ABOUT MORTALITY DATA FOR NEW ZEALAND

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GENERAL

The population data for New Zealand are complicated by different levels of data quality by ethnic group (Māori and Non-Māori). Data for Non-Māori meet international data quality standards, but data for Māori are affected by a variety of problems.

Data for population of New Zealand date back to the 19th century. Population statistics have been collected officially since the country became a Crown Colony in 1840. During the Crown Colony period, the Colonial Secretary was responsible for the compilation of population statistics in New Zealand. From 1853 to 1910, it was the duty of the Registrar-General, and from 1910 onwards, the Government Statistician (Statistics New Zealand, 2004b). Currently, Statistics New Zealand is the main institution responsible for the collecting, processing and disseminating statistical data in the country. Primary information about each birth, death and marriage in the territory of New Zealand is administered by the Births, Deaths and Marriages Registry under the Department of Internal Affairs. Original migration data are collected by the New Zealand Customs Service, which forwards this information for the further processing to Statistics New Zealand.

The first statistical publications about New Zealand were published in 1840 as "Blue books for the colony of New Zealand" by the Colonial Secretariat (Statistics New Zealand, 2004b). In 1956, these publications were replaced by the annual (until 1920) volumes of "Statistics of New Zealand". Since 1921, a series of subject statistical reports have been published annually. Aggregated information about births, deaths and population estimates are also available from serial and occasional publications such as "Demographic Trends", "Key Demographic Indicators", "New Zealand Official Yearbook" and others. Since 1871, information about each census has been published in separate volumes (Statistics New Zealand, 2004b). The most recent demographic data and some longer data series are freely available via the official web site of Statistics New Zealand (http://www.stats.govt.nz).

The first general census of New Zealand took place in 1851, although the Māori population was not counted (Statistics New Zealand, 2001). During the period from 1858 to 1881, censuses were conducted on a triennial basis. Since 1881, censuses have been held every five years (with exceptions of 1931 and 1941). The 1858 census marks the first attempt to count the Māori population. However, only limited, aggregate-level information on Māori is available from the early censuses. A separate census of the Māori population, which provided more detailed information, was conducted in 1926. Until 1951, separate census questionnaires designed for the Māori population were used. Since 1951, the Māori population has been counted by the general censuses of New Zealand and the practice of separate Māori censuses has been discontinued (Statistics New Zealand, 2001).

There were separate vital registers for Māori and for the rest of population (mostly European) until the beginning of the 1960s. The registration system of the Māori population was of much lower quality, therefore the corresponding historical data on the Māori population are affected by various problems such as under-registration of births and deaths. Since 1936 (and particularly since 1961), the data for Māori are considered more reliable, whereas reliable data on Non-Māori date back to 1876. The latter historical data are particularly interesting due to the longevity records shown by the Non- Māori population. Therefore, it is important to include a continuous demographic data series not only for the country as a whole, but also for these two most important population groups.

In 1961, separate birth and death registers for Māori and Non-Māori were abolished, and general registers began in 1962. As a consequence, Statistics New Zealand discontinued publishing data separately on Non-Māori. We have derived figures for Non-Māori by subtracting the Māori population from the total.

Although the completeness of Māori data has improved, data quality problems remain important (see the section on "Data quality issues"). Furthermore, starting in 1962, these problems may have also been relevant for the Non-Māori data[1] (because Non-Māori figures are derived by subtracting the the Māori population from the total).

A continuous series of annual population estimates (for the Total, Māori, and Non-Māori populations) date back to 1936. The 1990s mark two significant changes in the population definitions. First, both population estimates and vital statistics for the period starting in 1991 have been recalculated for the usually resident population (i.e., *de jure*), whereas these data previously covered the *de facto* population.

Second, the definition of ethnicity in the population statistics for New Zealand underwent a major shift in the beginning of the 1990s. Instead of strict definitions of ethnicity based on "degree of blood" or "belonging to a sole ethnic group", a new, more flexible definition (including the possibility of belonging to several ethnic groups) was introduced. These changes made a significant impact on the population estimates, births and deaths and other ethnic-specific statistical indicators. Consequently, non-standard methods were required in order to obtain continuous data series for Māori and Non-Māori populations.

Specific episodes in the demographic history of New Zealand

Mortality in New Zealand was affected by the two World Wars. However, this effect is not reflected in the official statistics because the military population (and, possibly, the majority of combat losses) are excluded during war years.

The influenza epidemic in 1918 caused about 8500 deaths in New Zealand creating a big increase in mortality during this particular year (Statistics New Zealand, 2004b). Other important events resulting in a significant increase in deaths include: the Hawke's Bay earthquake in 1931 that caused 256 deaths; and the 1979 crash of an

[1] For example, in 1996 there was a tendency to misclassify some deaths as Māori, resulting in over-estimation of Māori deaths and under-estimation of non- Māori deaths. It has a negligible effect for the general level of Non-Māori mortality, but at older ages (due to small numbers), this effect may be more important for some years.

Air New Zealand plane on Mount Erebus, Antarctica causing 257 deaths (Statistics New Zealand, 2004b).

Source of Data

The most recent population estimates and birth counts were downloaded from the official website of Statistics New Zealand (http://www.stats.govt.nz). Historical data for the period until 1926 come from Bloomfield (1984). All the remaining published and unpublished demographic data were provided by Statistics New Zealand.

TERRITORIAL COVERAGE

New Zealand consists of two larger Islands and several small islands in the South Pacific. Since the early proclamations in 1840, 1842, and 1847, the small islands were added in 1887 and 1901 and 1923. These territorial changes were so small in terms of population size that they do not influence mortality indicators. Therefore, it is not necessary to adjust for these changes. There have been no further territorial changes in New Zealand during the period covered by the data included in the database.

DEATH COUNT DATA

Coverage and completeness

According to Statistics New Zealand, death registration is complete and the majority of deaths are recorded (Statistics New Zealand, 2004a). Prior to 1991, data include all deaths that occurred in New Zealand and were registered in New Zealand (i.e., *de facto* population). Since 1991, data include deaths of New Zealand residents (i.e., *de jure* population).

By law, all deaths occurring in the territory of New Zealand must be registered within three working days after the burial or cremation of the body. The funeral director or other person responsible for death notification forwards the notification document to the Births, Deaths and Marriages Registry (under the Department of Internal Affairs). Together with the latter document, a Medical Certificate of Cause of Death from a doctor or coroner is also sent to the Registry. A computerized file containing information about each registered death is forwarded to Statistics New Zealand each month. Data are aggregated on a quarterly or annual basis, but only deaths registered in a given year are included into the official death statistics for that year (Statistics New Zealand, 2004a). That is, a death that occurred in 2000, but was not actually registered until 2001, would be included in the death statistics for 2001.

