -17% |
| | nonMaori nonPacific | 192 | 315 | 315 | 0% |
| 25-44 years | Maori | 189 | 291 | 288 | 1% |
| | Pacific | 57 | 90 | 96 | -7% |
| | nonMaori nonPacific | 720 | 987 | 984 | 0% |
| 45-64 years | Maori | 738 | 1,020 | 1,014 | 1% |
| | Pacific | 99 | 150 | 147 | 2% |
| | nonMaori nonPacific | 3,231 | 3,984 | 4,005 | -1% |
| 65-77 years | Maori | 408 | 606 | 612 | -1% |
| | Pacific | 111 | 162 | 153 | 6% # |
| | nonMaori nonPacific | 6,513 | 8,055 | 8,061 | 0% |

[7] Calculated using the Weight `W_AgEthAdj`

**Table 21 Comparison of number of weighed deaths on cohort data-set and number of weighted deaths on the HPL data-set 1996-1999 – by Age at *Death,* Sex and Prioritized Ethnicity**

| Age At Death | Prioritised Ethnicity | Linked cohort records | Weighted number of deaths - Cohort data-set[8] | Weighted Number of deaths - HPL data-set | % difference |
|---|---|---|---|---|---|
| *Males* | | | | | |
| 0-14 years | Maori | 99 | 150 | 147 | 2% |
| | Pacific | 21 | 33 | 30 | 10% |
| | Asian | 6 | 12 | 12 | 0% |
| | nonMaori nonPacific nonAsian | 141 | 183 | 183 | 0% |
| 15-24 years | Maori | 150 | 318 | 315 | 1% |
| | Pacific | 45 | 78 | 84 | 7% |
| | Asian | 18 | 27 | 24 | 2% |
| | nonMaori nonPacific nonAsian | 348 | 594 | 600 | 1% |
| 25-44 years | Maori | 357 | 696 | 717 | 3% # |
| | Pacific | 105 | 183 | 177 | 3% |
| | Asian | 36 | 57 | 60 | 5% |
| | nonMaori nonPacific nonAsian | 996 | 1,617 | 1,623 | 0% |
| 45-64 years | Maori | 1,104 | 1,608 | 1,599 | 1% |
| | Pacific | 267 | 399 | 393 | 2% |
| | Asian | 96 | 147 | 147 | 0% |
| | nonMaori nonPacific nonAsian | 4,338 | 5,409 | 5,430 | 0% |
| 65-77years | Maori | 810 | 1,089 | 1,080 | 1% |
| | Pacific | 186 | 288 | 303 | 5% # |
| | Asian | 72 | 108 | 108 | 0% |
| | nonMaori nonPacific nonAsian | 9,261 | 10,986 | 10,995 | 0% |
| *Females* | | | | | |
| 0-14 years | Maori | 72 | 105 | 108 | 3% |
| | Pacific | 12 | 24 | 24 | 0% |
| | Asian | 6 | 6 | 9 | 33% |
| | NonMaori nonPacific nonAsian | 105 | 135 | 138 | 2% |
| 15-24 years | Maori | 78 | 141 | 126 | 12% # |
| | Pacific | 18 | 21 | 18 | 17% |
| | Asian | 15 | 24 | 21 | 14% |
| | NonMaori nonPacific nonAsian | 150 | 228 | 222 | 3% |
| 25-44 years | Maori | 252 | 384 | 375 | 2% |
| | Pacific | 84 | 126 | 135 | 7% # |
| | Asian | 36 | 45 | 51 | 12% |
| | NonMaori nonPacific nonAsian | 642 | 843 | 840 | 0% |
| 45-64 years | Maori | 798 | 1,134 | 1,125 | 1% |
| | Pacific | 156 | 237 | 237 | 0% |
| | Asian | 66 | 87 | 87 | 0% |
| | NonMaori nonPacific nonAsian | 3,075 | 3,651 | 3,648 | 0% |
| 65-77years | Maori | 642 | 924 | 927 | 0% |
| | Pacific | 159 | 240 | 225 | 7% # |
| | Asian | 63 | 90 | 87 | 30% |
| | NonMaori nonPacific nonAsian | 6,012 | 7,086 | 7,101 | 0% |

[8] Calculated using the Weight `W_AgEthAdj`

## 4.3 Correcting for linkage bias by socioeconomic status

Blakely corrected for linkage bias in his odds ratios for mortality by occupational class and by NZ deprivation index by dividing the odds ratio (OR) for mortality by the corresponding Relative Risk (RR) for linkage (Blakely 2001). For example if the odds ratio for all cause mortality for occupational class one compared to occupational class four was 0.8 and the RR linkage for occupational class one compared to occupational class four was 1.2 then the linkage bias adjusted odds ratio was 0.8 / 1.2 = 0.67.

For the 1991 census cohort only it is possible to compare the results of this post-hoc method for adjusting for linkage bias with the outcomes of weighted logistic regression using the linkage weights. Blakely's original analyses were repeated for occupational class and NZ Deprivation (1991). Firstly Figure 2 shows the effect of the use of the Ethnicity scaled weight (W_AgEthadj) compared to using a post hoc adjustment by risk of linkage for odds of mortality by decile of NZDep91. The Odds Ratios produced by the three different weightings described in this report were very similar. These are given in the appendix (Table 41, page 76).

When cause specific mortality was considered there was a tendency for the ORs produced from the weighted regression to be slightly less than those produced by the post-hoc adjustment for NZDep91 quintile five, except for female cancer deaths where the Weighted OR was substantially higher than that produced by the ad-hoc adjustment - 1.48 compared to 1.30 (Table 22). That said, the two weighting methods (Blakely's post-hoc, and the linkage bias weights described in this report) give similar results overall that are often moderately different from the unweighted analyses.

Although the weighted regression for mortality by NZDep91 produced similar adjustments to the post-hoc adjustment for linkage bias, when mortality by NZSEI91 Occupational Class is considered there was a substantial difference between the adjusted Odds Ratios produced by the two methods (Figure 3). The difference is particularly notable at younger ages. There are a number of reasons why the two methods are likely to have produced different results.

**Figure 2 Comparison of Odds Ratio for All Cause Mortality by Deciles of NZDep91 with no weights, Weighted using W_AgEthAdj and Adjusted by RR of linkage. 1991 Cohort by Sex and Age Group.**

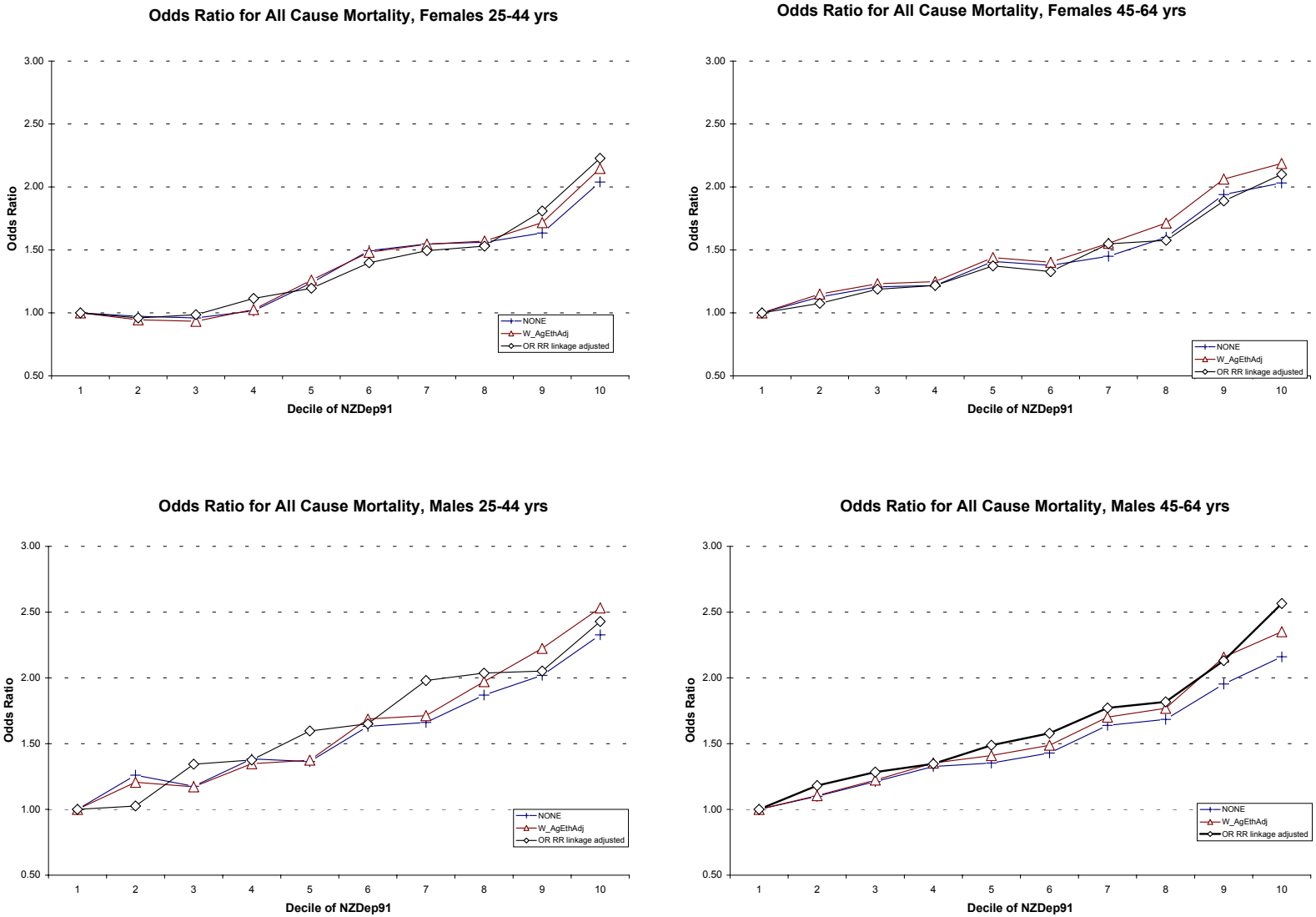


**Table 22 Ethnicity Scaled Weight and Post-Hoc Adjustment for RR of linkage.**

| | Weighting method | Quintile of NZDep 91 | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Males | | | | | | |
| Cancer | No Weighting | 1.00 | 1.07 | 1.17 | 1.28 | 1.47 |
| | W_AgEthAdj | 1.00 | 1.07 | 1.21 | 1.29 | 1.62 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.08 | 1.21 | 1.30 | 1.63 |
| CVD | No Weighting | 1.00 | 1.28 | 1.33 | 1.70 | 2.12 |
| | W_AgEthAdj | 1.00 | 1.29 | 1.39 | 1.79 | 2.30 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.29 | 1.39 | 1.80 | 2.32 |
| Injury | No Weighting | 1.00 | 1.05 | 1.29 | 1.42 | 1.49 |
| | W_AgEthAdj | 1.00 | 1.09 | 1.36 | 1.62 | 1.76 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.09 | 1.40 | 1.66 | 1.81 |
| Suicide | No Weighting | 1.00 | 1.19 | 1.05 | 1.55 | 1.60 |
| | W_AgEthAdj | 1.00 | 1.19 | 1.19 | 1.64 | 1.79 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.19 | 1.24 | 1.66 | 1.83 |
| Females | | | | | | |
| Cancer | No Weighting | 1.00 | 1.06 | 1.19 | 1.24 | 1.41 |
| | W_AgEthAdj | 1.00 | 1.07 | 1.22 | 1.30 | 1.48 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.02 | 1.18 | 1.19 | 1.30 |
| CVD | No Weighting | 1.00 | 1.34 | 1.58 | 1.80 | 2.59 |
| | W_AgEthAdj | 1.00 | 1.36 | 1.60 | 1.98 | 2.74 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.36 | 1.62 | 1.99 | 2.75 |
| Injury | No Weighting | 1.00 | 1.21 | 1.53 | 1.35 | 2.36 |
| | W_AgEthAdj | 1.00 | 1.24 | 1.50 | 1.36 | 2.46 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 1.23 | 1.55 | 1.39 | 2.49 |
| Suicide | No Weighting | 1.00 | 0.95 | 1.49 | 1.43 | 1.88 |
| | W_AgEthAdj | 1.00 | 0.94 | 1.57 | 1.62 | 1.76 |
| | OR $_{\text{RR linkage adjusted}}$ | 1.00 | 0.94 | 1.60 | 1.62 | 1.79 |

**Figure 3 Comparison of Odds Ratio from Weighted Regression with Post-Hoc Adjustment for Linkage Bias for Mortality by NZSEI Occupational Class**


Bias arising from differences in the recording of occupation between the census and death certificate is likely to have substantially affected the relative risk of linkage used to adjust the odds of mortality by occupational class for the post-hoc weighting. Prior analyses by Dr Blakely (Blakely 2001) found that only 33% of linked mortality records had the same occupational class on the linked census record (males aged 25-64 at death for the period 1992-1994). For NZSEI Class Six only 24 % of mortality records had the same occupational class on the linked census record. There was thus evidence of substantial bias in the recording of the occupational class variable that makes the post-hoc weighting for linkage bias for occupational class mortality gradients tenuous. For example, Blakely's adjustment of the census occupational class mortality relative risk for Class Six compared to Class One was based on a correction factor calculated from mortality data were only 24% of the death in Class Six had the same class on census data.

## 4.4 Correcting for linkage bias – Summary

The linkage bias weights described in this Report work well for adjustments by sex, age and ethnicity.

Regarding socio-economic position, it is important to first note that *residual linkage bias by socio-economic position after allowing for demographic factors was small*. Comparing the weightings with the use of a post-hoc adjustment for linkage bias suggests the weights perform similarly to these post-hoc weights for analyses of mortality by NZDep. However the weighted regression produced substantially different adjustments for linkage bias by occupational class, when compared to the post-hoc weighting. This is likely to be due to bias introduced to the previous post-hoc method of Blakely due to the *different* recording of occupation on the mortality and census records. In summary, we believe using the weights for cohort analyses of socio-economic mortality gradients will be superior to unweighted analyses.

# Chapter 5: Limitations of the weighting and conclusions

The weightings described here produce relatively stable adjustments for linkage bias. However the performance of the weights at a sub-national level has not been investigated. Calculations of expected and actual deaths by Territorial Local Authority and Urban Area (Table 37 to Table 40) show the weights do not necessarily produce good predictions for sub-national geographical areas. The performance of the weights to adjust for linkage will therefore need to be checked and an area based scaling of the Base weight may be required for these analyses.

The use of linkage weights will enable adjustment for linkage bias and the calculation of stratum specific mortality rates for a full range of socio-economic variable – not just small area deprivation. However these weightings may under-adjust for linkage bias by individual level socio-economic variables, because of the imperfect correlation between the area based NZDep used in calculating the weights and individual level socio-economic variables, such as income and education . Nevertheless, the weightings provide good adjustments for linkage bias by age, sex and ethnicity, which account for most of the linkage bias.

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# APPENDIX

**Table 23 1981-1984. Number of deaths and percentage of mortality records linked to a census record by Detailed Cause of Death Categories**

| 1981 – 84 Cause of Death – detailed | Actual Deaths | % Linked |
|---|---|---|
| Communicable Diseases | 468 | (62%) |
| Colorectal Cancer | 1,983 | (76%) |
| Lung/Bronchus Cancer | 2,838 | (74%) |
| Breast Cancer | 1,224 | (76%) |
| Prostate Cancer | 477 | (75%) |
| Other Cancer | 6,216 | (74%) |
| Diabetes | 714 | (64%) |
| IHD | 13,254 | (75%) |
| Other Heart Disease | 1,821 | (69%) |
| Cerebrovascular Disease | 3,621 | (69%) |
| Other Cardiovascular Disease | 1,008 | (75%) |
| Pnuemonia/Influenza | 819 | (59%) |
| COPD | 1,866 | (72%) |
| Asthma | 597 | (68%) |
| Other Respiratory | 213 | (69%) |
| Congenital | 210 | (74%) |
| Perinatal | 9 | (44%) |
| SIDS | 66 | (68%) |
| RTC | 1,926 | (59%) |
| Suicide | 1,002 | (59%) |
| Violent | 120 | (48%) |
| Unintentional Injury other than RTC | 1,284 | (61%) |
| Other Causes | 2,976 | (67%) |

**Table 24 1986-1989. Number of deaths and percentage of mortality records linked to a census record by Detailed Cause of Death Categories**

| 1981 - 84 Cause of Death - detailed | Actual Deaths | 2.8 |
|---|---|---|
| Communicable Diseases | 432 | (66%) |
| Colorectal Cancer | 2,076 | (81%) |
| Lung/Bronchus Cancer | 2,982 | (76%) |
| Breast Cancer | 1,341 | (79%) |
| Prostate Cancer | 558 | (81%) |
| Other Cancer | 6,501 | (78%) |
| Diabetes | 774 | (71%) |
| IHD | 12,294 | (77%) |
| Other Heart Disease | 1,674 | (70%) |
| Cerebrovascular Disease | 3,006 | (72%) |
| Other Cardiovascular Disease | 1,059 | (75%) |
| Pnuemonia/Influenza | 789 | (67%) |
| COPD | 1,881 | (76%) |
| Asthma | 537 | (73%) |
| Other Respiratory | 237 | (68%) |
| Congenital | 240 | (73%) |
| Perinatal | 18 | (61%) |
| SIDS | 45 | (83%) |
| RTC | 2,187 | (61%) |
| Suicide | 1,392 | (61%) |
| Violent | 183 | (51%) |
| Unintentional Injury other than RTC | 1,158 | (63%) |
| Other Causes | 3,132 | (71%) |

**Table 25 1991-1994. Number of deaths and percentage of mortality records linked to a census record by Detailed Cause of Death Categories**

| 1991 – 94 Cause of Death – detailed | Actual Deaths | % Linked |
|---|---|---|
| Communicable Diseases | 546 | (67%) |
| Colorectal Cancer | 2,130 | (84%) |
| Lung/Bronchus Cancer | 2,940 | (79%) |
| Breast Cancer | 1,317 | (83%) |
| Prostate Cancer | 645 | (83%) |
| Other Cancer | 6,927 | (80%) |
| Diabetes | 822 | (74%) |
| IHD | 10,071 | (80%) |
| Other Heart Disease | 1,620 | (76%) |
| Cerebrovascular Disease | 2,736 | (75%) |
| Other Cardiovascular Disease | 1,026 | (78%) |
| Pnuemonia/Influenza | 471 | (66%) |
| COPD | 1,800 | (80%) |
| Asthma | 234 | (77%) |
| Other Respiratory | 294 | (74%) |
| Congenital | 207 | (66%) |
| Perinatal | 12 | (40%) |
| SIDS | 60 | (77%) |
| RTC | 1,752 | (59%) |
| Suicide | 1,437 | (61%) |
| Violent | 186 | (53%) |
| Unintentional Injury other than RTC | 1,005 | (66%) |
| Other Causes | 3,081 | (73%) |

**Table 26 1996-1999. Number of deaths and percentage of mortality records linked to a census record by Detailed Cause of Death Categories**

| 1996 - 99 Cause of Death - detailed | Actual Deaths | % Linked |
|---|---|---|
| Communicable Diseases | 408 | (71%) |
| Colorectal Cancer | 2,154 | (84%) |
| Lung/Bronchus Cancer | 3,027 | (81%) |
| Breast Cancer | 1,377 | (84%) |
| Prostate Cancer | 660 | (84%) |
| Other Cancer | 7,287 | (82%) |
| Diabetes | 1,110 | (76%) |
| IHD | 8,151 | (81%) |
| Other Heart Disease | 1,725 | (76%) |
| Cerebrovascular Disease | 2,130 | (78%) |
| Other Cardiovascular Disease | 885 | (83%) |
| Pnuemonia/Influenza | 303 | (74%) |
| COPD | 1,923 | (82%) |
| Asthma | 282 | (81%) |
| Other Respiratory | 267 | (79%) |
| Congenital | 279 | (77%) |
| Perinatal | 9 | (86%) |
| SIDS | 33 | (76%) |
| RTC | 1,437 | (59%) |
| Suicide | 1,674 | (61%) |
| Violent | 156 | (56%) |
| Unintentional Injury other than RTC | 927 | (64%) |
| Other Causes | 3,324 | (76%) |