According to Ajwani et al. (2003), Māori mortality estimates for the 1980s and early 1990s are significantly affected by numerator-denominator bias due to differences in how ethnicity was defined by the death registry and in the censuses. Information about the degree of blood (the criterion used by the death registry until the 1st of September 1995) was often incomplete as "funeral directors often guessed or assumed the extent of 'blood' or did not complete this section at all" (Pomare et al. 1995; cited in Ajwani et al. 2003). Consequently, there was a relatively high

probability of mismatch between the ethnic identification indicated in the death record and self-reported ethnicity given in the corresponding census record. Unfortunately, we have not been able to resolve this inconsistency. Ajwani and his colleagues at the Wellington School of Medicine and Health Sciences (Statistics New Zealand) and Ministry of Health have attempted to avoid numerator-denominator bias by introducing special adjustment ratios (for more details see Ajwani et al. 2003). Unfortunately, even this study suffers from several methodological constraints.

Specific details

The official death counts are available for single years of age starting in 1948. During 1948-2003, data for Non-Māori were derived by subtracting the Māori deaths from the total deaths. For 1980-2003, death counts by sex, ethnic origin, age, birth cohort and year of registration were produced from the Births, Deaths and Marriages registry data (and provided to us by Statistics New Zealand).

There is some evidence that death registration was incomplete until the beginning of the 1960s. First of all, concerning Māori deaths, which were counted by a separate register until 1961, we found some evidence about possible underestimation of deaths at older ages prior to the 1960s. A similar problem appears among Non-Māori prior the 1920s (see the section on “Data Quality Issues”).

The change in definition of ethnicity noted earlier also affected death counts. Prior to September 1, 1995 the definition of Māori and other ethnic groups (by the death registry) was based on "the degree of blood" criterion (e.g. half Māori, full Māori). Since then, ethnic identification of the deceased has relied fully on information provided by the next kin (self-determination concept) (Statistics New Zealand, 2004a). As a consequence, deaths in 1995 are classified by a mixture of the previous and current definitions of ethnicity. We have attempted to solve this problem by introducing a special adjustment factor for deaths (see Appendix 2 for more details).

However, even after adjusting for the change in the definition of ethnicity, an unexpected increase in Māori deaths is apparent in 1996. A possible explanation is that there may have been a tendency to misreport ethnicity, especially for children.

POPULATION COUNT DATA

Coverage and completeness

A series of annual population estimates for the Total, Māori and Non-Māori population estimates date back to 1936. Official population estimates for 1936 refer to the population "as of December 31", population estimates for 1937-1990 refer to the average population ("the mean year ended December 31"), while population estimates for 1991-2003 refer to the population "as of June 30". During 1936-1990, data cover the *de facto* population. After 1990, the population estimates were recalculated (working backwards from the 2001 census) based on the usually resident population. To account for this change in population coverage, we use adjustment factors as described in the Methods Protocol (see Appendix D).

Māori and Non-Māori populations were counted separately until 1951. Population census data for the Non-Māori population are available from 1858 to 1926 (Bloomfield, 1984). Historical population data on Non-Māori (prior 1930s) seem to have data quality problems at older ages (see section on ”Data quality issues”).

There is evidence that the population during the First and Second World Wars comprises only the civilian population. The male population decreases at the beginning and increases at the end of the each World War.

Māori data are of much worse quality even in the most recent years. First, Statistics New Zealand acknowledges that Māori population data are incomplete and affected by underregistration of vital events at least until 1936 (or perhaps even 1961) (Statistics New Zealand, 2004a). Second, since the removal of the ethnicity questions on New Zealand arrival and departure cards in the mid-1980s, there has been no accurate information on Māori migration (Robson et al., 2001). Thus, the Māori population estimates can not be calculated without using some approximations. Statistics New Zealand (2004a) warns that "all estimates for the Māori ethnic group are supplied only as a guide for research and other analytical purposes". For more details about data problems see the section on the "Data Quality Issues".

Specific details

The latest population estimates (1991-2003)—recalculated on the basis of the 2001 census—have been adjusted for the census undercount. According to Statistics New Zealand, the total undercount in the 1981, 1986, and 1991 censuses was about 2% (or about 66,000-70,000 people) (Statistics New Zealand, 1998). Thus, population estimates and census counts for the same year may differ considerably.

The estimated *de facto* population includes all people present in New Zealand and counted by the census (census night population count). This estimate includes visitors from overseas who are counted on census night, but excludes New Zealand residents who are temporarily overseas. The usually resident population is an estimate of all people who usually live in New Zealand, or in an area of New Zealand, at a given date. This estimate is based on the census count of the usually resident population, which excludes visitors from overseas, and is adjusted to include: residents who are temporarily overseas on census night; residents who are missed or counted more than once by the census (net census undercount). Furthermore, these estimates are adjusted for births, deaths and net migration (arrivals less departures) of residents during the period between census night and the given date (Statistics New Zealand, 2004a).

Starting in 1991, the official population estimates for Māori and Non-Māori have also been recalculated according to the usually resident concept. In addition, Māori population estimates have been re-estimated (working backwards from the 2001 census to 1991) using a new definition of ethnicity. Consequently, Māori and Non-Māori population estimates prior to 1991 use a stricter definition based on self-identification by degree of blood or belonging to a sole ethnicity. Since 1991, official population estimates use a more flexible concept of ethnicity, which is based on self-identification with any ethnic group (with possibility to belonging to several ethnic groups). For more details see Appendix 3 by Jit Cheung.

Although the population data on Māori (and on Non-Māori) have been classified using the new definition of ethnicity since 1991, data on births and deaths retained the old definition until 1995. In order to assure correspondence between the ethnicity-specific data on births, deaths and population estimates, we have re-estimated the Māori population for 1991-1995 based on the older concept of ethnicity. As a result, we have extended the series of the Māori and Non-Māori population estimates by the old definition of ethnicity up to 1995. For more details about all the adjustments related to Māori and Non-Māori data, see Appendix 2.

BIRTH COUNT DATA

Coverage and completeness

According to Statistics New Zealand, birth registration is virtually complete with 99.9% of births recorded (Statistics New Zealand, 2004a). Since 1991, birth data refer to births by New Zealand female residents (i.e. *de jure* population). Birth data before 1991 include all births that occurred in New Zealand and were registered in New Zealand (i.e. *de facto* population).