**Table 27 1981-1984. Number of deaths and percentage of mortality records linked to a census record by Territorial Local Authority**

| 1981 – 84 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Far North | 606 | (58%) |
| Whangarei | 798 | (68%) |
| Kaipara | 189 | (66%) |
| Rodney | 552 | (62%) |
| North Shore | 1,623 | (76%) |
| Waitakere | 1,125 | (71%) |
| Auckland | 5,037 | (70%) |
| Manukau | 2,091 | (68%) |
| Papakura | 336 | (69%) |
| Franklin | 459 | (55%) |
| Thames Coromandel | 360 | (70%) |
| Hauraki | 264 | (72%) |
| Waikato | 441 | (60%) |
| Matamata-Piako | 399 | (71%) |
| Hamilton | 1,086 | (70%) |
| Waipa | 453 | (59%) |
| Otorohanga | 96 | (57%) |
| South Waikato | 255 | (72%) |
| Waitomo | 168 | (58%) |
| Taupo | 357 | (65%) |
| Western Bay of Plenty | 360 | (56%) |
| Tauranga | 897 | (71%) |
| Rotorua | 741 | (66%) |
| Whakatane | 399 | (62%) |
| **Kawerau** | 72 | (72%) |
| Opotiki | 129 | (63%) |
| Gisborne | 696 | (71%) |
| Wairoa | 192 | (57%) |
| Hastings | 894 | (72%) |
| Napier | 789 | (73%) |
| Central Hawkes Bay | 186 | (73%) |
| New Plymouth | 891 | (75%) |
| Stratford | 123 | (74%) |
| South Taranaki | 498 | (70%) |
| Ruapehu | 246 | (57%) |
| Wanganui | 744 | (70%) |
| Rangitikei | 276 | (67%) |
| Manawatu | 294 | (73%) |

| 1981 – 84 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Palmerston North | 834 | (75%) |
| Tararua | 315 | (71%) |
| Horowhenua | 555 | (74%) |
| Kapiti Coast | 531 | (72%) |
| Porirua | 489 | (71%) |
| Upper Hutt | 375 | (75%) |
| Lower Hutt | 1,389 | (79%) |
| Wellington | 1,809 | (75%) |
| Masterton | 339 | (74%) |
| Carterton | 72 | (70%) |
| South Wairarapa | 135 | (73%) |
| Tasman | 402 | (71%) |
| Nelson | 606 | (76%) |
| Marlborough | 510 | (71%) |
| Kaikoura | 63 | (75%) |
| Buller | 201 | (73%) |
| Grey | 261 | (76%) |
| Westland | 156 | (67%) |
| Hurunui | 87 | (64%) |
| Waimakariri | 318 | (74%) |
| Christchurch | 4,158 | (74%) |
| Banks Peninsula | 96 | (77%) |
| Selwyn | 189 | (62%) |
| Ashburton | 387 | (76%) |
| Timaru | 732 | (73%) |
| Mackenzie | 57 | (67%) |
| Waimate | 132 | (69%) |
| Chatham Islands | 6 | (80%) |
| Waitaki | 384 | (76%) |
| Central Otago | 210 | (71%) |
| Queenstown-Lakes | 75 | (65%) |
| Dunedin | 1,899 | (78%) |
| Clutha | 288 | (75%) |
| Southland | 387 | (66%) |
| Gore | 210 | (73%) |
| Invercargill | 912 | (68%) |
| TLA Not Applicable | 6 | (60%) |

**Table 28 1986-1989. Number of deaths and percentage of mortality records linked to a census record by Territorial Local Authority**

| 1986 – 89 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Far North | 693 | (60%) |
| Whangarei | 825 | (71%) |
| Kaipara | 210 | (73%) |
| Rodney | 645 | (71%) |
| North Shore | 1,602 | (79%) |
| Waitakere | 1,284 | (74%) |
| Auckland | 4,794 | (73%) |
| Manukau | 2,391 | (71%) |
| Papakura | 363 | (67%) |
| Franklin | 438 | (68%) |
| Thames Coromandel | 345 | (70%) |
| Hauraki | 219 | (76%) |
| Waikato | 429 | (67%) |
| Matamata-Piako | 342 | (75%) |
| Hamilton | 1,074 | (74%) |
| Waipa | 456 | (69%) |
| Otorohanga | 96 | (67%) |
| South Waikato | 294 | (68%) |
| Waitomo | 123 | (71%) |
| Taupo | 360 | (69%) |
| Western Bay of Plenty | 423 | (66%) |
| Tauranga | 942 | (72%) |
| Rotorua | 804 | (65%) |
| Whakatane | 447 | (73%) |
| Kawerau | 87 | (79%) |
| Opotiki | 141 | (64%) |
| Gisborne | 654 | (71%) |
| Wairoa | 159 | (57%) |
| Hastings | 906 | (73%) |
| Napier | 783 | (77%) |
| Central Hawkes Bay | 204 | (79%) |
| New Plymouth | 879 | (80%) |
| Stratford | 114 | (81%) |
| South Taranaki | 432 | (77%) |
| Ruapehu | 237 | (67%) |
| Wanganui | 699 | (72%) |
| Rangitikei | 264 | (68%) |
| Manawatu | 336 | (73%) |
| Palmerston North | 885 | (78%) |

| 1986 – 89 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Tararua | 306 | (76%) |
| Horowhenua | 576 | (75%) |
| Kapiti Coast | 561 | (76%) |
| Porirua | 474 | (70%) |
| Upper Hutt | 414 | (75%) |
| Lower Hutt | 1,353 | (78%) |
| Wellington | 1,656 | (75%) |
| Masterton | 345 | (78%) |
| Carterton | 87 | (75%) |
| South Wairarapa | 165 | (76%) |
| Tasman | 393 | (75%) |
| Nelson | 531 | (79%) |
| Marlborough | 468 | (75%) |
| Kaikoura | 54 | (82%) |
| Buller | 195 | (81%) |
| Grey | 231 | (78%) |
| Westland | 144 | (78%) |
| Hurunui | 114 | (74%) |
| Waimakariri | 330 | (73%) |
| Christchurch | 4,071 | (77%) |
| Banks Peninsula | 84 | (76%) |
| Selwyn | 183 | (74%) |
| Ashburton | 300 | (79%) |
| Timaru | 720 | (81%) |
| Mackenzie | 33 | (66%) |
| Waimate | 135 | (73%) |
| Chatham Islands | 6 | (50%) |
| Waitaki | 372 | (78%) |
| Central Otago | 195 | (80%) |
| Queenstown-Lakes | 93 | (68%) |
| Dunedin | 1,821 | (77%) |
| Clutha | 267 | (74%) |
| Southland | 423 | (68%) |
| Gore | 228 | (76%) |
| Invercargill | 798 | (73%) |
| TLA Not Applicable | 6 | (33%) |

**Table 29 1991-1994. Number of deaths and percentage of mortality records linked to a census record by Territorial Local Authority**

| 1991 – 94 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Far North | 714 | (64%) |
| Whangarei | 822 | (74%) |
| Kaipara | 222 | (72%) |
| Rodney | 714 | (76%) |
| North Shore | 1,497 | (81%) |
| Waitakere | 1,335 | (75%) |
| Auckland | 3,819 | (73%) |
| Manukau | 2,394 | (71%) |
| Papakura | 408 | (70%) |
| Franklin | 450 | (70%) |
| Thames Coromandel | 402 | (76%) |
| Hauraki | 252 | (75%) |
| Waikato | 417 | (73%) |
| Matamata-Piako | 354 | (78%) |
| Hamilton | 1,005 | (77%) |
| Waipa | 402 | (72%) |
| Otorohanga | 93 | (65%) |
| South Waikato | 318 | (75%) |
| Waitomo | 123 | (76%) |
| Taupo | 378 | (74%) |
| Western Bay of Plenty | 378 | (74%) |
| Tauranga | 996 | (78%) |
| Rotorua | 771 | (74%) |
| Whakatane | 450 | (68%) |
| Kawerau | 90 | (75%) |
| Opotiki | 129 | (58%) |
| Gisborne | 648 | (69%) |
| Wairoa | 195 | (74%) |
| Hastings | 828 | (76%) |
| Napier | 714 | (81%) |
| Central Hawkes Bay | 165 | (83%) |
| New Plymouth | 894 | (81%) |
| Stratford | 111 | (80%) |
| South Taranaki | 414 | (76%) |
| Ruapehu | 192 | (65%) |
| Wanganui | 672 | (76%) |
| Rangitikei | 234 | (79%) |
| Manawatu | 297 | (75%) |

| 1991 – 94 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Palmerston North | 753 | (78%) |
| Tararua | 246 | (85%) |
| Horowhenua | 555 | (76%) |
| Kapiti Coast | 579 | (82%) |
| Porirua | 486 | (74%) |
| Upper Hutt | 414 | (83%) |
| Lower Hutt | 1,107 | (82%) |
| Wellington | 1,392 | (80%) |
| Masterton | 288 | (82%) |
| Carterton | 90 | (87%) |
| South Wairarapa | 141 | (83%) |
| Tasman | 396 | (79%) |
| Nelson | 474 | (79%) |
| Marlborough | 411 | (80%) |
| Kaikoura | 54 | (82%) |
| Buller | 198 | (78%) |
| Grey | 186 | (83%) |
| Westland | 114 | (78%) |
| Hurunui | 114 | (81%) |
| Waimakariri | 363 | (75%) |
| Christchurch | 3,747 | (81%) |
| Banks Peninsula | 87 | (75%) |
| Selwyn | 159 | (69%) |
| Ashburton | 300 | (82%) |
| Timaru | 633 | (83%) |
| Mackenzie | 48 | (82%) |
| Waimate | 111 | (87%) |
| Chatham Islands | 12 | (83%) |
| Waitaki | 342 | (77%) |
| Central Otago | 198 | (87%) |
| Queenstown-Lakes | 72 | (78%) |
| Dunedin | 1,356 | (81%) |
| Clutha | 228 | (80%) |
| Southland | 357 | (72%) |
| Gore | 171 | (83%) |
| Invercargill | 765 | (76%) |
| TLA Not Applicable | 54 | (33%) |

**Table 30 1996-1999 . Number of deaths and percentage of mortality records linked to a census record by Territorial Local Authority**

| 1996 – 99 Territorial Local Authority | Actual Deaths | % Linked |
|---|---|---|
| Far North | 828 | (70%) |
| Whangarei | 867 | (75%) |
| Kaipara | 240 | (74%) |
| Rodney | 771 | (78%) |
| North Shore | 1,374 | (80%) |
| Waitakere | 1,431 | (79%) |
| Auckland | 3,291 | (74%) |
| Manukau | 2,394 | (74%) |
| Papakura | 375 | (68%) |
| Franklin | 474 | (76%) |
| Thames Coromandel | 372 | (82%) |
| Hauraki | 225 | (80%) |
| Waikato | 456 | (73%) |
| Matamata-Piako | 333 | (79%) |
| Hamilton | 1,023 | (77%) |
| Waipa | 450 | (72%) |
| Otorohanga | 96 | (64%) |
| South Waikato | 285 | (75%) |
| Waitomo | 135 | (71%) |
| Taupo | 375 | (77%) |
| Western Bay of Plenty | 414 | (73%) |
| Tauranga | 984 | (77%) |
| Rotorua | 825 | (75%) |
| Whakatane | 432 | (70%) |
| Kawerau | 120 | (83%) |
| Opotiki | 168 | (69%) |
| Gisborne | 678 | (76%) |
| Wairoa | 153 | (72%) |
| Hastings | 789 | (76%) |
| Napier | 696 | (78%) |
| Central Hawkes Bay | 132 | (86%) |
| New Plymouth | 669 | (83%) |
| Stratford | 93 | (81%) |
| South Taranaki | 312 | (79%) |
| Ruapehu | 204 | (72%) |
| Wanganui | 654 | (74%) |
| Rangitikei | 216 | (73%) |
| Manawatu | 243 | (75%) |
| Palmerston North | 705 | (80%) |
| Tararua | 216 | (80%) |
| Horowhenua | 525 | (83%) |
| Kapiti Coast | 567 | (83%) |
| Porirua | 504 | (75%) |
| Upper Hutt | 432 | (82%) |
| Lower Hutt | 993 | (81%) |
| Wellington | 1,221 | (81%) |
| Masterton | 288 | (82%) |
| Carterton | 84 | (81%) |
| South Wairarapa | 117 | (78%) |
| Tasman | 405 | (78%) |
| Nelson | 432 | (81%) |
| Marlborough | 465 | (80%) |
| Kaikoura | 51 | (75%) |
| Buller | 153 | (82%) |
| Grey | 174 | (79%) |
| Westland | 120 | (82%) |
| Hurunui | 108 | (79%) |
| Waimakariri | 339 | (81%) |
| Christchurch | 3,300 | (84%) |
| Banks Peninsula | 66 | (85%) |
| Selwyn | 144 | (74%) |
| Ashburton | 321 | (86%) |
| Timaru | 600 | (85%) |
| Mackenzie | 36 | (87%) |
| Waimate | 96 | (87%) |
| Chatham Islands | 12 | (55%) |
| Waitaki | 318 | (80%) |
| Central Otago | 192 | (87%) |
| Queenstown-Lakes | 114 | (83%) |
| Dunedin | 1,317 | (83%) |
| Clutha | 189 | (86%) |
| Southland | 324 | (83%) |
| Gore | 186 | (81%) |
| Invercargill | 714 | (84%) |
| TLA Not Applicable | 111 | (48%) |

**Table 31 1981-1984 Number of deaths and percentage linked by strata of Age-at-Death, sex and ethnicity**

| 1981 – 84 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Death** | **Sex** | **Ethnicity** | | |
| *0 – 14 yrs* | *Males* | Maori | 63 | (65%) |
| | | Pacific People | 12 | (83%) |
| | | NonMaori NonPacific | 447 | (68%) |
| | *Females* | Maori | 48 | (73%) |
| | | Pacific People | 15 | (69%) |
| | | NonMaori NonPacific | 303 | (67%) |
| *15 – 24 yrs* | *Males* | Maori | 156 | (50%) |
| | | Pacific People | 30 | (40%) |
| | | NonMaori NonPacific | 1,188 | (55%) |
| | *Females* | Maori | 78 | (49%) |
| | | Pacific People | 15 | (75%) |
| | | NonMaori NonPacific | 411 | (53%) |
| *25 – 44 yrs* | *Males* | Maori | 291 | (50%) |
| | | Pacific People | 42 | (51%) |
| | | NonMaori NonPacific | 1,875 | (60%) |
| | *Females* | Maori | 201 | (61%) |
| | | Pacific People | 24 | (58%) |
| | | NonMaori NonPacific | 1,092 | (65%) |
| *45 – 64 yrs* | *Males* | Maori | 822 | (54%) |
| | | Pacific People | 81 | (61%) |
| | | NonMaori NonPacific | 8,871 | (74%) |
| | *Females* | Maori | 579 | (58%) |
| | | Pacific People | 45 | (61%) |
| | | NonMaori NonPacific | 5,058 | (75%) |
| *65 – 78 yrs* | *Males* | Maori | 489 | (48%) |
| | | Pacific People | 57 | (60%) |
| | | NonMaori NonPacific | 13,143 | (75%) |
| | *Females* | Maori | 381 | (49%) |
| | | Pacific People | 30 | (57%) |
| | | NonMaori NonPacific | 8,850 | (73%) |

**Table 32 1986-1989 Number of deaths and percentage linked by strata of Age-at-Death, sex and ethnicity**

| 1986 – 89 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Death** | **Sex** | **Ethnicity** | | |
| *0 – 14 yrs* | *Males* | Maori | 60 | (68%) |
| | | Pacific People | 15 | (77%) |
| | | NonMaori NonPacific | 405 | (70%) |
| | *Females* | Maori | 33 | (64%) |
| | | Pacific People | 18 | (75%) |
| | | NonMaori NonPacific | 276 | (74%) |
| *15 – 24 yrs* | *Males* | Maori | 147 | (53%) |
| | | Pacific People | 18 | (50%) |
| | | NonMaori NonPacific | 1,314 | (60%) |
| | *Females* | Maori | 66 | (46%) |
| | | Pacific People | 15 | (79%) |
| | | NonMaori NonPacific | 426 | (57%) |
| *25 – 44 yrs* | *Males* | Maori | 288 | (51%) |
| | | Pacific People | 66 | (69%) |
| | | NonMaori NonPacific | 2,175 | (61%) |
| | *Females* | Maori | 159 | (59%) |
| | | Pacific People | 33 | (73%) |
| | | NonMaori NonPacific | 1,173 | (66%) |
| *45 – 64 yrs* | *Males* | Maori | 780 | (63%) |
| | | Pacific People | 108 | (74%) |
| | | NonMaori NonPacific | 8,382 | (75%) |
| | *Females* | Maori | 582 | (64%) |
| | | Pacific People | 57 | (86%) |
| | | NonMaori NonPacific | 4,869 | (77%) |
| *65 – 78 yrs* | *Males* | Maori | 453 | (58%) |
| | | Pacific People | 69 | (67%) |
| | | NonMaori NonPacific | 12,987 | (78%) |
| | *Females* | Maori | 387 | (57%) |
| | | Pacific People | 45 | (64%) |
| | | NonMaori NonPacific | 9,090 | (76%) |

**Table 33 1991-1994 Number of deaths and percentage linked by strata of Age-at-Death, sex and ethnicity**

| 1991 – 94 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Death** | **Sex** | **Ethnicity** | | |
| *0 – 14 yrs* | *Males* | Maori | 45 | (64%) |
| | | Pacific People | 27 | (61%) |
| | | NonMaori NonPacific | 330 | (71%) |
| | *Females* | Maori | 36 | (58%) |
| | | Pacific People | 15 | (73%) |
| | | NonMaori NonPacific | 240 | (70%) |
| *15 – 24 yrs* | *Males* | Maori | 153 | (49%) |
| | | Pacific People | 30 | (37%) |
| | | NonMaori NonPacific | 1,080 | (55%) |
| | *Females* | Maori | 42 | (67%) |
| | | Pacific People | 12 | (69%) |
| | | NonMaori NonPacific | 375 | (61%) |
| *25 – 44 yrs* | *Males* | Maori | 357 | (52%) |
| | | Pacific People | 75 | (47%) |
| | | NonMaori NonPacific | 2,142 | (62%) |
| | *Females* | Maori | 201 | (61%) |
| | | Pacific People | 36 | (53%) |
| | | NonMaori NonPacific | 1,134 | (73%) |
| *45 – 64 yrs* | *Males* | Maori | 897 | (63%) |
| | | Pacific People | 159 | (68%) |
| | | NonMaori NonPacific | 6,996 | (78%) |
| | *Females* | Maori | 720 | (70%) |
| | | Pacific People | 96 | (58%) |
| | | NonMaori NonPacific | 4,353 | (81%) |
| *65 – 78 yrs* | *Males* | Maori | 582 | (60%) |
| | | Pacific People | 126 | (51%) |
| | | NonMaori NonPacific | 12,225 | (82%) |
| | *Females* | Maori | 438 | (61%) |
| | | Pacific People | 81 | (59%) |
| | | NonMaori NonPacific | 8,313 | (81%) |

**Table 34 1996-1999 Number of deaths and percentage linked by strata of Age-at-Death, sex and Sole Ethnicity**

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Death** | **Sex** | **Sole Ethnicity** | | |
| *0 - 14 yrs* | *Males* | Maori | 111 | (66%) |
| | | Pacific | 21 | (71%) |
| | | Asian | 9 | (50%) |
| | | NonMaori NonPacific NonAsian | 228 | (77%) |
| | *Females* | Maori | 78 | (61%) |
| | | Pacific | 18 | (55%) |
| | | Asian | 6 | (100%) |
| | | NonMaori NonPacific NonAsian | 177 | (76%) |
| *15 - 24 yrs* | *Males* | Maori | 237 | (45%) |
| | | Pacific | 60 | (57%) |
| | | Asian | 24 | (64%) |
| | | NonMaori NonPacific NonAsian | 699 | (58%) |
| | *Females* | Maori | 90 | (51%) |
| | | Pacific | 15 | (80%) |
| | | Asian | 15 | (63%) |
| | | NonMaori NonPacific NonAsian | 270 | (66%) |
| *25 - 44 yrs* | *Males* | Maori | 600 | (47%) |
| | | Pacific | 150 | (60%) |
| | | Asian | 60 | (56%) |
| | | NonMaori NonPacific NonAsian | 1,770 | (62%) |
| | *Females* | Maori | 327 | (64%) |
| | | Pacific | 114 | (67%) |
| | | Asian | 48 | (70%) |
| | | NonMaori NonPacific NonAsian | 909 | (76%) |
| *45 - 64 yrs* | *Males* | Maori | 1,425 | (68%) |
| | | Pacific | 381 | (66%) |
| | | Asian | 132 | (67%) |
| | | NonMaori NonPacific NonAsian | 5,628 | (80%) |
| | *Females* | Maori | 1,038 | (70%) |
| | | Pacific | 243 | (65%) |
| | | Asian | 78 | (76%) |
| | | NonMaori NonPacific NonAsian | 3,735 | (84%) |

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| *65 - 77 yrs* | *Males* | Maori | 921 | (73%) |
| | | Pacific | 309 | (63%) |
| | | Asian | 105 | (65%) |
| | | NonMaori NonPacific NonAsian | 11,151 | (84%) |
| | *Females* | Maori | 819 | (67%) |
| | | Pacific | 225 | (66%) |
| | | Asian | 84 | (67%) |
| | | NonMaori NonPacific NonAsian | 7,209 | (85%) |

**Table 35 1996-1999 Number of deaths and percentage linked by strata of Age-at-Death, sex and prioritized ethnicity**

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| **Age at Death** | **Sex** | **Prioritised Ethnicity** | | |
| *0 – 14 yrs* | *Males* | Maori | 141 | (66%) |
| | | Pacific | 30 | (70%) |
| | | Asian | 12 | (55%) |
| | | NonMaori NonPacific NonAsian | 186 | (79%) |
| | *Females* | Maori | 96 | (66%) |
| | | Pacific | 21 | (52%) |
| | | Asian | 6 | (83%) |
| | | NonMaori NonPacific NonAsian | 153 | (75%) |
| *15 – 24 yrs* | *Males* | Maori | 276 | (46%) |
| | | Pacific | 72 | (56%) |
| | | Asian | 27 | (65%) |
| | | NonMaori NonPacific NonAsian | 645 | (58%) |
| | *Females* | Maori | 111 | (52%) |
| | | Pacific | 21 | (79%) |
| | | Asian | 18 | (67%) |
| | | NonMaori NonPacific NonAsian | 243 | (66%) |
| *25 – 44 yrs* | *Males* | Maori | 642 | (47%) |
| | | Pacific | 162 | (57%) |
| | | Asian | 63 | (57%) |
| | | NonMaori NonPacific NonAsian | 1,710 | (62%) |
| | *Females* | Maori | 354 | (66%) |
| | | Pacific | 129 | (65%) |
| | | Asian | 51 | (69%) |
| | | NonMaori NonPacific NonAsian | 861 | (77%) |
| *45 – 64 yrs* | *Males* | Maori | 1,527 | (68%) |
| | | Pacific | 399 | (66%) |
| | | Asian | 141 | (66%) |
| | | NonMaori NonPacific NonAsian | 5,505 | (80%) |
| | *Females* | Maori | 1,086 | (69%) |
| | | Pacific | 246 | (66%) |
| | | Asian | 81 | (77%) |
| | | NonMaori NonPacific NonAsian | 3,687 | (84%) |

| 1996 - 99 | | | Actual Deaths | % Linked |
|---|---|---|---|---|
| *65 – 77 yrs* | *Males* | Maori | 1,002 | (73%) |
| | | Pacific | 324 | (64%) |
| | | Asian | 111 | (65%) |
| | | NonMaori NonPacific NonAsian | 11,049 | (84%) |
| | *Females* | Maori | 873 | (67%) |
| | | Pacific | 231 | (67%) |
| | | Asian | 93 | (69%) |
| | | NonMaori NonPacific NonAsian | 7,146 | (85%) |

**Table 36 Final Strata used for calculation weights for linkage bias – 1991-94**

## Pacific

*Pacific 0-14 years*

| Causes of Death[1] | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| R | Male | | | | |
| | Female | | | | |
| S | Male | | | | |
| | Female | | | | |

*Pacific 15-24 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| R | Male | | | | |
| | Female | | | | |
| S | Male | | | | |
| | Female | | | | |

*Pacific 25-44 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| R | Male | | | | |
| | Female | | | | |
| G,L,W | Male | | | | |
| | Female | | | | |

*Pacific 45-64 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| R | Male | | | | |
| | Female | | | | |
| G,L,W | Male | | | | |
| | Female | | | | |

*Pacific 65-74 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| G | Male | | | | |
| | Female | | | | |
| L | Male | | | | |
| | Female | | | | |
| ~ | Male | | | | |
| | Female | | | | |

## Maori

*Maori 0-14 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| Q,U,P | Male | | | | |
| | Female | | | | |
| R | Male | | | | |
| | Female | | | | |

*Maori 15-24 years*

| Causes of Death | Sex | Deprivation 1-4 | 5-6 | 7-8 | 9-10 and missing |
|---|---|---|---|---|---|
| R | Male | | | | |
| | Female | | | | |
| Q | Male | | | | |
| | Female | | | | |
| W | Male | | | | |
| | Female | | | | |

[1] Groupings of cause of death code for which the same Age x Sex x Deprivation Strata were used. Refer to key at end of table for interpretation of these codes.

*Maori 25-44 years*

| Causes of Death | Sex | Deprivation | | | |
|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | 9-10 and missing |
| R | Female | | | | |
| M | Male | | | | |
| N | Male | | | | |
| G,L,W | Male | | | | |
| | Female | | | | |

*Maori 45-64 years*

| Causes of Death | Sex | Deprivation | | | |
|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | 9-10 and missing |
| E,B | Male | | | | |
| | Female | | | | |
| H,@,C | Male | | | | |
| | Female | | | | |
| A,R,O,K | Male | | | | |
| | Female | | | | |
| D,F,I,J | Male | | | | |
| | Female | | | | |

*Maori 65-74 years*

| Causes of Death | Sex | Deprivation | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | | 9-10 and missing | |
| G | Male | | | Urban | Rural | Urban | Rural |
| | Female | | | Urban | Rural | Urban | Rural |
| L | Male | | | Urban | Rural | Urban | Rural |
| | Female | | | Urban | Rural | Urban | Rural |
| ~ | Male | | | Urban | Rural | Urban | Rural |
| | Female | | | Urban | Rural | Urban | Rural |

## NonMaori NonPacific

*NonMaori NonPacific 0-14 yrs*

| Causes of Death | Sex | Deprivation | | | |
|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | 9-10 and missing |
| Q,M,P | Male | | | | |
| | Female | | | | |
| N | Male | | | | |
| | Female | | | | |
| U | Male | | | | |
| | Female | | | | |

*NonMaori NonPacific 15-24 yrs*

| Causes of Death | Sex | Deprivation | | | |
|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | 9-10 and missing |
| G,%,$,N,U | Male | | | | |
| | Female | | | | |
| L | Male | | | | |
| | Female | | | | |
| P | Male | | | | |
| | Female | | | | |

*NonMaori NonPacific 25-44 yrs*

| Causes of Death | Sex | Deprivation | | | |
|---|---|---|---|---|---|
| | | 1-4 | 5-6 | 7-8 | 9-10 and missing |
| B | Male | | | | |
| | Female | | | | |
| C,D,F,H,I,J,%,$,P,U | Male | | | | |
| | Female | | | | |
| E | Male | | | | |
| | Female | | | | |
| K | Male | | | | |
| | Female | | | | |

| *NonMaori NonPacific 45-64 yrs* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Causes of Death | Sex | Deprivation | | | | | | | |
| | | 1-4 | | 5-6 | | 7-8 | | 9-10 and missing | |
| C | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | | | | | | | | |
| D,H,Z | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| B,F | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | Urban | Rural | Urban | Rural | Urban | Rural | | |
| E,I,J,K,%,N,Y,A,O | Male | | | | | | | | |
| | Female | | | | | | | | |
| $ | Male | | | | | | | | |
| | Female | | | | | | | | |
| P | Male | | | | | | | | |
| | Female | | | | | | | | |

| *NonMaori NonPacific 65-74 yrs* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Causes of Death | Sex | Deprivation | | | | | | | |
| | | 1-4 | | 5-6 | | 7-8 | | 9-10 and missing | |
| B,C,F,H,J,# | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| D | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | Urban | Rural | Urban | Rural | Urban | Rural | | |
| E,K,R,Y,A,O | Male | | | | | | | | |
| | Female | | | | | | | | |
| I | Male | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural |
| | Female | | | | | | | | |

Note that all the causes of death groupings listed in the cause of death column are stratified separately. The key for these cause of death groupings are as follows.

**Key for cause of death categories**

| | |
|---|---|
| B | Colorectal Cancer |
| C | Lung/Bronchus Cancer |
| D | Breast Cancer |
| E | Prostate Cancer |
| F | Other Cancer |
| G | All Cancer |
| H | Ischaemic Heart Disease |
| I | Other Heart Disease |
| J | Cerebrovascular Disease |
| K | Other Cardiovascular Disease |
| L | Call cardiovascular Disease |
| M | Injury excluding suicide |
| N | Suicide |
| P | perinatal, SIDS, congenital |
| Q | Cancer and Cardiovascular Disease |
| R | Injury and suicide |
| S | all excluding Injury and suicide |
| T | all excluding Injury and suicide, perinatal, congenital & SIDS |
| Z | all excluding Injury and suicide, cancer, cardiovascular, perinatal, congenital, SIDS ,diabetes ,COPD, pneumonia |
| V | all excluding injury, perinatal, congenital & SIDS |
| W | all excluding Injury and suicide, cancer, cardiovascular, |
| X | All cancers excluding lung, breast and prostate |
| Y | Pneumonia/influenza |
| A | COPD |
| O | Diabetes |
| U | all excluding Injury and suicide, cancer, cardiovascular, perinatal, congenital, SIDS |
| % | Road traffic crashes (RTC) |
| ^ | All Injury excluding RTC, violent and suicide |
| ! | Violent |
| + | Injury excluding RTC & violent |
| ~ | All excluding Cancer and Cardiovascular Disease |
| # | all except injury and suicide ,cancer, cardiovascular, diabetes, COPD and pneumonia |
| @ | all except injury and suicide ,cancer, cardiovascular, diabetes, and COPD |
| $ | injury excluding suicide and RTC |

**Table 37: 1981-1984 Linked and total deaths compared to weighted numbers of linked deaths by various sociodemographic variables**

| 1981 - 84 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Age at Census** | | | | | | |
| 0 - 14 yrs | 723 | 1,095 | 1,095 | 1,095 | 1,095 | 1,085 |
| 15 - 24 yrs | 981 | 1,878 | 1,878 | 1,878 | 1,876 | 1,872 |
| 25 - 44 yrs | 2,355 | 3,777 | 3,777 | 3,777 | 3,775 | 3,769 |
| 45 - 64 yrs | 12,489 | 17,247 | 17,247 | 17,247 | 17,247 | 17,246 |
| 65 - 74 yrs | 15,192 | 20,709 | 20,709 | 20,709 | 20,709 | 20,707 |
| **Age at Census (5 yr groups)** | | | | | | |
| 0- 4 yrs | 327 | 492 | 487 | 492 | 492 | 487 |
| 5- 9 yrs | 138 | 216 | 210 | 216 | 216 | 212 |
| 10-14 yrs | 258 | 390 | 401 | 390 | 390 | 389 |
| 15-19 yrs | 567 | 1,029 | 1,083 | 1,029 | 1,028 | 1,026 |
| 20-24 yrs | 414 | 849 | 795 | 849 | 848 | 846 |
| 25-29 yrs | 354 | 684 | 589 | 684 | 684 | 678 |
| 30-34 yrs | 510 | 813 | 826 | 813 | 811 | 812 |
| 35-39 yrs | 588 | 912 | 948 | 912 | 912 | 912 |
| 40-44 yrs | 906 | 1,368 | 1,415 | 1,368 | 1,368 | 1,367 |
| 45-49 yrs | 1,389 | 1,986 | 1,962 | 1,986 | 1,986 | 1,985 |
| 50-54 yrs | 2,316 | 3,249 | 3,231 | 3,249 | 3,249 | 3,249 |
| 55-59 yrs | 3,813 | 5,235 | 5,243 | 5,235 | 5,235 | 5,235 |
| 60-64 yrs | 4,971 | 6,774 | 6,808 | 6,774 | 6,774 | 6,774 |
| 65-69 yrs | 7,104 | 9,606 | 9,723 | 9,606 | 9,606 | 9,604 |
| 70-74 yrs | 8,088 | 11,106 | 10,989 | 11,106 | 11,106 | 11,106 |
| **Sex** | | | | | | |
| Males | 19,590 | 27,573 | 27,574 | 27,573 | 27,571 | 27,563 |
| Females | 12,150 | 17,130 | 17,129 | 17,130 | 17,128 | 17,113 |
| **Ethnicity** | | | | | | |
| Maori | 1,653 | 3,105 | 3,108 | 3,105 | 3,099 | 3,075 |
| Pacific People | 210 | 357 | 354 | 357 | 356 | 356 |
| NonMaoriNonPac | 29,880 | 41,238 | 41,238 | 41,238 | 41,241 | 41,242 |
| **Cause of Death** | | | | | | |
| Cancer | 9,462 | 12,735 | 12,725 | 12,712 | 12,708 | 12,731 |
| Cardiovascular Diseases | 14,388 | 19,701 | 19,712 | 19,699 | 19,704 | 19,699 |
| Injury / Suicide | 2,568 | 4,332 | 4,331 | 4,359 | 4,356 | 4,328 |
| Other Causes | 5,322 | 7,935 | 7,936 | 7,933 | 7,931 | 7,918 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1981 - 84 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Cause of Death - detailed** | | | | | | |
| Communicable Diseases | 291 | 468 | 449 | 446 | 445 | 462 |
| Colorectal Cancer | 1,503 | 1,983 | 1,980 | 1,975 | 1,975 | 1,980 |
| Lung/Bronchus Cancer | 2,094 | 2,838 | 2,830 | 2,827 | 2,823 | 2,838 |
| Breast Cancer | 927 | 1,221 | 1,223 | 1,220 | 1,217 | 1,220 |
| Prostate Cancer | 354 | 474 | 475 | 475 | 475 | 474 |
| Other Cancer | 4,587 | 6,213 | 6,211 | 6,209 | 6,212 | 6,213 |
| Diabetes | 456 | 714 | 719 | 717 | 718 | 714 |
| IHD | 9,894 | 13,251 | 13,237 | 13,224 | 13,227 | 13,250 |
| Other Heart Disease | 1,260 | 1,821 | 1,842 | 1,844 | 1,845 | 1,821 |
| Cerebrovascular Disease | 2,481 | 3,621 | 3,625 | 3,624 | 3,625 | 3,621 |
| Other Cardiovascular Disease | 750 | 1,008 | 1,008 | 1,006 | 1,008 | 1,007 |
| Pnuemonia/Influenza | 480 | 816 | 828 | 830 | 829 | 814 |
| COPD | 1,344 | 1,863 | 1,861 | 1,859 | 1,857 | 1,859 |
| Asthma | 408 | 594 | 620 | 618 | 619 | 593 |
| Other Respiratory | 150 | 213 | 223 | 223 | 223 | 212 |
| Congenital | 153 | 210 | 225 | 226 | 225 | 210 |
| Perinatal | 6 | 9 | 6 | 6 | 7 | 6 |
| SIDS | 45 | 66 | 64 | 65 | 65 | 66 |
| RTC | 1,137 | 1,926 | 1,913 | 1,920 | 1,925 | 1,926 |
| Suicide | 588 | 1,005 | 1,011 | 1,021 | 1,019 | 1,004 |
| Violent | 57 | 117 | 102 | 107 | 103 | 114 |
| Unintentional Injury other than RTC | 789 | 1,284 | 1,304 | 1,311 | 1,309 | 1,284 |
| Other Causes | 1,989 | 2,976 | 2,934 | 2,936 | 2,938 | 2,976 |
| **NZ Deprivation Index (4 groups)** | 18 | 30 | 29 | 29 | 26 | 30 |
| Dep 1-4 | 10,296 | 14,217 | 14,198 | 14,195 | 14,217 | 14,203 |
| Dep 5-6 | 6,534 | 9,147 | 9,126 | 9,122 | 9,147 | 9,125 |
| Dep 7-8 | 7,056 | 10,020 | 10,063 | 10,060 | 10,020 | 10,034 |
| Dep 9-10 | 7,839 | 11,286 | 11,284 | 11,294 | 11,286 | 11,283 |
| Miss Dep | 18 | 30 | 29 | 29 | 26 | 30 |
| **NZ Deprivation Index** | | | | | | |
| Dep 1 | 2,226 | 2,988 | 3,017 | 3,016 | 3,021 | 3,011 |
| Dep 2 | 2,490 | 3,486 | 3,430 | 3,427 | 3,433 | 3,424 |
| Dep 3 | 2,676 | 3,705 | 3,704 | 3,700 | 3,708 | 3,718 |
| Dep 4 | 2,901 | 4,038 | 4,047 | 4,052 | 4,055 | 4,050 |
| Dep 5 | 3,150 | 4,449 | 4,401 | 4,400 | 4,410 | 4,410 |
| Dep 6 | 3,384 | 4,698 | 4,725 | 4,722 | 4,737 | 4,715 |
| Dep 7 | 3,273 | 4,644 | 4,656 | 4,655 | 4,635 | 4,653 |
| Dep 8 | 3,780 | 5,379 | 5,409 | 5,409 | 5,388 | 5,383 |
| Dep 9 | 3,897 | 5,523 | 5,531 | 5,536 | 5,533 | 5,529 |
| Dep10 | 3,945 | 5,766 | 5,757 | 5,761 | 5,756 | 5,758 |
| Miss Dep | 18 | 30 | 29 | 29 | 26 | 30 |
| **Rurality** | | | | | | |
| Urban | 24,972 | 34,275 | 34,586 | 34,592 | 34,587 | 34,566 |
| Minor Urban | 3,630 | 4,956 | 5,105 | 5,105 | 5,104 | 5,103 |
| Rural & Other | 3,141 | 5,472 | 5,012 | 5,007 | 5,008 | 5,008 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1981 - 84 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Regional Health Authority** | | | | | | |
| Northern | 8,826 | 12,819 | 12,416 | 12,415 | 12,413 | 12,398 |
| Midland | 5,991 | 8,847 | 8,716 | 8,718 | 8,711 | 8,718 |
| Central | 8,679 | 11,826 | 12,143 | 12,142 | 12,145 | 12,119 |
| Southern | 8,241 | 11,208 | 11,425 | 11,426 | 11,429 | 11,439 |
| Missing RHA | 6 | 6 | 5 | 5 | 4 | 5 |
| **Territorial Local Authority** | | | | | | |
| Far North | 348 | 606 | 557 | 555 | 555 | 554 |
| Whangarei | 546 | 798 | 794 | 792 | 791 | 786 |
| Kaipara | 126 | 189 | 189 | 189 | 189 | 186 |
| Rodney | 339 | 549 | 482 | 480 | 481 | 480 |
| North Shore | 1,236 | 1,623 | 1,683 | 1,680 | 1,681 | 1,684 |
| Waitakere | 798 | 1,128 | 1,121 | 1,121 | 1,119 | 1,120 |
| Auckland | 3,522 | 5,034 | 4,855 | 4,861 | 4,862 | 4,853 |
| Manukau | 1,425 | 2,091 | 2,038 | 2,035 | 2,036 | 2,031 |
| Papakura | 234 | 336 | 324 | 325 | 324 | 328 |
| Franklin | 252 | 459 | 368 | 370 | 369 | 370 |
| Thames Coromandel | 255 | 360 | 363 | 363 | 363 | 363 |
| Hauraki | 189 | 264 | 274 | 273 | 274 | 273 |
| Waikato | 261 | 438 | 393 | 392 | 391 | 393 |
| Matamata-Piako | 282 | 399 | 414 | 413 | 414 | 415 |
| Hamilton | 759 | 1,086 | 1,072 | 1,073 | 1,072 | 1,073 |
| Waipa | 270 | 453 | 380 | 382 | 381 | 380 |
| Otorohanga | 54 | 93 | 83 | 83 | 83 | 83 |
| South Waikato | 183 | 255 | 272 | 273 | 270 | 272 |
| Waitomo | 99 | 165 | 148 | 148 | 146 | 147 |
| Taupo | 234 | 360 | 354 | 356 | 355 | 353 |
| Western Bay of Plenty | 201 | 360 | 302 | 302 | 301 | 304 |
| Tauranga | 636 | 897 | 878 | 877 | 876 | 876 |
| Rotorua | 489 | 741 | 730 | 730 | 730 | 725 |
| Whakatane | 249 | 399 | 380 | 378 | 380 | 380 |
| Kawerau | 51 | 72 | 80 | 81 | 80 | 80 |
| Opotiki | 81 | 129 | 140 | 141 | 141 | 141 |
| Gisborne | 495 | 696 | 750 | 752 | 750 | 748 |
| Wairoa | 108 | 192 | 169 | 171 | 170 | 171 |
| Hastings | 642 | 891 | 910 | 911 | 911 | 907 |
| Napier | 579 | 789 | 797 | 797 | 797 | 797 |
| Central Hawkes Bay | 135 | 186 | 195 | 194 | 194 | 195 |
| New Plymouth | 669 | 888 | 931 | 932 | 931 | 936 |
| Stratford | 90 | 123 | 129 | 128 | 128 | 130 |
| South Taranaki | 351 | 498 | 504 | 503 | 504 | 508 |
| Ruapehu | 141 | 246 | 211 | 212 | 212 | 210 |
| Wanganui | 519 | 744 | 727 | 728 | 727 | 726 |
| Rangitikei | 183 | 279 | 271 | 272 | 271 | 270 |
| Manawatu | 216 | 294 | 315 | 315 | 315 | 311 |
| Palmerston North | 630 | 834 | 862 | 863 | 863 | 860 |
| Tararua | 228 | 315 | 330 | 329 | 329 | 329 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1981 - 84 | Linked Deaths | Actual Deaths | W_B$^{\phi}$ Adjusted Deaths | W_E$^{\gamma}$ Adjusted Deaths | W_D$^{\eta}$ Adjusted deaths | W_C$^{\iota}$ Adjusted Deaths |
|---|---|---|---|---|---|---|
| Horowhenua | 405 | 555 | 583 | 582 | 582 | 581 |
| Kapiti Coast | 384 | 534 | 523 | 522 | 522 | 522 |
| Porirua | 345 | 489 | 502 | 501 | 502 | 503 |
| Upper Hutt | 285 | 378 | 393 | 393 | 393 | 393 |
| Lower Hutt | 1,101 | 1,389 | 1,512 | 1,511 | 1,513 | 1,512 |
| Wellington | 1,365 | 1,809 | 1,868 | 1,866 | 1,868 | 1,858 |
| Masterton | 252 | 339 | 352 | 351 | 351 | 351 |
| Carterton | 51 | 75 | 76 | 76 | 76 | 76 |
| South Wairarapa | 99 | 135 | 140 | 140 | 141 | 140 |
| Tasman | 288 | 405 | 411 | 411 | 411 | 413 |
| Nelson | 459 | 606 | 628 | 628 | 630 | 627 |
| Marlborough | 366 | 513 | 509 | 509 | 509 | 508 |
| Kaikoura | 48 | 63 | 67 | 67 | 66 | 66 |
| Buller | 147 | 201 | 209 | 209 | 208 | 208 |
| Grey | 198 | 261 | 279 | 279 | 279 | 277 |
| Westland | 102 | 156 | 157 | 156 | 156 | 156 |
| Hurunui | 54 | 87 | 81 | 81 | 81 | 83 |
| Waimakariri | 234 | 318 | 330 | 331 | 332 | 329 |
| Christchurch | 3,081 | 4,158 | 4,196 | 4,199 | 4,197 | 4,211 |
| Banks Peninsula | 75 | 96 | 104 | 105 | 105 | 103 |
| Selwyn | 120 | 192 | 177 | 177 | 176 | 178 |
| Ashburton | 297 | 390 | 422 | 421 | 421 | 422 |
| Timaru | 534 | 735 | 738 | 737 | 739 | 735 |
| Mackenzie | 39 | 60 | 61 | 61 | 62 | 60 |
| Waimate | 90 | 132 | 128 | 128 | 129 | 128 |
| Chatham Islands | 6 | 6 | 8 | 8 | 7 | 8 |
| Waitaki | 288 | 384 | 406 | 405 | 405 | 405 |
| Central Otago | 150 | 210 | 212 | 213 | 213 | 216 |
| Queenstown-Lakes | 51 | 78 | 71 | 70 | 70 | 71 |
| Dunedin | 1,485 | 1,896 | 2,025 | 2,025 | 2,026 | 2,032 |
| Clutha | 216 | 291 | 324 | 323 | 324 | 324 |
| Southland | 255 | 387 | 379 | 380 | 381 | 380 |
| Gore | 153 | 210 | 211 | 212 | 212 | 209 |
| Invercargill | 621 | 912 | 856 | 856 | 855 | 853 |
| TLA Not Applicable | 6 | 6 | 5 | 5 | 4 | 5 |