By law, the hospital must notify the Registrar-General within 5 working days of every live birth or stillbirth (issuing a "Notification of birth for registration"). Within two months after the birth, a "Birth Registration Form" must be completed and posted to the Births, Deaths and Marriages Registry in the Department of Internal Affairs (Statistics New Zealand, 2004a). On the basis of the latter form, the Birth Certificate is issued.

Computerized information including both notifications of births and birth registration forms is sent to Statistics New Zealand once a month. Data are aggregated on a quarterly or annual basis, but only births registered in a given year (even if they actually occurred in an earlier year) are included into the official birth statistics for that year (Statistics New Zealand, 2004a). For more details see Appendix 3 by Jit Cheung.

Specific details

Basic registration of births began in 1848 and was made compulsory in 1855. A more comprehensive registration system started in 1875. Registration of stillbirths became compulsory only in 1919. Due to poor quality of Māori statistics, births may be underreported or misreported until 1961 (when the separate vital registration system for Māori was abolished) (Statistics New Zealand, 2004a). Pool (1967) noted several years when birthdates of Māori newborns were misreported. For example, because a universal system of family benefits was introduced in 1946, there was a tendency to register Māori children as being born during this particular year (although they were born earlier). The New Zealand Official Yearbook 1947–1949 reported: "Of the 5776 Māori births registered during 1946 no fewer than 1447 or 25% had occurred before 1945 - i.e. over a year before registration" (Statistics New Zealand, 2004a).

As in the case of deaths, in 1995 there was the major change in definition of ethnicity used on birth certificates. Prior to September 1, 1995, the definition of Māori and

other ethnic groups was based on identification by "the degree of blood" criterion (e.g. half Māori, full Māori). Since September 1 1995, ethnic identification relies on information specified by the parent(s) of the newborn (self-determination concept) (Statistics New Zealand, 2004a). As a consequence, births for the year 1995 are classified by a mixture of the previous and current definitions of ethnicity. We have solved this problem applying an adjustment factor for births (see Appendix 2 for more details).

DATA QUALITY ISSUES

1. Quality of data on population counts. There is evidence that New Zealand censuses conducted before 1926 are affected by undercount and age misreporting problems (Pool, 1973). Due to substantial under-reporting of vital events, the quality of Māori population estimates are considered less reliable until 1936, or perhaps even 1961 (Statistics New Zealand, 2004a).

More recent Māori population estimates are affected by different problems. The first problem is related to the approximation procedures used by the Statistics New Zealand because of the absence of ethnic-specific migration data for the period after 1986: they assume that the current age pattern of Māori migration is the same as during the period 1982-1986. A second problem relates to the Māori population estimates for the period 1991-1995. Because births and deaths were classified based on the old definition of Māori for this period, Statistics New Zealand estimated births and deaths based on the new definition of Māori using only indirect or additional information on births and deaths (for more details and our solution to this problem, see Appendix 2 and the section on “Population Count Data”).

Another problem with the quality of population estimates concerns the rounding procedures used by the Statistics New Zealand. Due to small numbers at older ages (especially among the Māori population), rounding to the nearest ten can produce some distortions or unexpected fluctuations in mortality rates these ages.

2. Under-reporting or misreporting of vital events is especially relevant for the Māori population. Pool (1973) suggests that registration of vital events for the Māori population was very incomplete at least until the mid-1930s. Statistics New Zealand applied smoothing procedures to Māori deaths for the period until 1947, making age-specific mortality data even more approximate.

Our own estimates suggest serious under-reporting of deaths at older ages among the Māori and Non-Māori populations. Among the Non-Māori population, these problems seem to be very notable until 1920, while under-reporting of Māori deaths seems apparent until the 1960s.

Substantially higher life expectancy at older ages for the Māori and Non-Māori populations compared with the corresponding higher quality Swedish data may indicate death undercount problems (Figures 1&2). In the case of Māori, mortality estimates at older ages also seem to be unreliable for some of the most recent years (Figure 2).

Data quality problems related to the change in the definition of ethnicity in 1995 are discussed in the Appendix 2.

3. Problems with Non-Māori old age mortality estimates before 1902. Prior to 1902, our estimated death rates at older ages are implausibly low, and consequently, we get implausibly high estimates of life expectancy for those surviving to those older ages. For example, among non-Māori females in 1877, our estimate of e_{80} is 14.4 years. A comparison with life expectancy in 1881-1901 published by Preston, Keyftiz, and Schoen (1972) also shows large discrepancies at advanced ages (see table 1).

Table 1. Life expectancy in New Zealand (non-Maori) in 1881, 1891, and 1901

Year	Age	Preston et all. (1972)		HMD		Difference	
		Males	Females	Males	Females	Males	Females
1881	0	53.34	56.80	53.87	57.33	0.54	0.53
	30	36.50	38.90	37.21	39.45	0.70	0.56
	60	15.88	17.00	16.88	17.69	1.00	0.69
	80	6.14	6.19	8.90	8.11	**2.76**	**1.92**
1891	0	54.50	57.73	54.87	57.65	0.37	-0.08
	30	36.91	38.91	37.11	38.61	0.20	-0.30
	60	14.51	16.86	14.79	16.37	0.28	-0.49
	80	6.22	10.86	7.05	7.00	0.84	-3.86
1901	0	58.05	59.93	58.33	60.48	0.29	0.54
	30	38.14	39.23	38.29	39.51	0.15	0.28
	60	15.00	16.16	15.19	16.52	0.19	0.36
	80	5.04	5.31	5.53	6.18	0.50	0.87

The source of these discrepancies relates to the fact that the original raw data for this historical period are available only in an aggregate format (i.e., 5-year age groups with an open age interval at 80+), and also that there are very few deaths at very old ages. For example, among females aged 80+, there were only 16 deaths in 1877 and 29 deaths in 1878. Unfortunately, the application of our current procedure for splitting deaths in open age intervals combined with our other methods for estimating the mortality surface produces implausible estimates of old age mortality estimates for this particular period (up to 1902).

For small populations, the number of deaths at advanced ages is likely to be small and highly variable, particularly during early historical periods. Big fluctuations in death counts for the open age interval create several problems for estimating mortality using the standard HMD methods. The nature of problems can be described in more detail as follows. First, the annual number of deaths for the open age interval 80+ tends to be unexpectedly low for some years. Second, as a consequence of applying the extinct cohort method to estimate population size at ages 80+, small number of deaths[2] observed during some years in combination with larger numbers of deaths in subsequent years leads to overestimation of population at higher ages. Consequently, we may underestimate mortality (because the numerator, deaths, is too small and/or the denominator, population exposure, is too big).