**Table 38: 1986-1989 Linked and total deaths compared to weighted numbers of linked deaths by various sociodemographic variables**

| 1986 - 89 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Age at Census** | | | | | | |
| 0 - 14 yrs | 726 | 1,020 | 1,020 | 1,020 | 1,018 | 1,018 |
| 15 - 24 yrs | 1,170 | 2,091 | 2,091 | 2,091 | 2,090 | 2,085 |
| 25 - 44 yrs | 2,574 | 4,014 | 4,014 | 4,014 | 4,014 | 4,003 |
| 45 - 64 yrs | 12,591 | 16,758 | 16,758 | 16,758 | 16,754 | 16,758 |
| 65 - 74 yrs | 15,774 | 20,625 | 20,625 | 20,625 | 20,620 | 20,625 |
| **Age at Census (5 yr groups)** | | | | | | |
| 0- 4 yrs | 309 | 441 | 428 | 441 | 441 | 440 |
| 5- 9 yrs | 120 | 171 | 172 | 171 | 171 | 171 |
| 10-14 yrs | 294 | 405 | 417 | 405 | 403 | 404 |
| 15-19 yrs | 648 | 1,062 | 1,144 | 1,062 | 1,062 | 1,059 |
| 20-24 yrs | 525 | 1,029 | 947 | 1,029 | 1,028 | 1,026 |
| 25-29 yrs | 444 | 816 | 737 | 816 | 816 | 813 |
| 30-34 yrs | 513 | 861 | 825 | 861 | 861 | 856 |
| 35-39 yrs | 717 | 1,044 | 1,096 | 1,044 | 1,044 | 1,041 |
| 40-44 yrs | 903 | 1,293 | 1,357 | 1,293 | 1,293 | 1,293 |
| 45-49 yrs | 1,419 | 1,968 | 1,923 | 1,968 | 1,968 | 1,968 |
| 50-54 yrs | 2,160 | 2,952 | 2,887 | 2,952 | 2,952 | 2,952 |
| 55-59 yrs | 3,546 | 4,758 | 4,709 | 4,758 | 4,755 | 4,758 |
| 60-64 yrs | 5,469 | 7,080 | 7,239 | 7,080 | 7,079 | 7,080 |
| 65-69 yrs | 6,816 | 8,841 | 8,924 | 8,841 | 8,840 | 8,841 |
| 70-74 yrs | 8,958 | 11,784 | 11,701 | 11,784 | 11,780 | 11,784 |
| **Sex** | | | | | | |
| Males | 20,082 | 27,279 | 27,279 | 27,279 | 27,276 | 27,274 |
| Females | 12,756 | 17,229 | 17,229 | 17,229 | 17,220 | 17,215 |
| **Ethnicity** | | | | | | |
| Maori | 1,755 | 2,955 | 2,955 | 2,955 | 2,961 | 2,960 |
| Pacific People | 318 | 447 | 447 | 447 | 450 | 448 |
| NonMaoriNonPacNonAs | 30,762 | 41,106 | 41,106 | 41,106 | 41,085 | 41,082 |
| **Cause of Death** | | | | | | |
| Cancer | 10,494 | 13,464 | 13,464 | 13,439 | 13,440 | 13,461 |
| Cardiovascular | 13,572 | 18,033 | 18,032 | 18,012 | 18,012 | 18,032 |
| Injury and Suicide | 2,994 | 4,920 | 4,919 | 4,955 | 4,946 | 4,920 |
| Other | 5,775 | 8,088 | 8,090 | 8,099 | 8,096 | 8,073 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1986 – 89 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Cause of Death – detailed** | | | | | | |
| Communicable Diseases | 288 | 432 | 411 | 413 | 413 | 430 |
| Colorectal Cancer | 1,677 | 2,076 | 2,076 | 2,075 | 2,074 | 2,076 |
| Lung/Bronchus Cancer | 2,256 | 2,982 | 2,995 | 2,985 | 2,986 | 2,980 |
| Breast Cancer | 1,056 | 1,341 | 1,343 | 1,340 | 1,339 | 1,341 |
| Prostate Cancer | 453 | 558 | 556 | 554 | 554 | 557 |
| Other Cancer | 5,052 | 6,501 | 6,488 | 6,479 | 6,481 | 6,501 |
| Diabetes | 549 | 774 | 779 | 779 | 780 | 772 |
| IHD | 9,438 | 12,294 | 12,309 | 12,291 | 12,291 | 12,294 |
| Other Heart Disease | 1,170 | 1,674 | 1,667 | 1,667 | 1,666 | 1,674 |
| Cerebrovascular Disease | 2,175 | 3,009 | 2,999 | 2,999 | 3,000 | 3,009 |
| Other Cardiovascular Disease | 789 | 1,062 | 1,063 | 1,061 | 1,061 | 1,061 |
| Pnuemonia/Influenza | 525 | 789 | 780 | 781 | 783 | 785 |
| COPD | 1,428 | 1,878 | 1,890 | 1,886 | 1,886 | 1,877 |
| Asthma | 393 | 537 | 570 | 572 | 569 | 537 |
| Other Respiratory | 162 | 237 | 229 | 228 | 229 | 232 |
| Congenital | 177 | 240 | 239 | 241 | 241 | 240 |
| Perinatal | 9 | 18 | 14 | 14 | 14 | 17 |
| SIDS | 36 | 45 | 49 | 51 | 52 | 45 |
| RTC | 1,332 | 2,187 | 2,205 | 2,213 | 2,212 | 2,187 |
| Suicide | 840 | 1,392 | 1,397 | 1,417 | 1,410 | 1,392 |
| Violent | 93 | 180 | 162 | 167 | 163 | 180 |
| Unintentional Injury other than RTC | 729 | 1,158 | 1,151 | 1,155 | 1,157 | 1,158 |
| Other Causes | 2,208 | 3,129 | 3,120 | 3,125 | 3,121 | 3,129 |
| **NZ Deprivation Index (4 groups)** | | | | | | |
| Dep 1-4 | 10,857 | 14,193 | 14,186 | 14,173 | 14,193 | 14,172 |
| Dep 5-6 | 6,627 | 8,919 | 8,926 | 8,929 | 8,919 | 8,930 |
| Dep 7-8 | 7,497 | 10,113 | 10,107 | 10,111 | 10,113 | 10,108 |
| Dep 9-10 | 7,839 | 11,244 | 11,259 | 11,265 | 11,244 | 11,251 |
| Miss Dep | 15 | 39 | 29 | 29 | 27 | 29 |
| **NZ Deprivation Index** | | | | | | |
| Dep 1 | 2,298 | 2,973 | 2,968 | 2,966 | 2,968 | 2,961 |
| Dep 2 | 2,667 | 3,471 | 3,489 | 3,486 | 3,494 | 3,482 |
| Dep 3 | 2,826 | 3,690 | 3,693 | 3,690 | 3,691 | 3,695 |
| Dep 4 | 3,069 | 4,056 | 4,033 | 4,029 | 4,037 | 4,031 |
| Dep 5 | 3,198 | 4,335 | 4,312 | 4,313 | 4,311 | 4,311 |
| Dep 6 | 3,432 | 4,584 | 4,613 | 4,616 | 4,608 | 4,619 |
| Dep 7 | 3,642 | 4,866 | 4,896 | 4,898 | 4,902 | 4,895 |
| Dep 8 | 3,855 | 5,244 | 5,208 | 5,210 | 5,208 | 5,210 |
| Dep 9 | 3,852 | 5,394 | 5,484 | 5,485 | 5,471 | 5,482 |
| Dep10 | 3,984 | 5,853 | 5,778 | 5,783 | 5,776 | 5,771 |
| Miss Dep | 15 | 39 | 29 | 29 | 27 | 29 |
| **Rurality** | | | | | | |
| Urban | 25,635 | 34,266 | 34,343 | 34,342 | 34,331 | 34,334 |
| Minor Urban | 3,747 | 4,989 | 5,135 | 5,135 | 5,135 | 5,133 |
| Rural & Other | 3,456 | 5,250 | 5,027 | 5,028 | 5,027 | 5,020 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1986 – 89 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Regional Health Authority** | | | | | | |
| Northern | 9,537 | 13,242 | 12,893 | 12,895 | 12,895 | 12,908 |
| Midland | 6,318 | 8,826 | 8,777 | 8,776 | 8,770 | 8,777 |
| Central | 8,739 | 11,637 | 11,824 | 11,821 | 11,817 | 11,810 |
| Southern | 8,238 | 10,800 | 11,013 | 11,015 | 11,013 | 10,992 |
| Missing RHA | 6 | 6 | 3 | 3 | 3 | 3 |
| **Territorial Local Authority** | | | | | | |
| Far North | 417 | 693 | 616 | 614 | 617 | 616 |
| Whangarei | 585 | 825 | 814 | 814 | 815 | 810 |
| Kaipara | 153 | 210 | 215 | 215 | 214 | 213 |
| Rodney | 453 | 645 | 611 | 609 | 607 | 608 |
| North Shore | 1,266 | 1,602 | 1,637 | 1,638 | 1,639 | 1,638 |
| Waitakere | 945 | 1,284 | 1,269 | 1,270 | 1,266 | 1,272 |
| Auckland | 3,492 | 4,794 | 4,663 | 4,668 | 4,666 | 4,675 |
| Manukau | 1,689 | 2,388 | 2,326 | 2,327 | 2,327 | 2,331 |
| Papakura | 243 | 363 | 331 | 331 | 331 | 335 |
| Franklin | 294 | 435 | 409 | 408 | 409 | 408 |
| Thames Coromandel | 243 | 345 | 331 | 331 | 332 | 335 |
| Hauraki | 165 | 216 | 229 | 229 | 229 | 227 |
| Waikato | 288 | 429 | 407 | 409 | 406 | 409 |
| Matamata-Piako | 258 | 345 | 353 | 352 | 351 | 352 |
| Hamilton | 792 | 1,074 | 1,071 | 1,067 | 1,068 | 1,072 |
| Waipa | 315 | 456 | 433 | 433 | 434 | 436 |
| Otorohanga | 63 | 96 | 94 | 94 | 95 | 95 |
| South Waikato | 198 | 294 | 291 | 293 | 291 | 290 |
| Waitomo | 87 | 123 | 128 | 128 | 129 | 127 |
| Taupo | 249 | 360 | 362 | 361 | 361 | 362 |
| Western Bay of Plenty | 279 | 423 | 388 | 388 | 387 | 388 |
| Tauranga | 675 | 939 | 901 | 899 | 900 | 902 |
| Rotorua | 516 | 801 | 731 | 731 | 729 | 731 |
| Whakatane | 327 | 447 | 462 | 464 | 464 | 461 |
| Kawerau | 66 | 84 | 96 | 96 | 97 | 96 |
| Opotiki | 90 | 141 | 138 | 138 | 138 | 138 |
| Gisborne | 462 | 657 | 660 | 660 | 659 | 658 |
| Wairoa | 90 | 156 | 133 | 134 | 134 | 134 |
| Hastings | 663 | 906 | 910 | 911 | 908 | 909 |
| Napier | 606 | 783 | 813 | 812 | 810 | 812 |
| Central Hawkes Bay | 162 | 204 | 229 | 232 | 232 | 234 |
| New Plymouth | 702 | 879 | 945 | 946 | 943 | 948 |
| Stratford | 93 | 114 | 124 | 123 | 123 | 123 |
| South Taranaki | 333 | 432 | 464 | 463 | 464 | 460 |
| Ruapehu | 159 | 237 | 231 | 232 | 231 | 231 |
| Wanganui | 504 | 702 | 682 | 682 | 682 | 680 |
| Rangitikei | 180 | 264 | 250 | 251 | 252 | 249 |
| Manawatu | 246 | 336 | 338 | 338 | 337 | 337 |
| Palmerston North | 687 | 885 | 920 | 920 | 920 | 922 |
| Tararua | 231 | 306 | 315 | 314 | 313 | 314 |
| Horowhenua | 432 | 579 | 601 | 602 | 602 | 599 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1986 – 89 | Linked Deaths | Actual Deaths | W_B$^{\phi}$ Adjusted Deaths | W_E$^{\gamma}$ Adjusted Deaths | W_D$^{\eta}$ Adjusted deaths | W_C$^{\iota}$ Adjusted Deaths |
|---|---|---|---|---|---|---|
| Kapiti Coast | 423 | 561 | 562 | 561 | 559 | 559 |
| Porirua | 333 | 474 | 472 | 471 | 474 | 467 |
| Upper Hutt | 312 | 414 | 418 | 417 | 417 | 414 |
| Lower Hutt | 1,059 | 1,353 | 1,428 | 1,424 | 1,425 | 1,432 |
| Wellington | 1,239 | 1,656 | 1,642 | 1,644 | 1,644 | 1,642 |
| Masterton | 267 | 348 | 365 | 365 | 366 | 362 |
| Carterton | 66 | 87 | 91 | 90 | 89 | 90 |
| South Wairarapa | 126 | 165 | 174 | 173 | 173 | 173 |
| Tasman | 297 | 393 | 398 | 397 | 397 | 398 |
| Nelson | 420 | 534 | 555 | 555 | 556 | 555 |
| Marlborough | 351 | 468 | 468 | 469 | 468 | 467 |
| Kaikoura | 45 | 54 | 59 | 59 | 59 | 59 |
| Buller | 156 | 195 | 223 | 223 | 223 | 222 |
| Grey | 180 | 231 | 244 | 244 | 245 | 243 |
| Westland | 111 | 144 | 152 | 153 | 153 | 153 |
| Hurunui | 87 | 114 | 119 | 119 | 119 | 118 |
| Waimakariri | 240 | 330 | 325 | 324 | 325 | 324 |
| Christchurch | 3,129 | 4,068 | 4,131 | 4,132 | 4,130 | 4,133 |
| Banks Peninsula | 63 | 81 | 83 | 84 | 84 | 84 |
| Selwyn | 135 | 183 | 184 | 184 | 184 | 185 |
| Ashburton | 234 | 297 | 311 | 312 | 313 | 312 |
| Timaru | 588 | 720 | 773 | 772 | 772 | 769 |
| Mackenzie | 21 | 36 | 35 | 35 | 35 | 35 |
| Waimate | 99 | 135 | 135 | 135 | 134 | 136 |
| Chatham Islands | 6 | 6 | 6 | 6 | 5 | 6 |
| Waitaki | 294 | 375 | 396 | 396 | 397 | 396 |
| Central Otago | 156 | 195 | 214 | 214 | 214 | 212 |
| Queenstown-Lakes | 63 | 96 | 88 | 88 | 88 | 87 |
| Dunedin | 1,395 | 1,818 | 1,852 | 1,850 | 1,847 | 1,840 |
| Clutha | 198 | 267 | 273 | 272 | 274 | 271 |
| Southland | 288 | 423 | 400 | 400 | 398 | 398 |
| Gore | 171 | 228 | 231 | 233 | 232 | 232 |
| Invercargill | 582 | 798 | 773 | 774 | 775 | 770 |
| Missing TLA | 6 | 6 | 3 | 3 | 3 | 3 |

**Table 39 1991-1994 Linked and total deaths compared to weighted numbers of linked deaths by various sociodemographic variables**

| 1991 - 94 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Age at Census** | | | | | | |
| 0 - 14 yrs | 573 | 831 | 831 | 831 | 829 | 827 |
| 15 - 24 yrs | 951 | 1,764 | 1,764 | 1,764 | 1,764 | 1,758 |
| 25 - 44 yrs | 2,736 | 4,209 | 4,209 | 4,205 | 4,206 | 4,198 |
| 45 - 64 yrs | 11,583 | 14,919 | 14,919 | 14,919 | 14,918 | 14,919 |
| 65 - 74 yrs | 15,792 | 19,587 | 19,587 | 19,587 | 19,584 | 19,586 |
| **Age at Census (5 yr groups)** | | | | | | |
| 0- 4 yrs | 264 | 384 | 380 | 384 | 383 | 383 |
| 5- 9 yrs | 120 | 162 | 166 | 162 | 161 | 161 |
| 10-14 yrs | 192 | 282 | 282 | 282 | 282 | 280 |
| 15-19 yrs | 525 | 900 | 974 | 900 | 900 | 898 |
| 20-24 yrs | 423 | 864 | 790 | 864 | 864 | 860 |
| 25-29 yrs | 417 | 804 | 675 | 804 | 804 | 797 |
| 30-34 yrs | 519 | 861 | 812 | 857 | 859 | 859 |
| 35-39 yrs | 744 | 1,080 | 1,149 | 1,080 | 1,079 | 1,080 |
| 40-44 yrs | 1,062 | 1,461 | 1,569 | 1,461 | 1,461 | 1,459 |
| 45-49 yrs | 1,413 | 1,881 | 1,845 | 1,881 | 1,881 | 1,881 |
| 50-54 yrs | 2,103 | 2,787 | 2,717 | 2,787 | 2,787 | 2,787 |
| 55-59 yrs | 3,045 | 3,927 | 3,940 | 3,927 | 3,926 | 3,927 |
| 60-64 yrs | 5,025 | 6,327 | 6,420 | 6,327 | 6,327 | 6,327 |
| 65-69 yrs | 7,200 | 8,889 | 8,947 | 8,889 | 8,886 | 8,888 |
| 70-74 yrs | 8,589 | 10,698 | 10,640 | 10,698 | 10,698 | 10,698 |
| **Sex** | | | | | | |
| Males | 19,101 | 25,221 | 25,221 | 25,221 | 25,218 | 25,204 |
| Females | 12,534 | 16,086 | 16,086 | 16,082 | 16,080 | 16,081 |
| **Ethnicity** | | | | | | |
| Maori | 2,148 | 3,474 | 3,474 | 3,474 | 3,474 | 3,481 |
| Pacific People | 378 | 657 | 657 | 653 | 654 | 653 |
| NonMaoriNonPac | 29,112 | 37,182 | 37,182 | 37,182 | 37,176 | 37,157 |
| **Cause of Death** | | | | | | |
| Cancer | 11,301 | 13,959 | 13,954 | 13,926 | 13,932 | 13,954 |
| Cardiovascular Diseases | 12,111 | 15,447 | 15,444 | 15,409 | 15,411 | 15,443 |
| Injury / Suicide | 2,667 | 4,377 | 4,380 | 4,442 | 4,435 | 4,376 |
| Other Causes | 5,553 | 7,524 | 7,529 | 7,526 | 7,519 | 7,512 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1991 - 94 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Cause of Death - detailed** | | | | | | |
| Communicable Diseases | 369 | 546 | 541 | 540 | 540 | 546 |
| Colorectal Cancer | 1,797 | 2,130 | 2,135 | 2,131 | 2,132 | 2,126 |
| Lung/Bronchus Cancer | 2,322 | 2,943 | 2,942 | 2,939 | 2,937 | 2,943 |
| Breast Cancer | 1,086 | 1,317 | 1,318 | 1,310 | 1,314 | 1,316 |
| Prostate Cancer | 537 | 645 | 640 | 638 | 638 | 645 |
| Other Cancer | 5,559 | 6,930 | 6,925 | 6,913 | 6,917 | 6,930 |
| Diabetes | 609 | 822 | 839 | 835 | 835 | 819 |
| IHD | 8,043 | 10,068 | 10,072 | 10,053 | 10,054 | 10,066 |
| Other Heart Disease | 1,230 | 1,620 | 1,635 | 1,631 | 1,629 | 1,620 |
| Cerebrovascular Disease | 2,046 | 2,736 | 2,723 | 2,714 | 2,716 | 2,735 |
| Other Cardiovascular Disease | 792 | 1,026 | 1,018 | 1,014 | 1,015 | 1,025 |
| Pnuemonia/Influenza | 312 | 474 | 477 | 478 | 477 | 474 |
| COPD | 1,443 | 1,800 | 1,794 | 1,792 | 1,789 | 1,798 |
| Asthma | 180 | 234 | 253 | 254 | 252 | 229 |
| Other Respiratory | 216 | 294 | 299 | 301 | 299 | 292 |
| Congenital | 135 | 207 | 201 | 202 | 203 | 207 |
| Perinatal | 6 | 9 | 6 | 5 | 6 | 9 |
| SIDS | 45 | 60 | 65 | 65 | 65 | 60 |
| RTC | 1,041 | 1,749 | 1,748 | 1,763 | 1,766 | 1,749 |
| Suicide | 870 | 1,434 | 1,452 | 1,484 | 1,481 | 1,434 |
| Violent | 99 | 186 | 155 | 159 | 159 | 185 |
| Unintentional Injury other than RTC | 663 | 1,005 | 1,023 | 1,033 | 1,027 | 1,005 |
| Other Causes | 2,241 | 3,078 | 3,055 | 3,054 | 3,053 | 3,078 |
| **NZ Deprivation Index (4 groups)** | | | | | | |
| Dep 1-4 | 10,890 | 13,689 | 13,664 | 13,655 | 13,689 | 13,652 |
| Dep 5-6 | 6,255 | 8,019 | 8,025 | 8,023 | 8,019 | 8,013 |
| Dep 7-8 | 6,951 | 9,165 | 9,183 | 9,187 | 9,165 | 9,187 |
| Dep 9-10 | 7,497 | 10,350 | 10,374 | 10,375 | 10,350 | 10,370 |
| Miss Dep | 42 | 87 | 64 | 65 | 78 | 65 |
| **NZ Deprivation Index** | | | | | | |
| Dep 1 | 2,505 | 3,069 | 3,099 | 3,100 | 3,106 | 3,098 |
| Dep 2 | 2,610 | 3,291 | 3,274 | 3,271 | 3,280 | 3,271 |
| Dep 3 | 2,871 | 3,606 | 3,615 | 3,612 | 3,620 | 3,607 |
| Dep 4 | 2,901 | 3,723 | 3,675 | 3,673 | 3,683 | 3,676 |
| Dep 5 | 3,102 | 3,978 | 3,988 | 3,983 | 3,984 | 3,983 |
| Dep 6 | 3,153 | 4,041 | 4,038 | 4,040 | 4,035 | 4,030 |
| Dep 7 | 3,429 | 4,545 | 4,518 | 4,518 | 4,507 | 4,518 |
| Dep 8 | 3,519 | 4,623 | 4,668 | 4,672 | 4,661 | 4,672 |
| Dep 9 | 3,753 | 4,995 | 5,134 | 5,135 | 5,127 | 5,140 |
| Dep10 | 3,747 | 5,355 | 5,239 | 5,240 | 5,223 | 5,230 |
| Miss Dep | 42 | 87 | 64 | 65 | 78 | 65 |
| **Rurality** | | | | | | |
| Urban | 24,159 | 31,122 | 31,176 | 31,175 | 31,164 | 31,165 |
| Minor Urban | 3,921 | 4,977 | 5,124 | 5,122 | 5,117 | 5,124 |
| Rural & Other | 3,555 | 5,211 | 5,009 | 5,008 | 5,020 | 4,999 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1991 - 94 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Regional Health Authority** | | | | | | |
| Northern | 9,078 | 12,378 | 11,932 | 11,936 | 11,929 | 11,930 |
| Midland | 6,561 | 8,766 | 8,750 | 8,749 | 8,747 | 8,738 |
| Central | 8,283 | 10,494 | 10,743 | 10,742 | 10,743 | 10,735 |
| Southern | 7,695 | 9,618 | 9,859 | 9,853 | 9,850 | 9,858 |
| Missing RHA | 18 | 57 | 28 | 28 | 33 | 28 |
| **Territorial Local Authority** | | | | | | |
| Far North | 459 | 714 | 656 | 656 | 656 | 655 |
| Whangarei | 603 | 819 | 806 | 808 | 804 | 806 |
| Kaipara | 159 | 222 | 220 | 220 | 219 | 221 |
| Rodney | 540 | 711 | 690 | 688 | 691 | 687 |
| North Shore | 1,218 | 1,497 | 1,521 | 1,520 | 1,522 | 1,520 |
| Waitakere | 999 | 1,335 | 1,292 | 1,296 | 1,294 | 1,292 |
| Auckland | 2,790 | 3,819 | 3,645 | 3,643 | 3,646 | 3,645 |
| Manukau | 1,704 | 2,394 | 2,294 | 2,297 | 2,292 | 2,294 |
| Papakura | 285 | 408 | 373 | 371 | 371 | 372 |
| Franklin | 312 | 450 | 427 | 427 | 427 | 431 |
| Thames Coromandel | 306 | 405 | 400 | 400 | 400 | 400 |
| Hauraki | 186 | 249 | 250 | 252 | 251 | 251 |
| Waikato | 303 | 414 | 417 | 417 | 416 | 416 |
| Matamata-Piako | 273 | 354 | 365 | 365 | 365 | 363 |
| Hamilton | 780 | 1,005 | 1,015 | 1,015 | 1,017 | 1,015 |
| Waipa | 288 | 402 | 376 | 377 | 378 | 377 |
| Otorohanga | 60 | 90 | 82 | 82 | 82 | 81 |
| South Waikato | 237 | 318 | 328 | 327 | 325 | 325 |
| Waitomo | 93 | 123 | 130 | 129 | 130 | 128 |
| Taupo | 279 | 375 | 377 | 377 | 378 | 378 |
| Western Bay of Plenty | 279 | 381 | 375 | 374 | 375 | 372 |
| Tauranga | 774 | 996 | 990 | 991 | 991 | 988 |
| Rotorua | 573 | 771 | 782 | 782 | 780 | 779 |
| Whakatane | 306 | 450 | 428 | 428 | 427 | 428 |
| Kawerau | 66 | 93 | 103 | 101 | 102 | 103 |
| Opotiki | 75 | 132 | 109 | 108 | 108 | 109 |
| Gisborne | 447 | 648 | 615 | 616 | 614 | 618 |
| Wairoa | 147 | 198 | 209 | 209 | 209 | 209 |
| Hastings | 633 | 828 | 834 | 832 | 832 | 832 |
| Napier | 576 | 714 | 739 | 738 | 736 | 737 |
| Central Hawkes Bay | 138 | 165 | 185 | 185 | 186 | 185 |
| New Plymouth | 720 | 894 | 926 | 927 | 928 | 927 |
| Stratford | 90 | 114 | 120 | 120 | 121 | 120 |
| South Taranaki | 315 | 411 | 420 | 419 | 421 | 418 |
| Ruapehu | 126 | 192 | 180 | 180 | 178 | 180 |
| Wanganui | 510 | 672 | 660 | 662 | 660 | 663 |
| Rangitikei | 186 | 234 | 244 | 243 | 244 | 244 |
| Manawatu | 225 | 297 | 299 | 298 | 299 | 299 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1991 - 94 | Linked Deaths | Actual Deaths | W_B$^{\phi}$ Adjusted Deaths | W_E$^{\gamma}$ Adjusted Deaths | W_D$^{\eta}$ Adjusted deaths | W_C$^{\iota}$ Adjusted Deaths |
|---|---|---|---|---|---|---|
| Palmerston North | 585 | 756 | 754 | 755 | 755 | 754 |
| Tararua | 207 | 243 | 272 | 272 | 273 | 272 |
| Horowhenua | 420 | 555 | 544 | 544 | 543 | 538 |
| Kapiti Coast | 474 | 579 | 589 | 588 | 587 | 591 |
| Porirua | 357 | 486 | 487 | 486 | 486 | 485 |
| Upper Hutt | 345 | 414 | 441 | 440 | 441 | 442 |
| Lower Hutt | 906 | 1,107 | 1,173 | 1,174 | 1,173 | 1,174 |
| Wellington | 1,110 | 1,395 | 1,407 | 1,410 | 1,413 | 1,410 |
| Masterton | 234 | 288 | 310 | 310 | 309 | 309 |
| Carterton | 78 | 90 | 101 | 101 | 100 | 99 |
| South Wairarapa | 117 | 141 | 156 | 156 | 156 | 155 |
| Tasman | 312 | 396 | 400 | 400 | 401 | 399 |
| Nelson | 372 | 474 | 474 | 476 | 476 | 477 |
| Marlborough | 327 | 408 | 424 | 421 | 421 | 420 |
| Kaikoura | 45 | 54 | 57 | 57 | 57 | 56 |
| Buller | 153 | 195 | 203 | 204 | 203 | 202 |
| Grey | 156 | 186 | 201 | 201 | 199 | 200 |
| Westland | 90 | 117 | 120 | 120 | 120 | 121 |
| Hurunui | 93 | 114 | 127 | 128 | 127 | 128 |
| Waimakariri | 273 | 360 | 346 | 347 | 347 | 345 |
| Christchurch | 3,039 | 3,747 | 3,858 | 3,854 | 3,852 | 3,856 |
| Banks Peninsula | 66 | 87 | 90 | 90 | 91 | 89 |
| Selwyn | 111 | 159 | 145 | 144 | 145 | 143 |
| Ashburton | 246 | 300 | 316 | 316 | 316 | 314 |
| Timaru | 528 | 633 | 668 | 667 | 667 | 668 |
| Mackenzie | 39 | 48 | 53 | 53 | 53 | 52 |
| Waimate | 96 | 108 | 120 | 119 | 119 | 119 |
| Chatham Islands | 9 | 12 | 16 | 16 | 19 | 17 |
| Waitaki | 264 | 342 | 333 | 333 | 333 | 332 |
| Central Otago | 171 | 198 | 223 | 223 | 223 | 226 |
| Queenstown-Lakes | 57 | 72 | 72 | 72 | 72 | 72 |
| Dunedin | 1,104 | 1,356 | 1,408 | 1,409 | 1,405 | 1,411 |
| Clutha | 183 | 231 | 239 | 239 | 239 | 242 |
| Southland | 258 | 357 | 343 | 343 | 345 | 342 |
| Gore | 141 | 174 | 178 | 178 | 178 | 178 |
| Invercargill | 579 | 765 | 740 | 737 | 737 | 742 |
| TLA not applicable | 18 | 57 | 28 | 28 | 33 | 28 |

**Table 40 1996-1999 Linked and total deaths compared to weighted numbers of linked deaths by various sociodemographic variables**