This problem can be solved by changing the parameters of the model for splitting deaths in the open age interval together with increasing the age interval for

[2] This may result from an undercount of deaths as well as real fluctuations in the observed data.

smoothing of death rates (e.g., from 80+ to 70+). In other words, such cases require special procedures for splitting deaths in the open age interval. Thus, the problem results in part from the application of a uniform set of methods across all countries, which helps ensure that HMD estimates are comparable across time and across countries, but may present problems in some special cases. We are working to devise a methodological solution that will help resolve this problem.

However, we strongly recommend using the aggregated data (e.g. for 5 or 10-year time intervals) for any analysis of mortality at older ages in New Zealand prior to 1902. It is important for users to keep in mind that our estimated death rates may be based on very limited observed data. A period life table is by nature a hypothetical construct. Thus, while we may provide estimated death rates by single year of age to 110+ across all countries and all periods, the user should remain conscious of the original raw data upon which these estimates are based.

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Figure 1. Trends in life expectancy at age 80 among New Zealand Non- Māori and Swedish males.

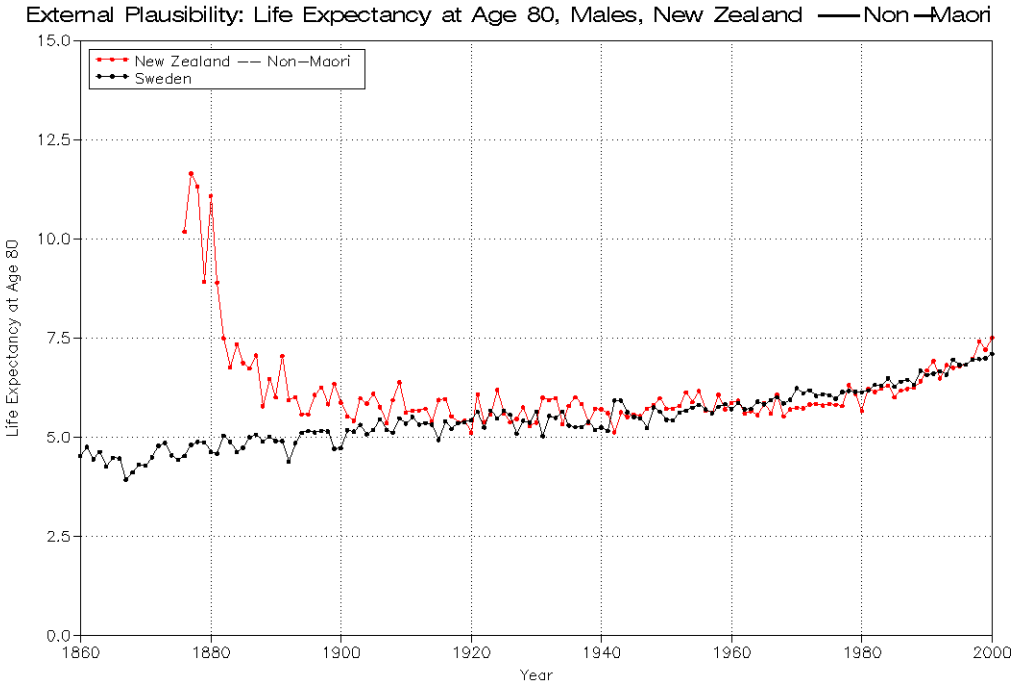
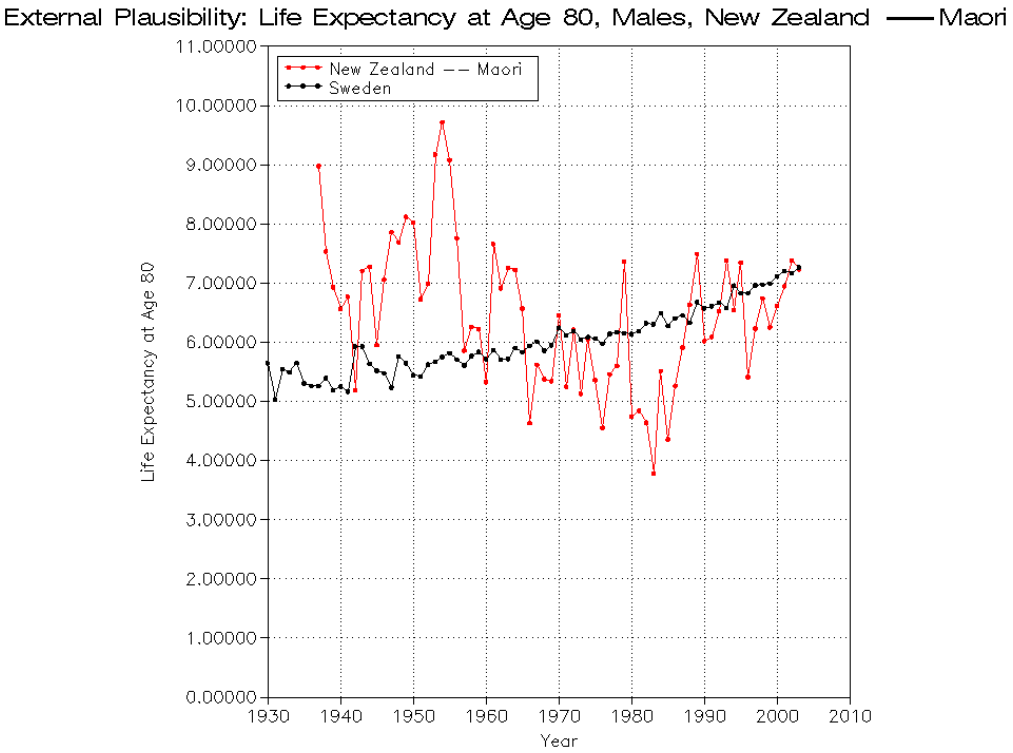


Figure 2. Trends in life expectancy at age 80 among New Zealand Māori and Swedish males. Should be replaced



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APPENDIX 1: DESCRIPTION OF DATA USED FOR LEXIS DATABASE

Data for 1937-1946 are calculated as the sum of Lexis files for Māori and Non-Māori.