| 1996 - 99 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Age at Census** | | | | | | |
| 0 - 14 yrs | 561 | 810 | 810 | 809 | 807 | 807 |
| 15 - 24 yrs | 822 | 1,482 | 1,482 | 1,482 | 1,482 | 1,476 |
| 25 - 44 yrs | 2,721 | 4,209 | 4,209 | 4,207 | 4,207 | 4,204 |
| 45 - 64 yrs | 11,052 | 14,031 | 14,031 | 14,031 | 14,031 | 14,029 |
| 65 - 74 yrs | 15,732 | 18,993 | 18,993 | 18,993 | 18,993 | 18,993 |
| **Age at Census (5 yr groups)** | | | | | | |
| 0- 4 yrs | 249 | 348 | 357 | 347 | 347 | 347 |
| 5- 9 yrs | 108 | 141 | 154 | 141 | 140 | 141 |
| 10-14 yrs | 204 | 318 | 296 | 318 | 317 | 316 |
| 15-19 yrs | 438 | 741 | 790 | 741 | 741 | 739 |
| 20-24 yrs | 387 | 738 | 689 | 738 | 738 | 734 |
| 25-29 yrs | 402 | 780 | 667 | 778 | 780 | 778 |
| 30-34 yrs | 567 | 930 | 899 | 930 | 928 | 930 |
| 35-39 yrs | 786 | 1,137 | 1,209 | 1,137 | 1,137 | 1,136 |
| 40-44 yrs | 966 | 1,365 | 1,437 | 1,365 | 1,365 | 1,363 |
| 45-49 yrs | 1,593 | 2,100 | 2,051 | 2,100 | 2,100 | 2,099 |
| 50-54 yrs | 2,079 | 2,703 | 2,658 | 2,703 | 2,703 | 2,703 |
| 55-59 yrs | 3,042 | 3,876 | 3,857 | 3,876 | 3,876 | 3,875 |
| 60-64 yrs | 4,335 | 5,346 | 5,459 | 5,346 | 5,346 | 5,346 |
| 65-69 yrs | 6,837 | 8,238 | 8,315 | 8,238 | 8,238 | 8,238 |
| 70-74 yrs | 8,895 | 10,758 | 10,681 | 10,758 | 10,758 | 10,758 |
| **Sex** | | | | | | |
| Males | 18,471 | 24,021 | 24,021 | 24,021 | 24,017 | 24,015 |
| Females | 12,414 | 15,504 | 15,504 | 15,501 | 15,503 | 15,494 |
| **Sole Ethnicity** | | | | | | |
| Maori | 3,675 | 5,643 | 5,616 | 5,618 | 5,616 | 5,595 |
| Pacific People | 990 | 1,539 | 1,540 | 1,540 | 1,544 | 1,536 |
| Asian | 375 | 561 | 558 | 556 | 555 | 557 |
| NonMaori NonPacific NonAsian | 25,851 | 31,782 | 31,811 | 31,809 | 31,805 | 31,820 |
| **Prioritised Ethnicity** | | | | | | |
| Maori | 3,981 | 6,108 | 6,108 | 6,108 | 6,103 | 6,085 |
| Pacific People | 1,053 | 1,635 | 1,635 | 1,635 | 1,640 | 1,632 |
| Asian | 396 | 597 | 597 | 594 | 595 | 594 |
| NonMaori NonPacific NonAsian | 25,458 | 31,188 | 31,188 | 31,188 | 31,185 | 31,200 |
| **Cause of Death** | | | | | | |
| Cancer | 11,910 | 14,499 | 14,499 | 14,478 | 14,472 | 14,496 |
| Cardiovascular Diseases | 10,275 | 12,888 | 12,881 | 12,857 | 12,860 | 12,887 |
| Injury / Suicide | 2,544 | 4,200 | 4,200 | 4,252 | 4,256 | 4,197 |
| Other Causes | 6,162 | 7,938 | 7,945 | 7,935 | 7,932 | 7,929 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1996 - 99 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Cause of Death – detailed** | | | | | | |
| Communicable Diseases | 291 | 408 | 386 | 386 | 385 | 408 |
| Colorectal Cancer | 1,800 | 2,154 | 2,151 | 2,148 | 2,146 | 2,153 |
| Lung/Bronchus Cancer | 2,448 | 3,027 | 3,025 | 3,015 | 3,015 | 3,026 |
| Breast Cancer | 1,152 | 1,374 | 1,380 | 1,378 | 1,375 | 1,374 |
| Prostate Cancer | 552 | 660 | 659 | 658 | 657 | 659 |
| Other Cancer | 5,955 | 7,284 | 7,284 | 7,278 | 7,278 | 7,284 |
| Diabetes | 846 | 1,110 | 1,120 | 1,118 | 1,121 | 1,109 |
| IHD | 6,573 | 8,151 | 8,162 | 8,139 | 8,138 | 8,150 |
| Other Heart Disease | 1,314 | 1,722 | 1,732 | 1,735 | 1,734 | 1,722 |
| Cerebrovascular Disease | 1,656 | 2,130 | 2,107 | 2,105 | 2,107 | 2,130 |
| Other Cardiovascular Disease | 732 | 885 | 880 | 879 | 880 | 885 |
| Pnuemonia/Influenza | 222 | 303 | 300 | 299 | 299 | 297 |
| COPD | 1,575 | 1,920 | 1,921 | 1,918 | 1,918 | 1,920 |
| Asthma | 231 | 285 | 308 | 307 | 307 | 284 |
| Other Respiratory | 210 | 267 | 275 | 275 | 274 | 266 |
| Congenital | 216 | 276 | 282 | 283 | 281 | 276 |
| Perinatal | 6 | 6 | 9 | 8 | 9 | 6 |
| SIDS | 24 | 33 | 33 | 32 | 32 | 33 |
| RTC | 843 | 1,440 | 1,409 | 1,419 | 1,419 | 1,440 |
| Suicide | 1,017 | 1,674 | 1,696 | 1,728 | 1,729 | 1,674 |
| Violent | 90 | 159 | 152 | 155 | 156 | 156 |
| Unintentional Injury other than RTC | 597 | 927 | 943 | 949 | 953 | 927 |
| Other Causes | 2,538 | 3,324 | 3,304 | 3,303 | 3,300 | 3,324 |
| **NZ Deprivation Index (4 groups)** | | | | | | |
| Dep 1-4 | 10,317 | 12,723 | 12,728 | 12,728 | 12,723 | 12,723 |
| Dep 5-6 | 6,060 | 7,611 | 7,602 | 7,603 | 7,611 | 7,598 |
| Dep 7-8 | 6,954 | 8,907 | 8,935 | 8,929 | 8,907 | 8,938 |
| Dep 9-10 | 7,482 | 10,137 | 10,154 | 10,155 | 10,137 | 10,142 |
| Miss Dep | 75 | 147 | 106 | 107 | 142 | 108 |
| **NZ Deprivation Index** | | | | | | |
| Dep 1 | 2,289 | 2,829 | 2,788 | 2,789 | 2,787 | 2,790 |
| Dep 2 | 2,553 | 3,114 | 3,131 | 3,134 | 3,133 | 3,127 |
| Dep 3 | 2,601 | 3,234 | 3,229 | 3,229 | 3,228 | 3,238 |
| Dep 4 | 2,874 | 3,546 | 3,580 | 3,577 | 3,575 | 3,568 |
| Dep 5 | 2,961 | 3,678 | 3,706 | 3,702 | 3,711 | 3,706 |
| Dep 6 | 3,096 | 3,930 | 3,893 | 3,898 | 3,897 | 3,889 |
| Dep 7 | 3,309 | 4,236 | 4,218 | 4,221 | 4,210 | 4,220 |
| Dep 8 | 3,645 | 4,674 | 4,721 | 4,711 | 4,700 | 4,721 |
| Dep 9 | 3,696 | 4,884 | 4,893 | 4,901 | 4,889 | 4,897 |
| Dep10 | 3,786 | 5,256 | 5,264 | 5,257 | 5,251 | 5,247 |
| Miss Dep | 75 | 147 | 106 | 107 | 142 | 108 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1996 - 99 | Linked Deaths | Actual Deaths | W_B[ϕ] Adjusted Deaths | W_E[γ] Adjusted Deaths | W_D[η] Adjusted deaths | W_C[ι] Adjusted Deaths |
|---|---|---|---|---|---|---|
| **Rurality** | | | | | | |
| Urban | 23,346 | 29,622 | 29,640 | 29,647 | 29,623 | 29,640 |
| Minor Urban | 3,984 | 5,031 | 5,101 | 5,094 | 5,091 | 5,096 |
| Rural & Other | 3,558 | 4,872 | 4,784 | 4,781 | 4,806 | 4,774 |
| **Regional Health Authority** | | | | | | |
| Northern | 9,060 | 12,045 | 11,777 | 11,775 | 11,776 | 11,774 |
| Midland | 6,546 | 8,586 | 8,560 | 8,553 | 8,533 | 8,541 |
| Central | 7,839 | 9,903 | 9,945 | 9,953 | 9,944 | 9,954 |
| Southern | 7,392 | 8,880 | 9,169 | 9,166 | 9,161 | 9,164 |
| Missing RHA | 54 | 114 | 77 | 78 | 108 | 79 |
| **Territorial Local Authority** | | | | | | |
| Far North | 576 | 825 | 801 | 798 | 799 | 800 |
| Whangarei | 648 | 867 | 846 | 847 | 845 | 847 |
| Kaipara | 177 | 240 | 230 | 230 | 229 | 230 |
| Rodney | 603 | 774 | 749 | 748 | 748 | 746 |
| North Shore | 1,095 | 1,374 | 1,345 | 1,345 | 1,346 | 1,345 |
| Waitakere | 1,122 | 1,431 | 1,452 | 1,449 | 1,452 | 1,450 |
| Auckland | 2,445 | 3,291 | 3,165 | 3,160 | 3,165 | 3,162 |
| Manukau | 1,776 | 2,394 | 2,383 | 2,390 | 2,387 | 2,385 |
| Papakura | 255 | 375 | 335 | 337 | 336 | 336 |
| Franklin | 360 | 477 | 474 | 474 | 472 | 475 |
| Thames Coromandel | 306 | 372 | 381 | 380 | 379 | 379 |
| Hauraki | 180 | 225 | 233 | 232 | 232 | 234 |
| Waikato | 330 | 453 | 436 | 436 | 436 | 433 |
| Matamata-Piako | 264 | 333 | 339 | 337 | 337 | 337 |
| Hamilton | 789 | 1,023 | 1,008 | 1,005 | 1,002 | 1,005 |
| Waipa | 321 | 450 | 409 | 410 | 410 | 412 |
| Otorohanga | 60 | 96 | 86 | 86 | 86 | 86 |
| South Waikato | 213 | 285 | 295 | 293 | 295 | 294 |
| Waitomo | 99 | 138 | 139 | 137 | 137 | 137 |
| Taupo | 285 | 372 | 385 | 388 | 388 | 386 |
| Western Bay of Plenty | 303 | 414 | 394 | 396 | 396 | 395 |
| Tauranga | 762 | 987 | 954 | 955 | 950 | 952 |
| Rotorua | 618 | 822 | 831 | 834 | 829 | 832 |
| Whakatane | 306 | 432 | 420 | 418 | 416 | 419 |
| Kawerau | 99 | 120 | 135 | 135 | 136 | 134 |
| Opotiki | 117 | 171 | 159 | 160 | 160 | 160 |
| Gisborne | 516 | 678 | 713 | 710 | 708 | 707 |
| Wairoa | 111 | 153 | 150 | 151 | 151 | 152 |
| Hastings | 597 | 789 | 785 | 789 | 788 | 785 |
| Napier | 543 | 696 | 679 | 680 | 680 | 676 |
| Central Hawkes Bay | 114 | 132 | 146 | 147 | 147 | 147 |
| New Plymouth | 558 | 669 | 692 | 690 | 688 | 688 |
| Stratford | 75 | 93 | 98 | 98 | 97 | 97 |
| South Taranaki | 246 | 312 | 317 | 316 | 315 | 316 |
| Ruapehu | 147 | 204 | 199 | 199 | 198 | 200 |

[ϕ] W_B = weighted using weight W_Base
[γ] W_E = weighted using weight W_AgEthAdj
[η] W_D = weighted using weight W_ AgDepAdj
[ι] W_C = weighted using weight W_ AgICDAdj

| 1996 - 99 | Linked Deaths | Actual Deaths | W_B$^{\phi}$ Adjusted Deaths | W_E$^{\gamma}$ Adjusted Deaths | W_D$^{\eta}$ Adjusted deaths | W_C$^{\iota}$ Adjusted Deaths |
|---|---|---|---|---|---|---|
| Wanganui | 486 | 654 | 619 | 620 | 620 | 620 |
| Rangitikei | 159 | 219 | 210 | 211 | 210 | 212 |
| Manawatu | 183 | 246 | 240 | 239 | 239 | 240 |
| Palmerston North | 567 | 708 | 708 | 708 | 707 | 707 |
| Tararua | 174 | 216 | 227 | 227 | 226 | 225 |
| Horowhenua | 435 | 525 | 548 | 548 | 548 | 551 |
| Kapiti Coast | 465 | 564 | 573 | 573 | 572 | 573 |
| Porirua | 375 | 504 | 499 | 497 | 499 | 497 |
| Upper Hutt | 354 | 432 | 439 | 439 | 440 | 438 |
| Lower Hutt | 807 | 993 | 1,024 | 1,025 | 1,024 | 1,024 |
| Wellington | 987 | 1,221 | 1,256 | 1,260 | 1,256 | 1,266 |
| Masterton | 237 | 288 | 299 | 298 | 298 | 298 |
| Carterton | 69 | 84 | 88 | 87 | 87 | 86 |
| South Wairarapa | 93 | 117 | 116 | 117 | 117 | 117 |
| Tasman | 312 | 405 | 392 | 392 | 392 | 392 |
| Nelson | 351 | 432 | 424 | 423 | 423 | 426 |
| Marlborough | 369 | 462 | 458 | 458 | 457 | 460 |
| Kaikoura | 39 | 51 | 47 | 47 | 46 | 47 |
| Buller | 126 | 153 | 161 | 162 | 161 | 162 |
| Grey | 138 | 171 | 172 | 174 | 173 | 173 |
| Westland | 99 | 120 | 125 | 125 | 125 | 127 |
| Hurunui | 84 | 108 | 113 | 114 | 113 | 115 |
| Waimakariri | 276 | 342 | 343 | 343 | 343 | 342 |
| Christchurch | 2,763 | 3,300 | 3,420 | 3,417 | 3,418 | 3,418 |
| Banks Peninsula | 57 | 66 | 69 | 69 | 70 | 68 |
| Selwyn | 105 | 144 | 139 | 138 | 139 | 138 |
| Ashburton | 273 | 321 | 334 | 334 | 333 | 333 |
| Timaru | 510 | 603 | 628 | 627 | 626 | 625 |
| Mackenzie | 33 | 39 | 43 | 43 | 43 | 43 |
| Waimate | 84 | 96 | 104 | 103 | 103 | 104 |
| Chatham Islands | 6 | 12 | 9 | 9 | 11 | 9 |
| Waitaki | 252 | 318 | 314 | 314 | 314 | 313 |
| Central Otago | 168 | 192 | 203 | 203 | 203 | 201 |
| Queenstown-Lakes | 96 | 114 | 119 | 119 | 119 | 118 |
| Dunedin | 1,098 | 1,317 | 1,353 | 1,353 | 1,353 | 1,358 |
| Clutha | 162 | 189 | 204 | 204 | 205 | 205 |
| Southland | 267 | 324 | 339 | 338 | 337 | 338 |
| Gore | 153 | 189 | 191 | 191 | 191 | 191 |
| Invercargill | 600 | 717 | 745 | 743 | 742 | 742 |
| TLA Not Applicable | 54 | 114 | 77 | 78 | 108 | 79 |

**Table 41 Odds Ratios for All Cause Mortality by Deciles of NZDep91, ages 25-64 yrs. Comparison of unweighted and weighted ORs using the four different weights, 1991-1994 .**

| | | | Weight | | |
|---|---|---|---|---|---|
| **NZDep Decile** | **No Weight** | **W_Base** | **W_AgEthAdj** | **W_AgDepAdj** | **W_AgICDAdj** |
| Females 25-44 yrs | | | | | |
| Dep 1 | 1 | 1 | 1 | 1 | 1 |
| Dep 2 | 0.97 (0.72-1.31) | 0.95 (0.74-1.23) | 0.94 (0.73-1.22) | 0.94 (0.73-1.22) | 0.93 (0.72-1.21) |
| Dep 3 | 0.96 (0.71-1.30) | 0.96 (0.74-1.24) | 0.93 (0.72-1.21) | 0.95 (0.74-1.23) | 0.92 (0.71-1.20) |
| Dep 4 | 1.02 (0.75-1.37) | 1.04 (0.80-1.34) | 1.03 (0.79-1.33) | 1.02 (0.79-1.32) | 1.01 (0.79-1.31) |
| Dep 5 | 1.24 (0.93-1.65) | 1.28 (1.00-1.64) | 1.26 (0.98-1.61) | 1.20 (0.93-1.53) | 1.25 (0.97-1.59) |
| Dep 6 | 1.49 (1.13-1.97) | 1.51 (1.19-1.91) | 1.48 (1.17-1.88) | 1.41 (1.11-1.79) | 1.43 (1.13-1.82) |
| Dep 7 | 1.55 (1.18-2.04) | 1.58 (1.25-2.01) | 1.55 (1.22-1.96) | 1.51 (1.20-1.92) | 1.54 (1.22-1.95) |
| Dep 8 | 1.56 (1.19-2.05) | 1.59 (1.26-2.02) | 1.57 (1.24-1.99) | 1.54 (1.22-1.94) | 1.53 (1.21-1.94) |
| Dep 9 | 1.63 (1.24-2.15) | 1.74 (1.38-2.19) | 1.72 (1.36-2.17) | 1.68 (1.33-2.11) | 1.72 (1.36-2.16) |
| Dep10 | 2.04 (1.56-2.66) | 2.20 (1.75-2.76) | 2.15 (1.71-2.69) | 2.11 (1.69-2.65) | 2.10 (1.68-2.63) |
| *Females 45-64 yr* | | | | | |
| Dep 1 | 1 | 1 | 1 | 1 | 1 |
| Dep 2 | 1.13 (0.98-1.30) | 1.15 (1.01-1.31) | 1.15 (1.01-1.31) | 1.15 (1.01-1.31) | 1.15 (1.00-1.31) |
| Dep 3 | 1.21 (1.05-1.39) | 1.23 (1.08-1.40) | 1.23 (1.08-1.40) | 1.23 (1.08-1.40) | 1.24 (1.08-1.41) |
| Dep 4 | 1.22 (1.05-1.41) | 1.25 (1.10-1.43) | 1.25 (1.10-1.42) | 1.25 (1.10-1.43) | 1.25 (1.10-1.43) |
| Dep 5 | 1.41 (1.22-1.62) | 1.44 (1.27-1.64) | 1.44 (1.27-1.64) | 1.44 (1.27-1.64) | 1.44 (1.27-1.63) |
| Dep 6 | 1.38 (1.20-1.59) | 1.40 (1.23-1.59) | 1.40 (1.23-1.59) | 1.40 (1.23-1.59) | 1.40 (1.23-1.60) |
| Dep 7 | 1.45 (1.26-1.67) | 1.55 (1.37-1.76) | 1.55 (1.37-1.76) | 1.55 (1.36-1.75) | 1.55 (1.37-1.76) |
| Dep 8 | 1.60 (1.39-1.84) | 1.72 (1.52-1.95) | 1.71 (1.51-1.94) | 1.71 (1.51-1.94) | 1.72 (1.52-1.95) |
| Dep 9 | 1.94 (1.70-2.22) | 2.06 (1.83-2.33) | 2.06 (1.83-2.33) | 2.06 (1.83-2.32) | 2.07 (1.83-2.33) |
| Dep10 | 2.03 (1.77-2.33) | 2.17 (1.92-2.46) | 2.19 (1.94-2.47) | 2.17 (1.92-2.45) | 2.18 (1.93-2.46) |
| *Males 25-44 yrs* | | | | | |
| Dep 1 | 1 | 1 | 1 | 1 | 1 |
| Dep 2 | 1.26 (0.98-1.61) | 1.24 (1.01-1.51) | 1.21 (0.99-1.48) | 1.21 (0.99-1.48) | 1.20 (0.98-1.46) |
| Dep 3 | 1.18 (0.91-1.51) | 1.18 (0.96-1.45) | 1.17 (0.95-1.44) | 1.17 (0.95-1.43) | 1.15 (0.93-1.41) |
| Dep 4 | 1.38 (1.08-1.77) | 1.36 (1.11-1.65) | 1.35 (1.10-1.64) | 1.34 (1.10-1.63) | 1.34 (1.10-1.63) |
| Dep 5 | 1.36 (1.07-1.75) | 1.41 (1.15-1.71) | 1.37 (1.13-1.68) | 1.35 (1.11-1.65) | 1.40 (1.15-1.71) |
| Dep 6 | 1.63 (1.29-2.07) | 1.70 (1.40-2.05) | 1.69 (1.39-2.04) | 1.64 (1.35-1.98) | 1.67 (1.38-2.02) |
| Dep 7 | 1.66 (1.31-2.11) | 1.75 (1.45-2.12) | 1.71 (1.42-2.07) | 1.69 (1.40-2.05) | 1.73 (1.43-2.09) |
| Dep 8 | 1.87 (1.48-2.36) | 1.97 (1.64-2.38) | 1.97 (1.64-2.38) | 1.95 (1.62-2.35) | 1.98 (1.64-2.39) |
| Dep 9 | 2.02 (1.60-2.55) | 2.29 (1.91-2.75) | 2.22 (1.85-2.67) | 2.17 (1.80-2.60) | 2.19 (1.82-2.64) |
| Dep10 | 2.33 (1.84-2.94) | 2.57 (2.14-3.09) | 2.53 (2.10-3.05) | 2.44 (2.03-2.94) | 2.47 (2.05-2.97) |
| *Males 45-64 yrs* | | | | | |
| Dep 1 | 1 | 1 | 1 | 1 | 1 |
| Dep 2 | 1.10 (0.98-1.24) | 1.11 (1.00-1.23) | 1.10 (0.99-1.23) | 1.10 (0.99-1.23) | 1.10 (0.99-1.23) |
| Dep 3 | 1.21 (1.08-1.36) | 1.22 (1.10-1.36) | 1.22 (1.10-1.36) | 1.22 (1.10-1.35) | 1.23 (1.10-1.36) |
| Dep 4 | 1.33 (1.18-1.49) | 1.35 (1.22-1.50) | 1.35 (1.22-1.50) | 1.35 (1.22-1.50) | 1.36 (1.22-1.50) |
| Dep 5 | 1.35 (1.21-1.52) | 1.41 (1.27-1.56) | 1.41 (1.27-1.56) | 1.42 (1.28-1.57) | 1.41 (1.27-1.56) |
| Dep 6 | 1.43 (1.28-1.60) | 1.49 (1.34-1.64) | 1.49 (1.34-1.65) | 1.49 (1.35-1.65) | 1.49 (1.34-1.65) |
| Dep 7 | 1.64 (1.47-1.83) | 1.70 (1.54-1.88) | 1.70 (1.54-1.88) | 1.70 (1.53-1.87) | 1.70 (1.54-1.88) |
| Dep 8 | 1.68 (1.51-1.88) | 1.77 (1.60-1.95) | 1.77 (1.60-1.95) | 1.76 (1.59-1.94) | 1.77 (1.61-1.96) |
| Dep 9 | 1.95 (1.75-2.18) | 2.16 (1.96-2.37) | 2.16 (1.96-2.37) | 2.15 (1.96-2.37) | 2.17 (1.97-2.38) |
| Dep10 | 2.16 (1.94-2.41) | 2.35 (2.14-2.60) | 2.35 (2.13-2.59) | 2.34 (2.13-2.58) | 2.36 (2.14-2.60) |

**Table 42 Odds Ratios for Four Causes Mortality by Quintiles of NZDep91, ages 25-64 yrs. Comparison of unweighted and weighted ORs using the four different weights**

| Cause of Death | Quintile of Deprivation | Weighting | | | | |
|---|---|---|---|---|---|---|
| | | No Weight | W_Base | W_AgEthAdj | W_AgDepAdj | W_AgICdAdj |
| *Females* | | | | | | |
| Cancer | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.06 (0.94-1.20) | 1.07 (0.96-1.20) | 1.07 (0.96-1.19) | 1.07 (0.96-1.19) | 1.08 (0.97-1.20) |
| | Quintile 3 | 1.19 (1.06-1.34) | 1.22 (1.10-1.36) | 1.22 (1.10-1.36) | 1.21 (1.09-1.34) | 1.23 (1.10-1.36) |
| | Quintile 4 | 1.24 (1.10-1.40) | 1.30 (1.17-1.45) | 1.30 (1.17-1.45) | 1.29 (1.16-1.43) | 1.31 (1.18-1.46) |
| | Quintile 5 | 1.41 (1.25-1.59) | 1.48 (1.33-1.65) | 1.48 (1.33-1.65) | 1.47 (1.32-1.63) | 1.48 (1.33-1.65) |
| CVD | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.34 (1.10-1.64) | 1.36 (1.14-1.63) | 1.36 (1.13-1.63) | 1.36 (1.14-1.63) | 1.37 (1.14-1.64) |
| | Quintile 3 | 1.58 (1.30-1.93) | 1.62 (1.36-1.93) | 1.62 (1.36-1.93) | 1.60 (1.34-1.90) | 1.61 (1.35-1.92) |
| | Quintile 4 | 1.80 (1.49-2.18) | 1.99 (1.68-2.36) | 1.99 (1.68-2.36) | 1.98 (1.67-2.34) | 1.99 (1.68-2.36) |
| | Quintile 5 | 2.59 (2.15-3.11) | 2.75 (2.33-3.24) | 2.75 (2.33-3.25) | 2.74 (2.32-3.23) | 2.74 (2.33-3.23) |
| Injury | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.21 (0.74-1.98) | 1.23 (0.81-1.88) | 1.23 (0.81-1.87) | 1.24 (0.82-1.87) | 1.19 (0.78-1.80) |
| | Quintile 3 | 1.53 (0.95-2.46) | 1.56 (1.04-2.34) | 1.55 (1.04-2.31) | 1.50 (1.00-2.24) | 1.42 (0.95-2.14) |
| | Quintile 4 | 1.35 (0.83-2.20) | 1.41 (0.93-2.14) | 1.39 (0.92-2.10) | 1.36 (0.90-2.06) | 1.33 (0.88-2.01) |
| | Quintile 5 | 2.36 (1.50-3.73) | 2.52 (1.72-3.71) | 2.49 (1.70-3.65) | 2.46 (1.68-3.60) | 2.38 (1.62-3.50) |
| Suicide | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 0.95 (0.54-1.68) | 0.96 (0.59-1.55) | 0.94 (0.58-1.52) | 0.94 (0.58-1.52) | 1.00 (0.62-1.62) |
| | Quintile 3 | 1.49 (0.88-2.50) | 1.62 (1.04-2.50) | 1.60 (1.04-2.47) | 1.57 (1.01-2.42) | 1.66 (1.07-2.58) |
| | Quintile 4 | 1.43 (0.83-2.46) | 1.64 (1.05-2.57) | 1.62 (1.04-2.52) | 1.62 (1.05-2.52) | 1.64 (1.05-2.57) |
| | Quintile 5 | 1.88 (1.10-3.23) | 1.86 (1.18-2.95) | 1.79 (1.13-2.83) | 1.76 (1.12-2.79) | 1.88 (1.19-2.99) |
| *Males* | | | | | | |
| Cancer | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.07 (0.95-1.20) | 1.08 (0.97-1.19) | 1.08 (0.97-1.20) | 1.07 (0.97-1.20) | 1.08 (0.97-1.20) |
| | Quintile 3 | 1.17 (1.04-1.31) | 1.20 (1.08-1.33) | 1.21 (1.09-1.34) | 1.21 (1.09-1.35) | 1.20 (1.08-1.33) |
| | Quintile 4 | 1.28 (1.14-1.44) | 1.29 (1.16-1.43) | 1.30 (1.17-1.44) | 1.29 (1.16-1.43) | 1.29 (1.16-1.44) |
| | Quintile 5 | 1.47 (1.31-1.66) | 1.62 (1.46-1.80) | 1.63 (1.47-1.81) | 1.62 (1.46-1.80) | 1.63 (1.47-1.80) |
| CVD | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.28 (1.14-1.44) | 1.29 (1.16-1.43) | 1.29 (1.16-1.44) | 1.29 (1.16-1.43) | 1.29 (1.16-1.44) |
| | Quintile 3 | 1.33 (1.18-1.50) | 1.39 (1.25-1.55) | 1.39 (1.25-1.55) | 1.39 (1.25-1.55) | 1.40 (1.26-1.56) |
| | Quintile 4 | 1.70 (1.52-1.90) | 1.81 (1.63-2.00) | 1.80 (1.63-1.99) | 1.79 (1.62-1.98) | 1.81 (1.64-2.00) |
| | Quintile 5 | 2.12 (1.89-2.37) | 2.32 (2.10-2.57) | 2.32 (2.10-2.57) | 2.30 (2.08-2.54) | 2.32 (2.10-2.57) |
| Injury | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.05 (0.80-1.38) | 1.08 (0.86-1.35) | 1.09 (0.88-1.36) | 1.09 (0.88-1.36) | 1.12 (0.90-1.41) |
| | Quintile 3 | 1.29 (0.99-1.68) | 1.40 (1.13-1.73) | 1.40 (1.13-1.73) | 1.36 (1.10-1.68) | 1.42 (1.15-1.76) |
| | Quintile 4 | 1.42 (1.10-1.85) | 1.63 (1.32-2.00) | 1.66 (1.35-2.03) | 1.62 (1.32-1.99) | 1.65 (1.34-2.04) |
| | Quintile 5 | 1.49 (1.14-1.95) | 1.80 (1.46-2.22) | 1.81 (1.47-2.23) | 1.76 (1.43-2.17) | 1.79 (1.44-2.21) |
| Suicide | Quintile 1 | 1 | 1 | 1 | 1 | 1 |
| | Quintile 2 | 1.19 (0.87-1.61) | 1.20 (0.93-1.55) | 1.19 (0.93-1.53) | 1.19 (0.93-1.52) | 1.18 (0.91-1.52) |
| | Quintile 3 | 1.05 (0.76-1.45) | 1.24 (0.96-1.61) | 1.24 (0.96-1.59) | 1.19 (0.93-1.53) | 1.23 (0.95-1.59) |
| | Quintile 4 | 1.55 (1.15-2.10) | 1.70 (1.33-2.17) | 1.66 (1.31-2.11) | 1.64 (1.29-2.08) | 1.69 (1.33-2.16) |
| | Quintile 5 | 1.60 (1.16-2.19) | 1.88 (1.46-2.42) | 1.83 (1.43-2.35) | 1.79 (1.40-2.30) | 1.86 (1.44-2.39) |

# 5.1 SAS code for stratification of mortality records

### 5.1.1 1981-1984 Weighting strata

```
data JFbias812;
set JFB812;
length  B_D B_E B_A B_S B_U B_C $1;
/* groupings for cause of death*/
if AgeAtCensus lt 4 then B_C=CauseDeath;
if ageatCensus GE 4 then B_C=Cod16Gp;
/* groupings for ethnicity*/
B_E=put(M_Ethnic,fiL_E.);
/* RHA groups*/
B_S=put(sex_nmds, fiL_S.);
/* rurality*/
B_U=put(Rural2, fiL_U.);
/*Age*/
B_A=put(AgLB,fiL_A.);
/*Dep*/
B_D=put(NZDepfour, fiL_D.);
/* RHA groups*/
B_R=put(RHA2, fiL_R.);
CatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;
ECATLink=CatLink||'/E:'||B_E;
CodCat='C:'||icd_gp||'/A:'||B_A||'/S:'||B_S||'/E:'||B_E;
SexbyAG5Gp=Ag5Gp||B_S||B_E;
SEXbyAG5GpbyDep=Ag5Gp||B_S||B_D;
SEXbyAG5GpbyCOD=Ag5Gp||B_S||icd_Gp;
run;

set JFBias812;
/* regroupings by age. 0-14 yrs*/
if B_A eq 'C' then do;
       if B_D eq 'Z' then B_D = 'E';

       IF B_E eq 'P' then do;
              B_U = 'A';
              B_R = 'A';
              if B_C in ('M','N') then B_C = 'R';
              else B_C = 'S';
              B_D = 'A';
              end;

       IF B_E eq 'M' then do;
              B_R = 'A';
              B_U = 'A';
              if B_C in ('G','L')then B_C = 'Q';
              if B_C in ('M','N')then B_C = 'R';
              if B_C in ('P','U')then B_C = 'W';
              if B_D in ('B','C','D')then B_D = 'H';
              if B_C eq 'Q' then B_D = 'A';
              end;

       if B_E eq 'R' then do;
              B_R = 'A';
              B_U = 'A';
```

```
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('M','N')then B_C = 'R';
            end;
      end;
/*15-24 yrs*/
if B_A='H' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      If B_E in ('P','M') then B_E = 'B';

      if B_E eq 'B' then do;
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('P','U') then B_C = 'W';
            if B_C in ('M','N') then B_C = 'R';
            if B_D in ('B','C','D')and B_C in ('Q','W') then B_D = 'H';
            if B_D in ('B','C')and B_C eq 'R' then B_D = 'G';
            end;

if B_E eq 'R' then do;
            if B_C in ('P','U') then B_C = 'W';
            if B_C in ('G','L') then B_C = 'Q';
            if B_D in ('B','C') and B_C eq 'L' then B_D = 'G';
            If B_C eq 'M' then B_C=put(icd_gp,$F16dth.);
            if B_C eq '!' then B_D = 'A';
            if B_C eq 'N' and B_S eq 'F' then do;
                  if B_D in ('B','C') then B_D = 'G';
                  else B_D = 'K';
                  end;
            if B_C eq '%' and B_S eq 'M' then B_U=put(Rural2, fiL_U.);
            end;
end;


/* 25-44 yrs*/

if B_A='R' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';
      If B_C in ('P','U') then B_C = 'W';

      if B_E in ('P','M') then B_E = 'B';

      if B_E eq 'B' then do;
            if B_C eq'M' then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('!','^') then B_C = '$';
            if B_C in ('%','$')then do;
                  if B_D in ('B','C','D') and B_S eq 'M' then B_D = 'H';
                  if B_S eq 'F' then B_D = 'A';
                  end;
            if B_D in ('B','C','D') and B_C eq 'N' then B_D = 'H';
            end;

      if B_E eq 'R' then do;
            if B_C in ('G','L','M','N') then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('!','^') then B_C = '$';
            if B_C in ('K','C') then do;
                  if B_D in ('D','E') then B_D = 'K';
                  else B_D = 'G';
                  end;
```

```
            if B_C in ('H','I') and B_S eq 'F' and B_D in ('C','B') then B_D =
'G';
            if B_C eq 'J' and B_S eq 'M' and B_D in ('C','B') then B_D = 'G';
            if B_C eq 'C' and B_S eq 'F' then B_D = 'A';
            end;
end;

/* 45-64 yrs */
if B_A eq 'V' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'P' then do;
            B_C=put(icd_Gp,$F6dth.);
            if B_C in ('M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_C in ('G','L') then B_C = 'Q';
            if B_D in ('B','C')and B_C in ('Q')then B_D = 'G';
            if B_D in ('B','C','D')and B_C eq 'R' then B_D = 'H';
            if B_C in ('R','W') then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            if B_C in ('%','^','!','N')then B_C = 'R';
            if B_c in ('Z','P') then B_C = '#';
            if B_C in ('B','F')then B_C = 'X';
            if B_C ne 'H' and B_D in ('B','C') then B_D = 'G';
            if B_C in ('E','Y') then B_D = 'A';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            if B_C in ('O','#','K') and B_D in ('D','G') then B_D = 'H';
            if B_C eq 'H' and B_D in ('D','E') and B_S eq 'F' then B_U =
put(Rural2, fiL_U.);
            end;

      if B_E ='R' then do;
            if B_C in ('M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_C in ('!','^') then B_C = '$';
            if B_C in ('$','W') and B_D in ('D','E') then B_D = 'K';
            if B_C in ('W') and B_D in ('B','C') then B_D = 'G';
            if B_C in ('Z','H','F') then B_U = put(Rural2, fiL_U.);
            END;
      end;

/* age 65-74 yrs*/
if B_A eq 'X' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'P' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_D in ('B','C') then B_D = 'G';
            if B_S eq 'F' and B_C eq 'G' then B_D = 'A';
            if B_D in ('D','G')and B_C in ('G','L') then B_D = 'H';
            if  B_C eq '~' then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            if B_C in ('B','F') then B_C = 'X';
            if B_C in ('%','^','!','M','N') then B_C = 'R';
```

```
            if B_C in ('Z','P') then B_C = '#';
            if B_D in ('B','C') then B_D = 'G';
            if B_C in ('A','C','I','J','K','O','X') and B_D in ('G','D') then
B_D = 'H';
            if B_C in ('R','Y','D','E','K') then B_D = 'A';
            if B_C eq 'R' then B_S = 'A';
            if B_C eq 'O' and B_S eq 'F' then B_D = 'A';
            end;

      if B_E ='R' then do;
            if B_C in ('%','^','!','M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_C eq 'W' then B_D = 'A';
            if B_C in ('A','B','C','D','F','H','I','J','Z') then
            B_U=put(Rural2, fiL_U.);
            if B_C in ('I','C') and B_S eq 'F' then B_U = 'A';
            END;
      end;
```

### 5.1.2 1986-1989 Weighting strata

```
data JFbias862;
set JFB862;
length  B_D B_E B_A B_S B_U B_C B_R$1;
/* groupings for cause of death*/
if AgeAtCensus lt 4 then B_C=put(icd_Gp,$F6dth.);
if ageatCensus GE 4 then B_C=put(icd_gp,$F16dth.);
/* groupings for ethnicity*/
B_E=put(Eth_NMDS_A,fiL_E.);
/* sex groups*/
B_S=put(sex_nmds, fiL_S.);
/* rurality*/
B_U=put(Rural2, fiL_U.);
/*Age*/
B_A=put(AgLB,fiL_A.);
/*Dep*/
B_D=put(NZDepfour, fiL_D.);
/* RHA groups*/
B_R=put(RHA2, fiL_R.);
CatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;
ECATLink=CatLink||'/E:'||B_E;
CodCat='C:'||icd_gp||'/A:'||B_A||'/S:'||B_S||'/E:'||B_E;
SexbyAG5Gp=Ag5Gp||B_S||B_E;
SEXbyAG5GpbyDep=Ag5Gp||B_S||B_D;
run;

data JFBias86regrouped2;
set JFBias862;
/* regroupings by age. 0-14 yrs*/
if B_A eq 'C' then do;
      if B_D eq 'Z' then B_D = 'E';
      if B_E eq 'P' then do;
            if B_C in ('M','N') then B_C = 'R';
            else B_C = 'S';
            B_U = 'A';
            B_R = 'A';
            if B_D in ('B','C','D')then B_D = 'H';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            end;
      IF B_E eq 'M' then do;
```

```
            B_R = 'A';
            B_U = 'A';
            if B_C in ('G','L')then B_C = 'Q';
            if B_C in ('M','N') then B_C = 'R';
            if B_D in ('B','C')then B_D = 'G';
            if B_C in ('R') then do;
                  if B_D in ('D','G')then B_D = 'H';
                  end;
            if B_C IN ('U','Q','P') then B_D = 'A';
            end;

      if B_E eq 'O' then do;
            B_R = 'A';
            B_U = 'A';
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('N','U') then do;
                  if B_D in ('B','C') then B_D = 'G';
                  end;
            if B_C eq 'N' and B_S eq 'F' then B_D = 'A';
            end;
end;

/*15-24 yrs*/
if B_A='H' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      If B_E eq 'P' then do;
            if B_C in ('M','N') then B_C = 'R';
             else if B_C not in ('M','N') then B_C = 'S';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            if B_C eq 'R' and B_S eq 'M' and B_D in ('B','C','D') then B_D =
'H';
            if B_C eq 'S' and B_S eq 'F' and B_D in ('B','C','D') then B_D =
'H';
            if B_C eq 'S' then B_D = 'A';
      end;

      if B_E eq 'M' then do;
            if B_C eq 'M' then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('^','!') then B_C = '$';
            if B_C in ('G','L') then B_C = 'Q';
            if B_D in ('B','C','D')then do;
                  if B_C in ('$','W','N','U') then B_D = 'H';
                  if B_C eq '%' and B_S eq 'M' then B_D = 'H';
                  end;
            if B_C in ('%','$','N','U') and B_S eq 'F' then B_D = 'A';
            if B_C in ('Q') then B_D = 'A';
            end;

if B_E eq 'O' then do;
            if B_C eq 'M' then B_C=put(icd_Gp,$F16dth.);
            if B_C eq '^' and B_S eq 'F' and B_D in ('E','D') then B_D = 'K';
            if B_C eq '^' and B_S eq 'F' and B_D in ('C','B') then B_D = 'G';
            if B_C eq '!' and B_S eq 'F' then B_D = 'A';
            if B_C in ('P','L') and B_D in ('E','D') then B_D = 'K';
            if B_C eq '!' and B_D in ('E','D') and B_S eq 'M' then B_D = 'K';
            if B_C in ('P','L') and B_D in ('B','C') then B_D = 'G';
            end;
end;
```

```
/* 25-44 yrs*/

if B_A='R' then do;
       if B_D eq 'Z' then B_D = 'E';
       B_R = 'A';
       B_U = 'A';
       If B_C in ('P','U') then B_C = 'W';

       if B_E eq 'P' then do;
              B_U = 'A';
              if B_C in ('M','N') then B_C = 'R';
              if B_D in ('B','C','D') then B_D = 'H';
              if B_C ne 'G' and B_S eq 'F' then B_D = 'A';
              end;

       if B_E eq 'M' then do;
              if B_C in ('M','N') and B_S eq 'F' then B_C = 'R';
              if B_C in ('W','R','G','L') and B_D in ('B','C') then B_D = 'G';
              if B_C eq 'G' and B_D in ('G','D') and B_S eq 'M' then B_D = 'H';
              if B_C eq 'N' then B_D = 'A';
              end;

       if B_E eq 'O' then do;
              if B_C in ('G','L','M','N') then B_C=put(icd_Gp,$F16dth.);
              if B_C in ('!','^') then B_C = '$';
              if B_C in ('K','C') then do;
                     if B_D in ('D','E') then B_D = 'K';
                     else B_D = 'G';
                     end;
              if B_C in ('H','I') and B_S eq 'F' then do;
                     if B_D in ('C','B') then B_D = 'G';
                     end;
              if B_C eq 'E' then B_C = 'F';
              end;
end;

/* 45-64 yrs */
if B_A eq 'V' then do;
       if B_D eq 'Z' then B_D = 'E';
       B_R = 'A';
       B_U = 'A';

       if B_E eq 'P' then do;
              B_C=put(icd_Gp,$F6dth.);
              if B_C in ('M','N') then B_C = 'R';
              if B_C in ('P','U') then B_C = 'W';
              if B_D in ('B','C','D')and B_C in ('L','R','G','W')then B_D = 'H';
              if B_C eq 'R' then B_D = 'A';
              end;

       if B_E eq 'M' then do;
              if B_C in ('%','^','!','N')then B_C = 'R';
              if B_c in ('Z','P','Y') then B_C = '@';
              if B_C ne 'H' and B_D in ('B','C') then B_D = 'G';
              if B_C in ('E','Y') then B_D = 'A';
              if B_C in ('A','R','O','K') and B_D in ('D','G') then B_D = 'H';
              if B_C eq 'B'  then B_D = 'A';
              end;

       if B_E ='O' then do;
              if B_C in ('M','N') then B_C = 'R';
              if B_C in ('P','U') then B_C = 'W';
              if B_C in ('!','^') then B_C = '$';
```

```
            if B_C in ('$','W') and B_D in ('D','E') then B_D = 'K';
            if B_C in ('W') and B_D in ('B','C') then B_D = 'G';
            if B_C in ('Z','H','F','D','C','B') then B_U = put(Rural2,
fiL_U.);
            if B_C in ('B','F') and B_D eq 'E' and B_S eq 'F' then B_U = 'A' ;
            if B_C eq 'C' and B_S eq 'F' then B_U = 'A' ;
            END;
      end;

/* age 65-74 yrs*/
if B_A eq 'X' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'P' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_C eq 'G' and B_S eq 'F' then B_D = 'A';
            if B_D in ('B','C','D') then B_D = 'H';
            if B_C eq '~' then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_C eq 'G' and B_D in ('B','C') then B_D = 'G';
            end;

      if B_E ='O' then do;
            if B_C in ('%','^','!','M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_C eq 'W' and B_D in ('B','C') then B_D = 'G';
            if B_C eq 'W' and B_D in ('E','D') then B_D = 'K';
            if B_C in ('A','B','C','D','F','H','I','J','Z') then
B_U=put(Rural2, fiL_U.);
            if B_C eq 'I' and B_S eq 'F' then B_U = 'A';
            if B_C eq 'A' and B_S eq 'F' and B_D eq 'E' then B_U = 'A';
            END;
      end;

GpCatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;

GpECATLink='A:'||B_A||'/E:'||B_E||'/C:'||B_C||'/U:'||B_U||'/D:'||B_D||'/S:'||B_S
;
GpCodCat='/C:'||B_C||'/A:'||B_A||'/S:'||B_S;
/*format      B_E $fvL_E7.
            B_S $fvL_S5.
            B_A $fvL_A5.
            B_U $fvL_U5.
            B_R $fvL_R5.
            B_C $fvL_C.
            icd_gp $3.;*/
run;
```