DEATHS

Period	Type of Data	Age Grouping	Comments	RefCode†
1947-1948	Annual number of deaths for the *de facto* population by sex and age	0,1,2, … , 100+		NZLR08
1950-1979	Annual number of deaths for the *de facto* population by sex and age	0,1,2, … , max age		NZLR08
1980-1990	Annual number of deaths for the *de facto* population by sex, age, and year of births	0,1,2,…, max age		NZLR09, NZLR10, NZLR11
1991-2003	Annual number of deaths for the "usually resident" (*de jure*) population by sex, age, and year of births	0,1,2,…, max age		NZLR09, NZLR10, NZLR11

POPULATION

Period	Type of Data	Age Grouping	Comments	RefCode†
1947-1990	Mid-year population estimates ("mean year ended December 31") for the *de facto* population.	0, 1, 2, …89, 90+		NZLR52
1991-2003	Population estimates as of June 30 for the "usually resident" (*de jure*) population	0, 1, 2, …89, 90+		NZLR53

BIRTHS

Period	Type of Data	Comments	RefCode†
1937-1990	Annual counts of births by sex for the actually present (*de facto*) population		NZLR01
1991-2003	Annual counts of births by sex for the usually resident (*de jure*) population		NZLR01, NZLR02, NZLR16

† The reference code is used in the raw data files (Input Database) to link data with sources.

APPENDIX 2:

CHANGES IN THE DEFINITION OF ETHNICITY IN NEW ZEALAND: ADJUSTMENTS TO RAW POPULATION DATA AND DEATH COUNTS

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Changes in the census ethnicity questions in the 1980s and 1990s

The definition of Māori used on census questionnaires changed over time. The earliest definitions, based on "belonging to the Māori race" or "quantum of Māori blood" (proportion of descent criterion), were used until the 1986 census. Starting with the 1986 census, ethnicity was identified according to a more flexible concept of self-identification with any ethnic group. However, ethnic-specific population estimates counted as Māori only those people who indicated solely that ethnicity (on the census form). Until 1990, the definition of ethnicity used for estimating the Māori population seem to be rather comparable, as there were no obvious discontinuities in the trends for the Māori population during the 1980s.

A new concept of ethnic group was introduced in the 1991 census. For the first time, the Māori ethnic group also included those who indicated more than one ethnicity in the census. Such flexibility, together with changes in the questions about ethnic group, resulted in a substantial increase in people identifying themselves as Māori. Each of the three censuses in 1991, 1996, and 2001 used different wordings for the ethnicity questions (based on self-identification). New population estimates were recalculated backwards from the census 2001 to 1991 (which are more or less comparable in terms of the wording of the ethnicity question), replacing population estimates based on the census 1996.

Changes in the identification of ethnicity in birth, death and migration records

While a new flexible concept of ethnicity was introduced as early as in 1986 for population counts, similar reform in the definition of ethnicity used for birth and death certificates was not introduced until 1995. Interestingly, the new concept of ethnicity was applied not at the beginning of the year but rather on the 1st of September. Until that date, the old concept (based on quantum of Māori blood) was used.

Information on the ethnicity of external migrants has not been collected since 1987. Statistics New Zealand assumes that Māori net migration follows the same pattern as during the period 1982-1986. This assumption affects the quality of Māori population estimates as well.

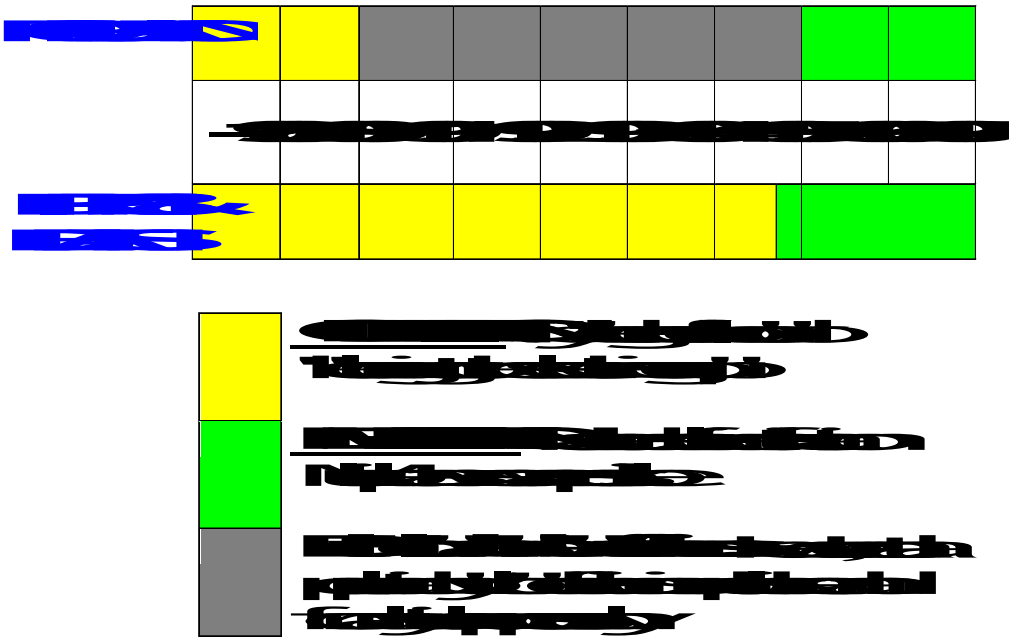
Implications of changes in official definitions of ethnicity on demographic data

Because the new definition of ethnicity was not used for birth and death certificates until September 1995 (more than four years after the change was introduced for population estimates), we could not calculate ethnic-specific demographic indicators for 1991-1995. Statistics New Zealand used indirect or additional information on births and deaths to calculate revised birth and death counts (based on the new definition of ethnicity) for the Māori population during this period. For example, births

were redefined as Māori if there was any indication of Māori ethnicity (based on ethnicity of the parents, and other indicators of ethnicity). Māori deaths for the period 1991-1995 based on the "new" concept were derived from death rates that were used for the 1996-based Māori population projections (Statistics New Zealand, 2004a). These revised birth and death counts have never been published, therefore we were not able to use these approximations either.

Consistency between the definitions of ethnicity used for population estimates and births and deaths is shown on Figure 3.