### 5.1.3 1991-1994 Weighting strata

```
data JFbias912;
set JFB912;
```

```
length  B_D B_E B_A B_S B_U B_C B_R$1;
/* groupings for cause of death*/
if AgeAtCensus lt 4 then B_C=put(icd_Gp,$F6dth.);
if ageatCensus GE 4 then B_C=put(icd_gp,$F16dth.);
/* groupings for ethnicity*/
B_E=put(Eth_NMDS_A,fiL_E.);
/* sex groups*/
B_S=put(sex_nmds, fiL_S.);
/* rurality*/
B_U=put(Rural2, fiL_U.);
/*Age*/
B_A=put(AgLB,fiL_A.);
/*Dep*/
B_D=put(NZDepfour, fiL_D.);
/* RHA groups*/
B_R=put(RHA2, fiL_R.);
CatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;
ECATLink=CatLink||'/E:'||B_E;
CodCat='C:'||icd_gp||'/A:'||B_A||'/S:'||B_S||'/E:'||B_E;
SexbyAG5Gp=Ag5Gp||B_S||B_E;
SEXbyAG5GpbyDep=Ag5Gp||B_S||B_D;
run;

data JFBias91regrouped2;
set JFBias912;
/* regroupings by age. 0-14 yrs*/
if B_A eq 'C' then do;
       if B_D eq 'Z' then B_D = 'E';
       if B_E eq 'P' then do;
              if B_C in ('M','N') then B_C = 'R';
              else B_C = 'S';
              B_U = 'A';
              B_R = 'A';
              if B_D in ('B','C','D')then B_D = 'H';
              if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
              if B_C eq 'S' and B_S eq 'M' then B_D = 'A';
              end;
       IF B_E eq 'M' then do;
              B_R = 'A';
              B_U = 'A';
              if B_C in ('G','L')then B_C = 'Q';
              if B_C in ('M','N') then B_C = 'R';
              if B_D in ('B','C')then B_D = 'G';
              if B_C in ('R') then do;
                     if B_D in ('D','G')then B_D = 'H';
                     end;
              if B_C IN ('U','Q','P') then B_D = 'A';
              if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
              end;

       if B_E eq 'R' then do;
              B_R = 'A';
              B_U = 'A';
              if B_C in ('G','L') then B_C = 'Q';
              if B_C in ('N','U') then do;
                     if B_D in ('B','C','D') then B_D = 'H';
                     end;
              if B_C eq 'N' and B_S eq 'F' then B_D = 'A';
              end;
end;

/*15-24 yrs*/
if B_A='H' then do;
```

```
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      If B_E eq 'P' then do;
            if B_C in ('M','N') then B_C = 'R';
             else if B_C not in ('M','N') then B_C = 'S';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            if B_C eq 'R' and B_S eq 'M' and B_D in ('B','C','D') then B_D =
'H';
            if B_C eq 'S' and B_S eq 'F' and B_D in ('B','C','D') then B_D =
'H';
            if B_C eq 'S' then B_D = 'A';
      end;

      if B_E eq 'M' then do;
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('M','N') then B_C = 'R';
            if B_C not in ('Q','R') then B_C = 'W';
            if B_D in ('B','C','D')and B_C in ('R','W') then B_D = 'H';
            if B_C eq 'Q' then B_D = 'A';
            if B_C eq 'W' and B_S eq 'F' then B_D = 'A';
            end;

if B_E eq 'R' then do;
            if B_C eq 'M' then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('^','!') then B_C = '$';
            if B_C eq 'L' and B_D in ('B','C') then B_D = 'G';
            if B_C eq 'L' and B_D in ('D','E') then B_D = 'K';
            if B_C eq 'P' then B_D = 'A';
            end;
end;

/* 25-44 yrs*/

if B_A='R' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';
      If B_C in ('P','U') then B_C = 'W';

      if B_E eq 'P' then do;
            B_U = 'A';
            if B_C in ('M','N') then B_C = 'R';
            if B_D in ('B','C','D') then B_D = 'H';
            if B_C ne 'G' and B_S eq 'F' then B_D = 'A';
            if B_S eq 'M' and B_C in ('G','W') then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            if B_C in ('M','N') and B_S eq 'F' then B_C = 'R';
            if B_C in ('W','R','G','L') and B_D in ('B','C') then B_D = 'G';
            if B_C eq 'N' and B_D in ('B','C','D','G') then B_D = 'H';
            end;

      if B_E eq 'R' then do;
            if B_C in ('G','L','M','N') then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('!','^') then B_C = '$';
            if B_C in ('B') then do;
                  if B_D in ('D','E') then B_D = 'K';
                  else B_D = 'G';
                  end;
            if B_C eq 'E' and B_S eq 'M' then B_D = 'A';
```

```
            if B_C eq 'K' then B_D = 'A';
            end;
end;

/* 45-64 yrs */
if B_A eq 'V' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'P' then do;
            B_C=put(icd_Gp,$F6dth.);
            if B_C in ('M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_D in ('B','C','D')and B_C in ('L','R','G','W')then B_D = 'H';
            if B_C eq 'R' then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            if B_C in ('%','^','!','N')then B_C = 'R';
            if B_c in ('Z','P','Y') then B_C = '@';
            if B_C not in ('H','@','C') and B_D in ('B','C') then B_D = 'G';
            if B_C in ('Y','B') then B_D = 'A';
            if B_C in ('A','R','O','K') and B_D in ('D','G') then B_D = 'H';
            end;

      if B_E ='R' then do;
            if B_C in ('!','^') then B_C = '$';
            if B_C in ('$','P') and B_D in ('D','E') then B_D = 'K';
            if B_C eq 'P' and B_D in ('B','C') then B_D = 'G';
            if B_C in ('H','F','D','C','B','Z') then B_U = put(Rural2,
fiL_U.);
            if B_C in ('B','F') and B_D eq 'E' and B_S eq 'F' then B_U = 'A' ;
            if B_C eq 'C' and B_S eq 'F' then B_U = 'A' ;
            END;
      end;

/* age 65-74 yrs*/
if B_A eq 'X' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'P' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_C eq 'G' and B_S eq 'F' then B_D = 'A';
            if B_D in ('B','C','D') then B_D = 'H';
            if B_C eq '~' then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_C eq 'G' and B_D in ('B','C') then B_D = 'G';
            if B_C in ('G','L') and B_D in ('D','E')then B_U=put(Rural2,
fiL_U.);
            end;

      if B_E ='R' then do;
            if B_C in ('%','^','!','M','N') then B_C = 'R';
            if B_C in ('P','Z') then B_C = '#';
```

```
              if B_C in ('B','C','D','F','H','I','J','#') then B_U=put(Rural2,
fiL_U.);
              if B_C eq 'I' and B_S eq 'F' then B_U = 'A';
              if B_C eq 'D' and B_S eq 'F' and B_D eq 'E' then B_U = 'A';
              END;
       end;

GpCatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;

GpECATLink='A:'||B_A||'/E:'||B_E||'/C:'||B_C||'/U:'||B_U||'/D:'||B_D||'/S:'||B_S
;
GpCodCat='/C:'||B_C||'/A:'||B_A||'/S:'||B_S;
/*format      B_E $fvL_E7.
              B_S $fvL_S5.
              B_A $fvL_A5.
              B_U $fvL_U5.
              B_R $fvL_R5.
              B_C $fvL_C.
              icd_gp $3.;*/
run;
```

### 5.1.4 1996-1996 Weighting Strata

```
data JFbias962;
set JFB962;
length  B_D B_E B_A B_S B_U B_C B_R$1;
/* groupings for cause of death*/
if AgeAtCensus lt 4 then B_C=put(icd_Gp,$F6dth.);
if ageatCensus GE 4 then B_C=put(icd_gp,$F16dth.);
/* groupings for ethnicity*/
B_E=put(EthnmdsPr,fiL_E.);
/* if B_E eq 'O' then B_E='R'; note this is done purely to avoid having
rewrite this programme which is based on the 1996 programme. A new format
is used to ensure correct labelling*/
/* sex groups*/
B_S=put(sex_nmds, fiL_S.);
/* rurality*/
B_U=put(Rural2, fiL_U.);
/*Age*/
B_A=put(AgLB,fiL_A.);
/*Dep*/
B_D=put(NZDepfour, fiL_D.);
/* RHA groups*/
B_R=put(RHA2, fiL_R.);
CatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;
ECATLink=CatLink||'/E:'||B_E;
CodCat='C:'||icd_gp||'/A:'||B_A||'/S:'||B_S||'/E:'||B_E;
SexbyAG5Gp=Ag5Gp||B_S||B_E;
SEXbyAG5GpbyDep=Ag5Gp||B_S||B_D;
SEXbyAG5GpbyCOD=Ag5Gp||B_S||icd_Gp;
run;

data JFBias96regrouped2;
set JFBias962;
/* regroupings by age. 0-14 yrs*/
if B_A eq 'C' then do;
       if B_D eq 'Z' then B_D = 'E';
       if B_E in ('A','P') then do;
              if B_C in ('M','N') then B_C = 'R';
```

```
            else B_C = 'S';
            end;
      IF B_E eq 'A' then do;
            B_U = 'A';
            B_R = 'A';
            B_D = 'A';
            end;
      IF B_E eq 'P' then do;
            B_U = 'A';
            B_R = 'A';
            if B_D in ('B','C','D')then B_D = 'H';
            end;
      IF B_E eq 'M' then do;
            B_R = 'A';
            B_U = 'A';
            if B_C in ('G','L')then B_C = 'Q';
            if B_D in ('B','C')then B_D = 'G';
            if B_C in ('P','N') then do;
                  if B_S = 'M' and B_D in ('D','G')then B_D = 'H';
                  if B_S = 'F' then B_D = 'A';
                  end;
            if B_C eq 'Q' and B_D in ('D','E') then B_D = 'K';
            end;
      if B_E eq 'O' then do;
            B_R = 'A';
            B_U = 'A';
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('N','U') then do;
                  if B_D in ('B','C') then B_D = 'G';
                  if B_D in ('D','E') then B_D = 'K';
                  end;
            if B_C eq 'Q' and B_D in ('D','E') then B_D = 'K';
            end;
end;

/*15-24 yrs*/
if B_A='H' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'A' then do;
            if B_C in ('M','N') then B_C = 'R';
            if B_C ne 'R' then B_C = 'S';
            if B_D in ('B','C') then B_D ='G';
            if B_D in ('D','E') then B_D ='K';
            end;

      If B_E eq 'P' then do;
            if B_C in ('M','N') then B_C = 'R';
             else if B_C not in ('M','N') then B_C = 'S';
            if B_S eq 'F' then do;
                  if B_D in ('B','C','D') then B_D = 'H';
                  end;
            end;

      if B_E eq 'M' then do;
            if B_C eq 'M' then B_C=put(icd_Gp,$F16dth.);
            if B_C in ('^','!') then B_C = '$';
            if B_C in ('G','L') then B_C = 'Q';
            if B_C in ('P','U') then B_C = 'W';
            if B_D in ('B','C','D')then do;
                  if B_C in ('$','W') then B_D = 'H';
```

```
                    if B_C eq '%' and B_S eq 'F' then B_D = 'H';
                    end;
             if B_D in ('B','C')and B_C in ('N','Q') then B_D = 'G';
             end;

if B_E eq 'O' then do;
             if B_C in ('P','U') then B_C = 'W';
             if B_D in ('B','C')and B_C eq 'L' and B_S eq 'M' then B_D = 'G';
             if B_C in ('M') and B_S eq 'M' then B_U=put(Rural2, fiL_U.);;
             end;
end;

/* 25-44 yrs*/

if B_A='R' then do;
       if B_D eq 'Z' then B_D = 'E';
       B_R = 'A';
       B_U = 'A';
       If B_C in ('P','U') then B_C = 'W';

       if B_E Eq 'A' then do;
             if B_C in ('M','N') then B_C = 'R';else B_C = 'S';
             if B_D in ('B','C') then B_D ='G';
             if B_D in ('D','E') then B_D ='K';
             end;

       if B_E eq 'P' then do;
             B_U = 'A';
             if B_C in ('M','N') then B_C = 'R';
             if B_D in ('B','C','D') then B_D = 'H';
             end;

       if B_E eq 'M' then do;
             if B_D in ('B','C') then do;
                    if B_C eq 'N' then B_D = 'G';
                    if B_C eq 'M' and B_S eq 'F' then B_D = 'G';
                    end;
             if B_D eq 'E' and B_C not in ('N') then B_U=put(Rural2, fiL_U.);
             end;

       if B_E eq 'O' then do;
             if B_C in ('G','L','M','N') then B_C=put(icd_Gp,$F16dth.);
             if B_C in ('!','^') then B_C = '$';
             if B_C in ('K','C') then do;
                    if B_D in ('D','E') then B_D = 'K';
                    else B_D = 'G';
                    end;
             if B_C in ('H','I') and B_S eq 'F' then do;
                    if B_D in ('C','B') then B_D = 'G';
                    end;
             end;
end;


/* 45-64 yrs */
if B_A eq 'V' then do;
       if B_D eq 'Z' then B_D = 'E';
       B_R = 'A';
       B_U = 'A';

       if B_E eq 'A' then do;
             B_C=put(icd_Gp,$F6dth.);
             if B_C in ('P','U') then B_C = 'W';
```

```
            if B_C in ('M','N') then B_C = 'R';
            if B_D in ('B','C') then B_D = 'G';
            if B_D in ('D','E') then B_D = 'K';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            if B_C eq 'L' and B_S eq 'F' then B_D = 'A';
            end;

      if B_E eq 'P' then do;
            B_C=put(icd_Gp,$F6dth.);
            if B_C in ('M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_D in ('B','C')and B_C in ('L','G')then B_D = 'G';
            if B_D in ('B','C','D')and B_C in ('R')then B_D = 'H';
            if B_C eq 'R' and B_S eq 'F' then B_D = 'A';
            end;

      if B_E eq 'M' then do;
            if B_C in ('%','^','!','N')then B_C = 'R';
            if B_c in ('Z','P') then B_C = '#';
            if B_C ne 'H' and B_D in ('B','C') then B_D = 'G';
            if B_C in ('E','Y') then B_D = 'A';
            if B_C eq 'K' and B_D in ('D','G') then B_D = 'H';
            if B_C eq 'H' and B_D in ('D','E') then B_U = put(Rural2, fiL_U.);
            end;

      if B_E ='O' then do;
            if B_C in ('M','N') then B_C = 'R';
            if B_C in ('P','U') then B_C = 'W';
            if B_C in ('!','^') then B_C = '$';
            if B_C eq '$' and B_D in ('D','E') then B_D = 'K';
            if B_C in ('Z','H','F','D','C','B') then B_U = put(Rural2,
fiL_U.);
            END;
      end;

/* age 65-74 yrs*/
if B_A eq 'X' then do;
      if B_D eq 'Z' then B_D = 'E';
      B_R = 'A';
      B_U = 'A';

      if B_E eq 'A' then do;
            B_C=put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_D in ('B','C') then B_D = 'G';
            if B_D in ('D','E') then B_D = 'K';
            end;

      if B_E eq 'P' then do;
            B_C = put(icd_Gp,$F6dth.);
            If B_C not in ('G','L') then B_C = '~';
            if B_D in ('B','C') then B_D = 'G';
            end;

      if B_E eq 'M' then do;
            if B_C in ('B','F') then B_C = 'X';
            if B_C in ('%','^','!','M','N') then B_C = 'R';
            if B_c in ('Z','P') then B_C = '#';
            if B_C in ('D','E','J','K') and B_D in ('B','C','D') then B_D =
'H';
            if B_C in ('I','O') and B_D in ('B','C') then B_D = 'G';
            if B_C in ('R','Y') then B_D = 'A';
            end;
```

```
       if B_E ='O' then do;
              if B_C in ('%','^','!','M','N') then B_C = 'R';
              if B_C in ('P','U') then B_C = 'W';
              if B_C eq 'W' and B_D in ('B','C') then B_D = 'G';
              else if B_C eq 'W' then B_D = 'K';
              if B_C in ('A','B','C','D','F','H','I','J','Z') then
B_U=put(Rural2, fiL_U.);
              END;
       end;

GpCatLink='A:'||B_A||'/S:'||B_S||'/C:'||B_C||'/D:'||B_D||'/U:'||B_U;

GpECATLink='A:'||B_A||'/E:'||B_E||'/C:'||B_C||'/U:'||B_U||'/D:'||B_D||'/S:'||B_S
;
GpCodCat='/C:'||B_C||'/A:'||B_A||'/S:'||B_S;
format        B_E $fL_2BE7.
              B_S $fvL_S5.
              B_A $fvL_A5.
              B_U $fvL_U5.
              B_R $fvL_R5.
              B_C $fvL_C.
              icd_gp $3.;
run;
```