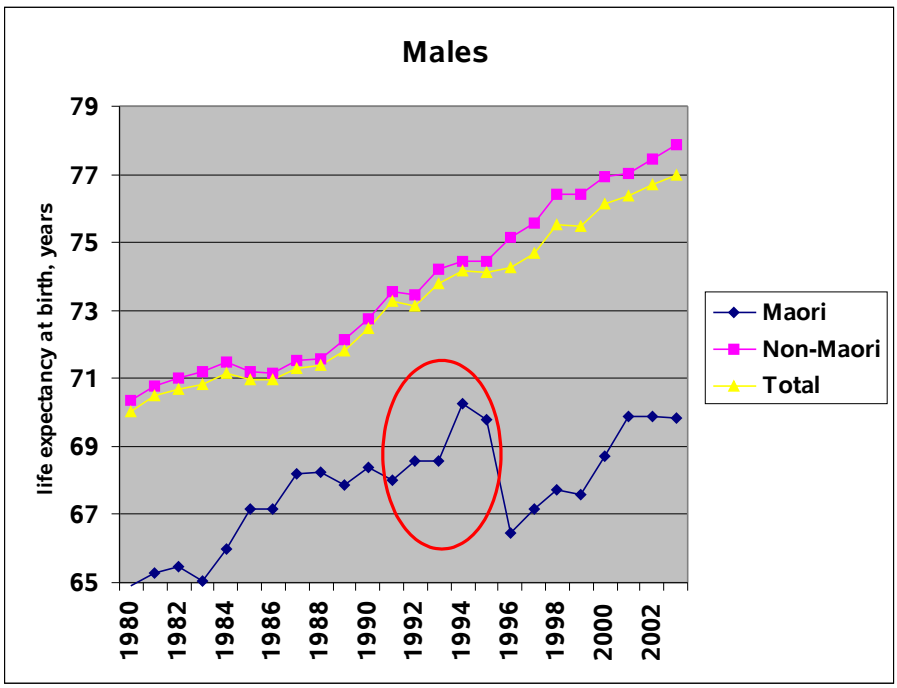
Figure 3. Changes in definitions of the Māori ethnic group



If we use the official published population estimates and deaths for the period 1991-1995, we will over-estimate life expectancy of Māori due to the disagreement between concepts of ethnicity used classifying data on deaths and population (see Figure 4).

It is worth mentioning that Statistics New Zealand has attempted to solve this disagreement and produced Māori population estimates by the "old" definition for the period 1991-1995. However, these data are also imperfect and have never been published. We were able to use them only indirectly for our own estimates of population, births and deaths by the old definition of Māori.

Figure 4. Life expectancy at birth of Māori population calculated from the official (unadjusted) data.



The most serious problem with the ethnic-specific data concerns the year 1995. Because the new definition of ethnicity took effect on the 1st of September, data on Māori births and deaths for this year are classified by a mixture of narrower "old" and more flexible "new" concept of ethnicity. Therefore, although Māori population estimates based on the "old" definition are available, we would over-estimate mortality and fertility due to a more flexible concept of ethncity used for birth and death certificates in the latter part of 1995.

Solution to the problems related to the changes in definitions of Māori

We treat changes in the definition of ethnicity as a change in population coverage. Although such changes are not due to territorial changes, they can be treated as such in order to make appropriate adjustments to the formulas. Thus, we apply a standard procedure described in the Methods protocol (see Appendix D) to derive our own intercensal population estimates for 1991-1995. For this, we need to calculate adjustment factors for births (*Rb*) and population (*Vx*).

For calculation of $R_b(1995)$ we used following equation:

$$R_b(1996) = \frac{\overline{B}(1992-1994)}{\overline{B}(1996-1998)}\ , \qquad \text{(A2.1)}$$

where $\overline{B}(1992-1994)$ is the average number of births identified as Māori during 1992-1994 and $\overline{B}(1996-1998)$ is the comparable figure during 1996-1998. We could not use the standard definition of the *Rb* factors (see Appendix D of the Methods protocol) because births are not available by both definitions for 1995. In fact, we excluded births for year 1995 due to mixture of classification used for this particular year. This Rb factor is used as described in Appendix D of the Methods Protocol.

The ratio between the Māori population as defined by the new concept and the old one is treated like the ratio between populations after and before territorial change (i.e. Vx adjustment factor). More exactly:

$$V(x,1996) = \frac{P^{new}(x,1996)}{P^{old}(x,1996)} \ , \qquad \text{(A2.2)}$$

where $P^{new}(x,1996)$ is the Māori population at age x on January 1, 1996, based on the new concept and $P^{old}(x,1996)$ is the respective population number based on the old definition.

Unfortunately, in this case, we also need to adjust deaths in 1995 to account for the excess due to the new definition of ethnicity introduced in September. Therefore, an additional territorial adjustment factor for deaths (not specified in the Methods protocol) has been calculated according to the following formula:

$$Rd(x,1995) = \frac{\overline{M}(x,1994,1996)}{M(x,1995)} \ , \qquad \text{(A2.3)}$$

where $M(x,1995)$ is the actual age-specific mortality rate for Māori in 1995 (where deaths represent a mixture of old and new definitions and population estimates have been adjusted to represent the "old" definition) and $\overline{M}(x,1994,1996)$ is the average between age-specific mortality rates for Māori in 1994 and 1996. By applying this ratio to the original Māori death count in 1995 ($D(x,1995)$), we get the approximate number of deaths ($\hat{D}(x,1995)$) based on the old definition:

$$\hat{D}(x,1995) = Rd(x,1995) \cdot D(x,1995) \ . \qquad \text{(A2.4).}$$

In other words, we are removing the excess deaths due to the introduction of the new definition of ethnicity (so that both deaths and population for 1995 are based on the "old" definition). The result of this procedure for males is shown on the Figure 5.

After calculating the adjustment factors and correcting death numbers for 1995, we apply the intercensal method for calculation of population estimates for the years between 1991 and 1996 (see Appendix D of the Methods Protocol). The result is a new continuous series of Māori indicators, which are calculated using adjusted ethnic-specific data on deaths and population for 1991-1995. Comparison of trends in life expectancy at birth using the original raw data and our adjusted figures is presented on Figure 6. We can see that, after adjustment, the large increases in life expectancy at birth in the 1991-1995 period have almost disappeared. Using adjusted Māori data we can easily derive appropriate figures for the Non-Māori population.

Unfortunately, we were not able to solve numerator-denominator bias arising from possible misreporting of ethnicity in death records, therefore even adjusted data on Māori and Non-Māori should be treated with caution.

Figure 5. Trends in Māori deaths before and after application of the adjustment factor

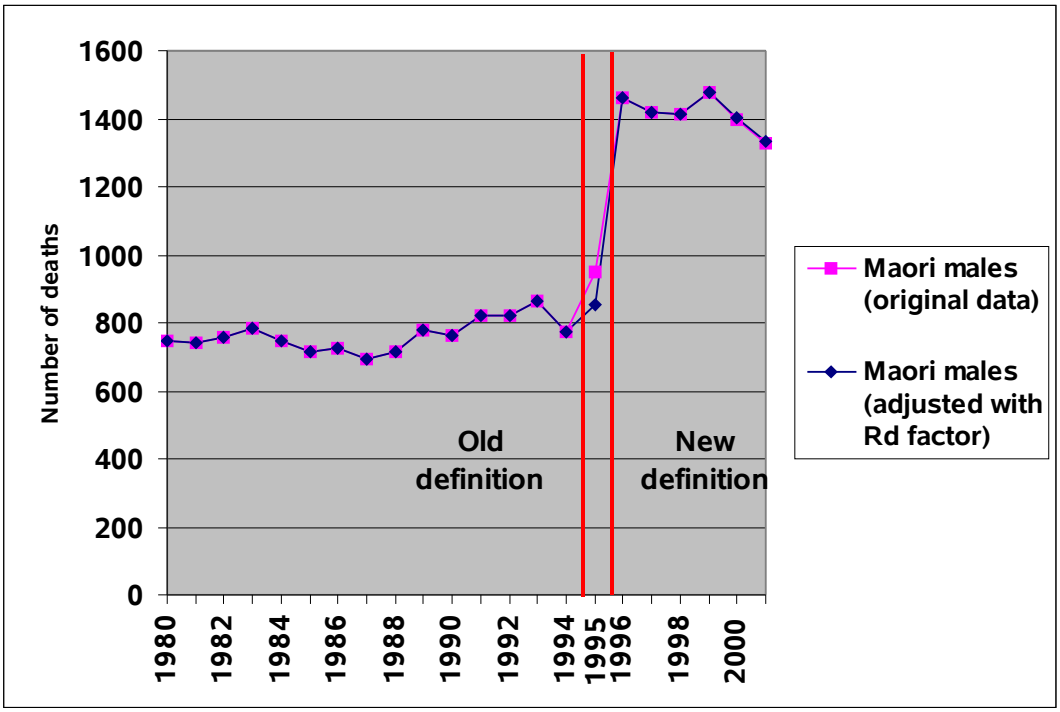
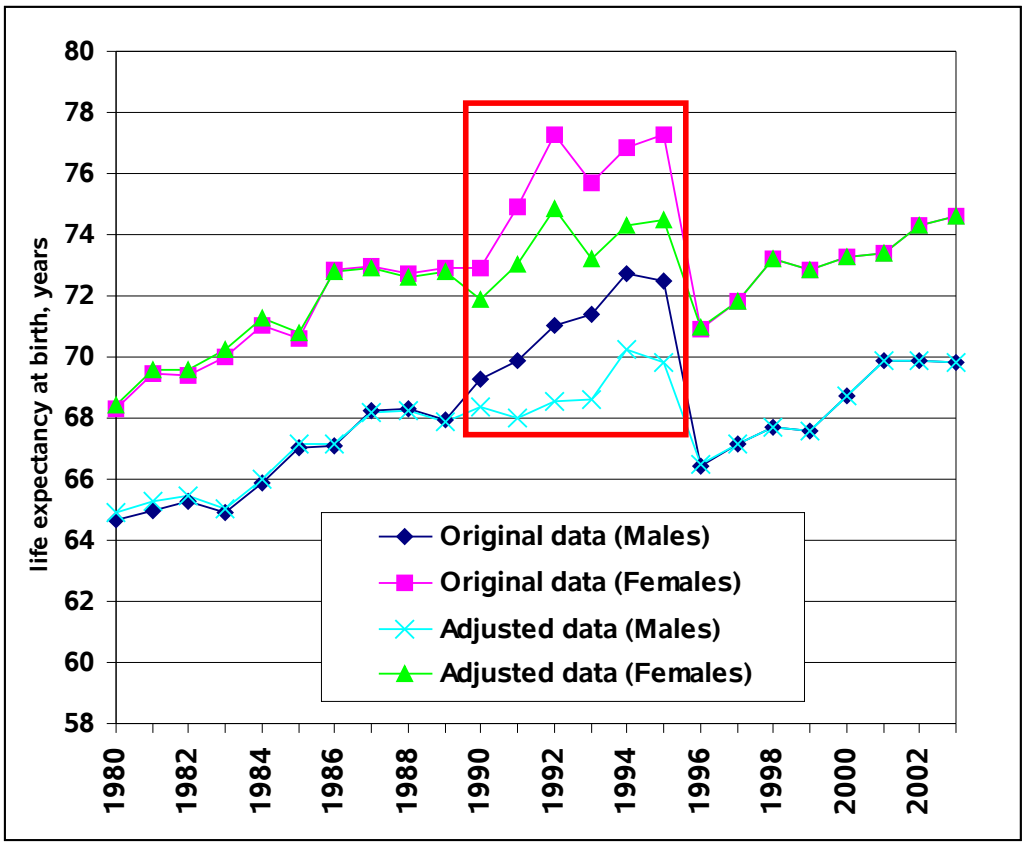


Figure 6. Life expectancy at birth of Māori population calculated from the official (unadjusted) and adjusted data.



APPENDIX 3:

COMMENTS ON THE QUALITY ISSUES RELEVANT TO THE ETHNIC-SPECIFIC POPULATION DATA

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Introduction

Increasing ethnic diversity is a demographic reality in New Zealand and around the world. This worldwide phenomenon is a point of celebration for societies as well as among research communities. At the same time methodological issues around ethnic definition, data collection and measurement are becoming more complicated. In the New Zealand context, changes in official definition of ethnicity reflect not only changes in administrative practice, but more importantly changes in society's understanding, perceptions and empathy to race and ethnic issues. These latter changes were driven by social, economic, political, demographic and other forces.

In this appendix more detailed comments are provided on the ethnic dimension in New Zealand population and vital statistics.

Current situation

In New Zealand the issues of defining ethnicity and making comparative assessments along the ethnic dimension are particularly pertinent. Historically, the New Zealand population is made up of two major ethnic groups: the indigenous Māori population and the more dominant European population. Over time these two ethnic populations have undergone different demographic and health transitions, and, as a result, have attained distinctively different age structures and mortality profiles. Currently, these two major ethnic groups occupy opposing ends of the socio-economic spectrum. Health and demographic analyses that fail to disaggregate trends and patterns by ethnicity will mask considerable disparities between the ethnic groups.

Moreover, New Zealand's ethnicity make-up has also greatly diversified over the last few decades, largely as a result of international migration. At the latest 2001 Census, the fastest growing Asian population has overtaken Pacific peoples as the third largest major ethnic group in the country. Moreover, people who identified with two or more ethnic groups have also increased.

Table 1 shows the ethnic mix at the 2001 Census by the five major ethnic groups derived by Statistics New Zealand, by "single ethnic group only" (those who identify with only the ethnic group reported in Table 1 and none other) and "total responses" (those who identify with the ethnic group reported in Table 1 plus at least one of the other four major ethnic groups).

Differences between "single ethnic group only" and "total responses" correspond to the number of people identifying with multiple ethnic groups. For example, 2.610

million people (or 70.0% of the total population) reported European ethnic group only; an additional 0.258 million people (or 6.9% of total) reported European and one or more of the other ethnic groups, bringing European "total responses" to 2.868 million people (or 76.9% of the total population). Thus numbers in the "Total responses" column are not mutually exclusive and add up to more than the total.

Table 1. New Zealand 2001 Census resident population by major ethnic group

	Numbers of people		Percentage of total	
	Single ethnic group only	Total responses	Single ethnic group only	Total responses
European	2,610,408	2,868,009	70.0%	76.9%
Māori	294,726	526,281	7.9%	14.1%
Pacific Peoples	166,056	231,801	4.5%	6.2%
Asian	213,582	237,459	5.7%	6.4%
Other	19,533	24,924	0.5%	0.7%
Not stated	-	143,598	-	3.8%
Total	3,730,332			

Source: Statistics New Zealand

Accompanying the increasing ethnic diversity are changes in social perception towards the issue of ethnicity, as reflected by the increasing proportion of people identifying with multiple ethnic groups and changes in the official definitions in successive censuses and vital statistics collections. The most significant change in Māori ethnic definition started in 1980s, from a biological concept of blood count to a self-identified social concept of cultural affiliation. The process of change can be described as one of an on-going experiment, in a continuous search for the optimal combination of concept and phraseology.

For simplicity of presentations, hereafter the term **Non-Māori** is used to refer to **all persons in the population who do not identify Māori in the total response on question of ethnicity**.

Remarks on ethnic population data

Prior to the 1976 census, Māori ethnicity was defined in New Zealand censuses as "persons of half or more Māori blood". In the 1976 census, an additional question was added that asked respondents whether they claimed Māori descent, even if they gave a negative response to the question on degree of Māori blood. The net effect of this change appeared to be an over-reporting of people claiming half or more Māori blood (Pool and Pole, 1987). The question on Māori descent was dropped in the 1981 census, but was picked up again as a separate ancestry and descent question in 1991, 1996 and 2001 respectively. Meanwhile, a self-identified, cultural affiliation definition of ethnicity and a hierarchical procedure of ethnicity coding were introduced in the 1986 census, which were also used in the next three subsequent censuses.

Under the new system, respondents were asked to check as many circles as needed to show to which ethnic group(s) they belong. If New Zealand Māori is one of the groups reported, the person is assigned to New Zealand Māori, otherwise a series of procedures is used to assign that person to another ethnic group. Further problems arising from this change were the issue of category jumping, where individuals may change ethnic identity between data collections.

The series of changes in census ethnicity definition and coding practices rendered longitudinal analysis of Māori ethnic data during the change over periods difficult. The implications of this problem extend beyond the census data, affecting comparability between the census and other data sources (see below). The effects on Non-Māori population data, however, were greatly mitigated by its much larger population size.

Remarks on ethnic death data

Prior to September 1995, a biological definition of ethnicity was used on the death registration form, asking about the "degree of Māori or Pacific Islander blood" of the deceased's parents. A new form was introduced on 1 September 1995, with the question on ethnicity being the same as the self-identified, cultural affiliation definition used in the 1996 census. This change improved the comparability between census and death data, but it also introduced a definitional discrepancy in the mortality historical time series. Again this is an issue affecting Māori data disproportionately.

Ethnic death data for the 1995 calendar year was adversely affected by definitional change coupled with possible administrative lag in its full implementation around the country. Data for the last quarter were of particularly questionable quality.

A number of potential problems also exist in the analysis of historical ethnic mortality statistics in New Zealand. Historically the ethnicity of the deceased was often determined by an observer, usually the funeral director. The family of the deceased was rarely consulted (see Kilgour and Keefe, 1992). Often ethnic identification became based on skin colour, a questionable identification technique. Furthermore, non-responses to the ethnicity question on the death registration form were subsequently coded as Other, or Non-Māori, and this can lead to considerable under-reporting for Māori.

The inconsistency in the timing of changes in ethnicity definition in the census and vital statistics generated severe bias in the estimation of Māori and Pacific death and, to a lesser extent, birth rates, known as numerator-denominator bias. In a major study, the New Zealand Census-Mortality Study (NZCMS), Ajwani et al (2003) quantify numerator-denominator bias by using probabilistic matching of ethnicity entry on death records in the three years following the Census to the Census unit record. It was found that numerator-denominator bias negatively affected Māori and Pacific ethnic groups strongly in the 1980s and early 1990s, and among younger age groups. The situation has improved markedly in the more recent years. The NZCMS calculated adjusters for Māori, Pacific, Non-Māori Non-Pacific ethnic death statistics for different periods of time. Most adjusters converge to one for the more recent years, pointing to disappearance of numerator-denominator bias.

Age misreporting, particularly at very old ages of 85 years and over, may be another source of concern. Problems arise when age recording relies on secondhand reporting and is cannot be verified by birth certificates. This is particularly true for older Māori as birth registrations for Māori prior to 1948 were unsatisfactory, as well perhaps, for a small numbers of immigrants included in the Non-Māori population coming from societies in which registration was incomplete. The study by Kannisto (1994) suggests that Non-Māori mortality data at older ages is of generally good quality. The issue of age mis-reporting among Non-Māori is of minor concern in comparison with that for Māori.

Remarks on ethnic birth data

Currently Statistics New Zealand defines a live birth as: "The birth of a child, who breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached."

As with deaths, birth registrations have changed in 1996 from a biological-based ethnic definition to one based on self-identification of cultural affiliation. The current registration form asks the ethnicity of the mother, father (where applicable) and the child using the same question as that employed in the census. All responses are treated as valid, and no attempt is made to match the ethnicity of the child with that of the parents. In cases where ethnic details are missing for a child, the child is assigned to all of the ethnic groups of the parents, restricted to a maximum of three ethnicities following the prioritising procedure used in the census.

The new ethnicity question may result in more Māori births than under the old regime. Accordingly, changes in ethnic-specific patterns may reflect definitional changes rather than an actual change in ethnic-specific fertility.

There are a number of other noticeable disruptions to ethnic birth data time series. The universal family benefit introduced in 1946 affecting primarily low-income families was responsible for a surge of late registration of births among these families. Māori and Pacific families were over-represented in the low-income category. More recently, the Births and Deaths Registration Act 1995 redefined and broadened slightly what constitutes a stillbirth. Under the new definition if a child either weighs 400g or more, or the gestation has lasted 21 weeks or longer then the death should be registered as a stillbirth. Before this Act, a stillborn was defined as a child born dead after 28 weeks of pregnancy.